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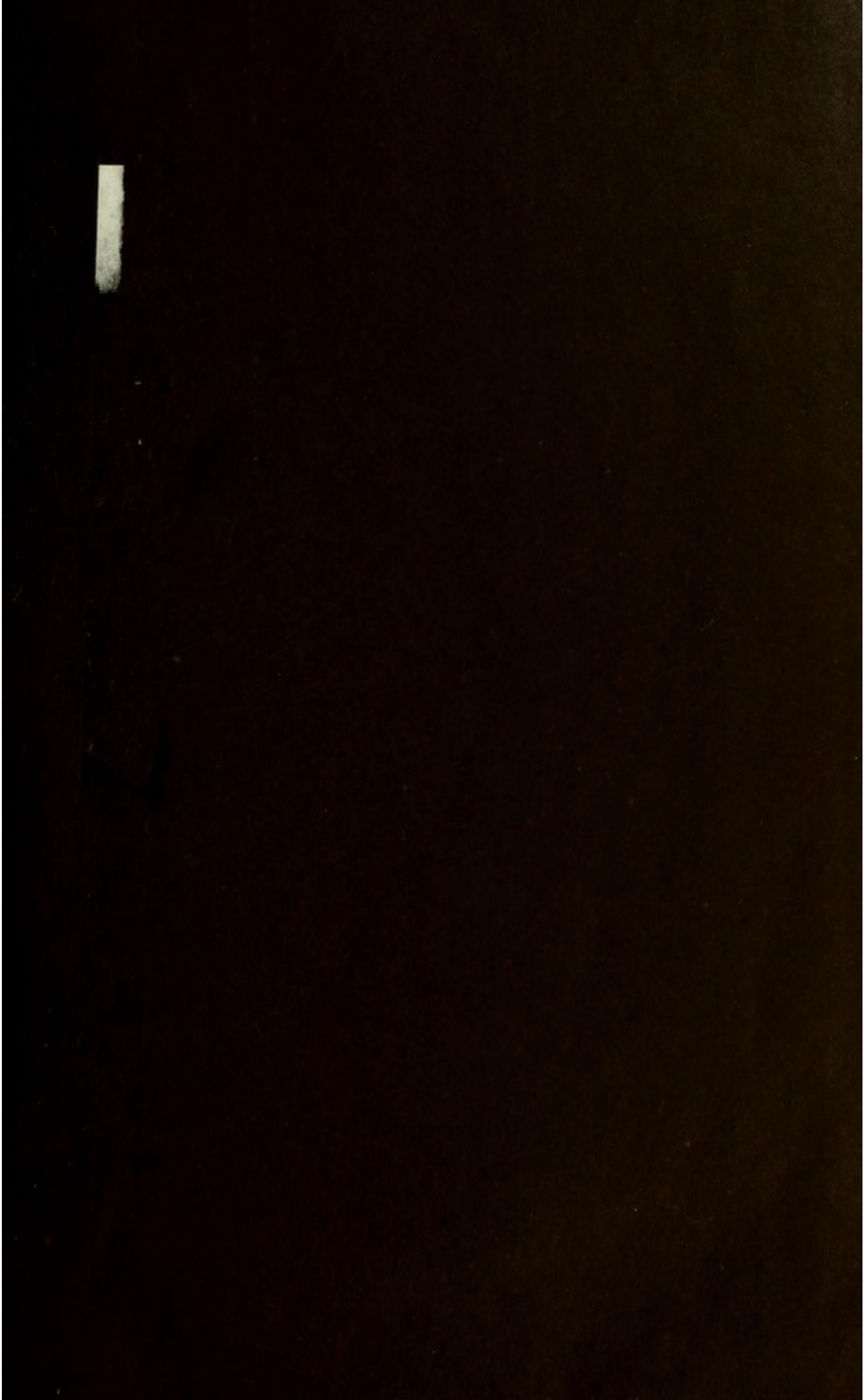

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BY

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Professor of Forensic Medicine and Public Health in the University of Glasgow; Ex-President and Fellow of the Royal Faculty of Physicians and Surgeons of Glasgow; Licentiate of the Royal Colleges of Physicians and Surgeons of Edinburgh; Examiner in Medical Jurisprudence and Hygiene to the Royal Colleges of Physicians and Surgeons of Edinburgh, and the Royal Faculty of Physicians and Surgeons of Glasgow for Diplomas in Medicine and Surgery, and Examiner in Public Health for the Diploma in Public Health of these United Corporations; formerly Examiner in the University of Birmingham; Senior Medico-Legal Examiner in Crown Cases for Glasgow and Lanarkshire, etc.

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The Medical Press 28 June 1910 p. 869

A TEXT-BOOK OF MEDICAL JURISPRUDENCE AND TOXICOLOGY. By John Glaister, M.D., D.P.H.Camb., F.R.S.E., Professor of Forensic Medicine and Public Health in the University of Glasgow. Published by E. & S. Livingstone. (Edinburgh: 1910.) Second edition. Price 14s. net.

In the first edition of his work Dr. Glaister included hygiene and public health with the subjects treated in the present issue, but the increasing importance of the former and the expansion of information on the subject as a whole has led him to devote an entire volume to medical jurisprudence and toxicology, with the intention of bringing out a separate book on hygiene and public health.

The relation of the medical practitioner to the State will thus be treated in all its branches. Expert evidence, and especially medical evidence, is acknowledged to be full of difficulties. Technical information has to be presented in a form comprehensible to those who have no special knowledge which will enable them to appreciate the bearing of facts upon the point at issue, whose significance is quite clear to the trained observer; and Dr. Glaister gives his readers excellent instruction as to the best and clearest manner of interpreting observations and presenting them to the judge and jury in language comprehensible to those without special knowledge or training. The subject of medical evidence is, in fact, treated most exhaustively, and many trials are quoted to exemplify mistakes which may be made and the best way of avoiding them.

Breach of professional confidence has always been a bugbear of the medical witness, but it will be quite clear, from the examples quoted by the author, that in the law courts a medical witness has to consider his duty to the State before his duty to his patients; and, again, in the matter of precognition of evidence he is advised not to withhold information from either side. His attitude, in fact, should be impartial, and rather that of the judge than the partisan.

Identification of criminals is obviously a subject full of interest to the author, and in his chapter on the medico-legal bearings of personal identity he gives an elaborate account of the anthropometrical system and the system of identification by thumb marks, incidentally mentioning the means by which tattoo marks can be removed.

The tenth chapter, which is devoted to wounds in their medico-legal relations, is most elaborately and almost unnecessarily illustrated, as the pictures are rather ghastly in themselves and add but little to the information already given by the description.

The law of lunacy as applied in England and Scotland is treated very fully, the procedure being compared, to the great disadvantage of the former as compared with the latter, and there is no doubt that the English law regarding the treatment of a mentally diseased person in the house of a medical man is unduly harsh and restrictive. In his account of a series of legal trials the author points out the difficulty of determining the responsibility of a criminal who is alleged to be mentally defective, and comments on the uncertainty and inconsistency of the verdicts.

The section dealing with toxicology is very complete, and the law relating to the sale of poisons is fully discussed in all its bearings. The evidences of poisoning and the duty of a practitioner who suspects it in a case he is attending are shortly and clearly treated. The author proceeds with the classification of poisons, dealing in the usual way with the symptoms and morbid appearances produced by them both before and after death; acids, alkalies, irritants, alkaloids, and ptomaines being dealt with in order. As before stated, however, this part of the book is very full and elaborate, fairly long sections being devoted to each individual poison, while the chemical tests are given at great length and in minute detail.

Generally it may be stated that the book deals with the English and Scotch legal procedure, the differences being clearly described and exemplified by accounts of trials in both English and Scotch courts. Dr. Glaister's book may be strongly recommended as a very complete and readable treatise on a subject of great importance to every practitioner of medicine.

PREFACE TO SECOND EDITION

In preparing a second edition of this book, the Author has been much encouraged by the appreciation which the first edition received from the medical press, and from students and practitioners in the professions of Medicine and Law.

The combination of the subjects of Medical Jurisprudence, Toxicology, and Public Health which was introduced in the first edition, while it undoubtedly had some advantages, was at the same time not unattended by certain drawbacks. As the subjects tended to expand, it becomes increasingly difficult to maintain the combination in a single volume such as would result at once in a handy book for the student and a work of reference for the practitioner.

These considerations, therefore, have induced the Author to issue the present edition in two separate volumes, of which the present volume deals with Medical Jurisprudence and Toxicology, and the second volume, which is to follow soon, with the subject of Public Health.

Perusal of this volume will reveal that an effort has been made—it is hoped with some measure of success—to bring the subjects of which it treats into line with present-day advancements. Some of the chapters have been largely re-written or re-modelled; many have received substantial additions; and all have been carefully re-edited. More detailed attention has been given, for example, to Lunacy Law and Procedure, and some enlarged consideration of the subject of Anæsthetics and their administration has been thought necessary.

In the section of Toxicology, the number of poisons considered has been added to.

From his records of practical medico-legal work, the Author has, moreover, added several new cases for the purpose of more fully illustrating and thereby verifying the text, in the hope that their narration will render the subjects which they illustrate more attractive to the student, and more useful to the members of the legal as well as the medical profession.

The Author desires gratefully to acknowledge his thanks to those who have so willingly given him assistance in preparing this edition; in particular, to Alexander Duncan, Esq., B.A., LL.D., for his generous

and valuable help in again reading proofs; to Archibald Crawford, Esq., M.A., LL.B., Advocate at the Scottish Bar, and to George John Spreull, Esq., M.A., LL.B., Barrister-at-Law, London, for their kind and able assistance in the preparation of some of the more purely legal aspects of subjects treated of in the volume; to Dr H. Galt, late Professor of Medical Jurisprudence, Saint Mungo's College, for the use of photographs; and to the publishers for their ever-ready aid in all matters in bringing the publication of the volume to successful completion.

University of Glasgow,
18*th April* 1910.

PREFACE TO FIRST EDITION

In the following pages the experiment has been tried of combining in a single Text-Book or Manual the subjects of Medical Jurisprudence, Toxicology, and Public Health. All three subjects imply relationships subsisting between the medical practitioner and the State; and at most of the qualifying Examining Boards the subjects are now conjoined for examining purposes. To have them treated in the same text-book may therefore be found to be a matter of convenience, especially for the Student of Medicine. On none of the subjects does the volume pretend to be exhaustive. As regards range of topics all that is claimed is that it comprehends many of the most important problems in each of the departments of which it treats. Its aim is to be a practical guide to the chief relationships of the members of the medical profession to the State as regards both the criminal and civil law, and to give a fairly adequate exposition of the principles and practice of Public Health. Nor have the needs of the legal profession been overlooked. Many references will be found to legal cases and text-books, Acts of Parliament and the like, in their relation to medico-legal questions and decisions. To the legal practitioner and law student therefore it is hoped that the book may afford a useful guide in a class of cases often perplexing to the legal mind.

The experience gained by the Author in the field of medico-legal work and practice for a quarter of a century and in the teaching of the subjects treated of in this Manual for over twenty-one years has convinced him that the kind of book most needed by practitioners and students alike is one which combines the exposition of principles with practical details. His experience as a teacher has also shown him the greater need than has hitherto been provided for of illustrating the exposition of the subjects considered. Out of the large store of material therefore which the Author has accumulated during the above-named period, he has selected some for illustrating this volume.

In the preparation of these pages he has to acknowledge most gratefully assistance received from several sources. It would be impossible, however, to do this individually. To some he is indebted for the use of certain illustrations, the sources of which are indicated in the text. To others he is a debtor for suggestions. To all of these he now tenders his warm thanks. But special acknowledgment must be made with cordial appreciation and gratitude to two of his friends

who have rendered more signal service: To Dr Arbuckle Brown, his University Assistant, for much painstaking labour in the drawing and preparation of illustrations, reading of proofs, and compilation of indices; and to Alexander Duncan, Esq., B.A., LL.D., Secretary and Librarian of the Faculty of Physicians and Surgeons of Glasgow, for his kindness in the arduous task of proof-reading and for much literary assistance, the Author tenders his most cordial thanks. In conclusion, he further desires to express his acknowledgments to the publishers who have spared neither time, trouble, nor expense in presenting this volume to our readers.

University of Glasgow,
April 18*th*, 1902.

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MEDICAL JURISPRUDENCE

SECTION I

MEDICAL JURISPRUDENCE

CHAPTER I

LEGAL CRIMINAL PROCEDURE

MEDICAL Jurisprudence, Forensic Medicine, Juridical Medicine, Legal Medicine, and State Medicine, are some of the designations of that science which correlates medical knowledge to the purposes of the law; and the term "medico-legal" is used in connection with such words as "report," "knowledge," "skill," "testimony," to signify the practical application of this knowledge. The precise kind of knowledge which may require to be brought to bear upon any particular legal problem having in it relations to the science and art of medicine must, however, be of the most varied character. Chemistry, Botany, Materia Medica, Anatomy, Physiology, Midwifery, Medicine, Surgery, and Pathology, in addition to other departments embraced in the training of the modern practitioner may, therefore, be laid under contribution: Chemistry, in cases of poisoning and in cases of corrosive fluids applied externally; Botany and Materia Medica, in the detection of poisonous plants, and in the recognition of official or other preparations of drugs; Anatomy, in the recognition of parts of human remains, and in the differentiation of the bones of the lower animals and man; Physiology, in the estimation of the effects of growth upon the human body, and their modifications under special circumstances; Midwifery, in cases of feigned pregnancy, in the determination of the duration of the period of gestation, and of the signs of pregnancy, in criminal abortion, in sterility, and in the question of determination of virginity; Medicine, in the differentiation of diseases from the effects of poison, and in many other relations; Surgery, in the determination of the causes and characters of lesions, the result of violence applied to the body; and Pathology, in the dissection or post-mortem examination of the body in cases of suspicious death from any cause, and the differentiation of normal from abnormal conditions. Besides, in certain kinds of medico-legal cases it will probably happen that aid may require to be invoked from more than one of these departments in the elucidation of truth regarding any given case.

Since no medical practitioner can help himself from being called upon to render such assistance as the law may require of him, it behoves the student of medicine to diligently study the various problems which

the subject offers. There are those who, entering upon the duties of a medical career, hope that it may never be their lot to become witnesses in medico-legal cases, or to become acquainted with the atmosphere of a court of law, and still less with, what appears to them, the disagreeable and uncomfortable environment of the witness-box. This, however, is but a fond delusion in the large majority of cases. It ought to be recollected that a medical practitioner presents a two-sided relationship to the State; first, as a physician or surgeon, the healer of disease, and second, as something of a forensic expert, whose professional watchfulness and acumen are expected to prevent crime from going undetected, and, at the same time, to protect the innocent from unfounded criminal charges. Indeed it may be said with tolerable certainty that so soon as a man starts upon his medical career, whether as a hospital assistant, general practitioner, or a specialist, he is liable to be called upon to render professional services in cases in which circumstances may, later, compel his attendance in the witness-box.

While it is the prime aim and object of the physician and surgeon to cure, and to save life, the medical jurist has to deal with problems ahead of these efforts; for example, while his immediate duty in a given case of cut-throat is to save the life of his patient, it may be required of him to give an opinion whether, from the character of the wound and other facts, such wound was inflicted suicidally or homicidally, and, if the former, whether the person, at the time the wound was inflicted, was or was not of unsound mind. Moreover, he has a relationship to the dead as well as to the living. The body of a man, let us say, has been found. The criminal authorities call upon a practitioner to guide them as to their future action by giving an opinion whether the death was due to natural or unnatural causes, and if the latter, what was the cause; or, the dead body of a person is taken out of the water, and he is called upon to pronounce an opinion as to whether the person died in the water from the effects of submersion, or whether the body had been thrown into the water after death to hide the real cause of death, and to suggest that drowning was the cause. These and many like problems are largely solved by the aid of medical knowledge. A medical man, called to act in any of these relations, must be practically alive, therefore, to the importance and gravity of the situation; for any mistake in his judgment may cause the punishment of the innocent, or the escape of the guilty. In view of the foregoing considerations, therefore, the medical practitioner must cultivate the habit of rapid, accurate, and close observation, and must develop the qualities of the logician in the application of his science to a body of facts; having acquired these, his judgment is likely to become less liable to error; it is certain to be honest; and he will be in a position to give good reasons for the opinions he offers.

MEDICAL EVIDENCE

From a long practical experience with criminal law-courts in connection with medico-legal work, and from observation over a long period of the ordinary medical witness as a giver of testimony, we

have arrived at the conclusion that one principal ground upon which it has been freely said by judges and members of the bar that medical men usually make bad witnesses, is a want of knowledge of legal procedure on the part of medical men, coupled with a want of familiarity with law-courts and a legal atmosphere. This may, in great measure, be overcome by the student taking every opportunity of being present in criminal courts when cases of medico-legal interest are being tried. There is, however, a more important reason which, in our view, accounts for the awkwardness of the young medical witness, and that is, the entire absence of practical illustration of theoretical teaching of Forensic Medicine which, too generally, prevails in our Medical Schools. Although this is essentially a practical subject, and only attains its value when applied to practice, it is about the only one which the student has few opportunities of seeing in practical operation, and too frequently it is expected of him to know the subject by listening merely to lectures.

To remove the former difficulty, the subject of legal procedure, in so far as it throws light upon the position of the medical witness, shall be first considered.

LEGAL CRIMINAL PROCEDURE

I. In England and Ireland.—Since in these divisions of the kingdom the same mode of procedure obtains, they may be bracketed together in the one description. Up till some years ago there was no public prosecutor in England. Then, however, an Act was passed authorising the appointment of such an official, who should undertake this duty in certain specific cases of public importance, and in such districts as the appointment might be agreed upon. In ordinary circumstances it is left to the person against whom the crime has been committed to himself prosecute the offender. Assuming that he has resolved to do this, the procedure thereafter is as follows :—The witnesses in the case, before a magistrate, a justice of the peace, or a body of justices, and in presence of the accused, make their depositions, which are taken down in writing, and after having been read over to them are severally signed by them and by the presiding justice. From the *primâ facie* evidence given, it remains for the justice to decide whether or not the accused shall be committed for trial, because, in serious cases, it is not his duty to say whether the accused person is guilty. If the prisoner be committed for trial, he is either kept in prison—if the crime be one for which bail may not be accepted, such as murder or treason—or, otherwise, he may be liberated on sureties given by himself, or by friends, or by both. His case next comes before the grand jury—a body of gentlemen numbering not fewer than twelve, and not more than twenty-three—at the next assizes or term. The mode of procedure before the grand jury is to call witnesses to support the charge against the prisoner, and if a majority of jurors numbering at least twelve conclude that there is a *primâ facie* case against the accused, they " find a true bill," which then becomes the indictment ; if, however, a majority think that the evidence which has been led is

inadequate to support the charge, they "throw out the bill." In this preliminary investigation—because it is not a trial in respect that the accused is not called upon to plead—the sole object is to prevent a trumpery case being brought forward and to determine whether or not there is sufficient evidence to warrant the trial. If a "true bill" be returned against a prisoner, he stands committed for trial before the petty or ordinary jury, when he is brought before the court and is required to plead to the indictment against him; the presiding judge of the court sitting by virtue of a fivefold commission—viz. (1) of Oyer et Terminer; (2) Gaol-Delivery; (3) Nisi Prius; (4) of the Peace; and (5) of Assize. The procedure at the trial is as follows:—The prisoner having pled "not guilty," and the jury being sworn, the prosecuting counsel opens the case against the prisoner by stating the facts to which the witnesses he is about to call will testify. He next calls and examines his witnesses in turn. This examination of a witness is called the examination-in-chief. Each witness, at the conclusion of this examination, may be cross-examined by the counsel for the accused, or by the accused himself if not represented by counsel, after which the prosecuting counsel may re-examine each witness on points brought out in cross-examination, but he may not examine the witness on any fresh subject of evidence not previously brought out; after which, if the witness is to be asked any further questions, such must be put through the judge. After these witnesses have been called, counsel for the prosecution is informed by the accused or his counsel whether or not he intends to call witnesses. If he proposes to do so, then the position of counsel with reference to examination of defendant's witnesses is reversed. At the conclusion of the evidence, defending counsel addresses the jury on behalf of the prisoner, thereafter the prosecuting counsel addresses the jury, and last of all the judge sums up, and the jury are left to return their verdict. If, however, defending counsel does not propose to call witnesses, the order of procedure is changed to this extent—viz. that at the end of the evidence for the prosecution, prosecuting counsel proceeds to address the jury, after him the defending counsel, and then follows the summing-up of the judge. If the prisoner be not defended by counsel, the right of addressing the jury possessed by the prosecuting counsel under other circumstances is denied him. In certain circumstances a convicted person may appeal to the Court of Criminal Appeal under Section 3 of the Criminal Appeal Act, 1907 (7 Edw. VII. c. 23).

The other court in England, in which medical evidence is largely required, is the Coroner's Court or Inquest. Legally speaking this is not a trial, for as at the magistrate's inquiry the prisoner or accused, if such there be, cannot be called upon to plead. It is, therefore, essentially an inquiry or inquest. A want of knowledge of the powers of the coroner and the limitations of his office on the part of medical men continually gives rise to much heart-burning. Coroners are of three kinds—viz. (1) Those by virtue of office; (2) those by virtue of charter, commission, or statute; and (3) those by election. The Lord Chief-Justice of the Court of King's Bench is the chief coroner of England, the other judges of that court being sovereign coroners by right of office. Under the second head are the coroner appointed by the Dean and Chapter of Westminster for the city of Westminster, and the coroner of the King's

Household. These hold office by virtue of charter. By the Municipal Corporation Reform Act, 1835 (5 & 6 Will. IV. c. 76), sec. 62, it was enacted that after May 1, 1836, the council of every borough in which a separate court of quarter sessions shall be holden, was to elect a coroner for such borough, who should hold office so long as he shall "well behave himself in his office," and who, when so elected, was not to be a corporate officer. This provision was renewed in the Municipal Corporations Act, 1882. By the Local Government Act, 1888, boroughs are divided into three kinds—viz. (1) County boroughs with a population at June 1881 of 50,000 and upwards, forming administrative counties: (2) larger Quarter Sessions boroughs with a population at same date of 10,000 and upwards which by virtue of the Municipal Corporations Act, 1882, have power to appoint their own coroners; and (3) smaller Quarter Sessions boroughs with a population of less than 10,000. The coroners for the last class are the county coroners of the county in which they are situated. These hold office under statute. County coroners are elected under the statute 3 Edw. I. c. 10, which enacts that "through all shires sufficient men shall be chosen to be coroners of the most lawful and most wise knights." The number of coroners in individual counties varies, as it is not limited by statute. The election of a county coroner formerly proceeded under the writ *De coronatore eligendo* directed to the sheriff, whose acts were regulated by the Act 7 & 8 Vict. c. 92. The provisions of this Act were repealed by the Local Government Act, 1888 (51 & 52 Vict. c. 41, s. 5), and the duty of electing a county coroner is now laid upon County Councils, the writ of appointment being sent to the County Council by the Lord Chancellor instead of, as before, to the sheriff of the county. A coroner so elected does not demit office on the demise of the monarch. Freeholders of the county are the electors. By the Act 14 Edw. III. c. 8, the holder of the office was required to have sufficient land in fee in the county to answer all people. It is, however, sufficient that the person appointed should possess land sufficient for the degree of a knight, which is to the amount of twenty pounds per annum. By the Act 6 & 7 Will. IV. c. 105, sec. 6, every borough coroner, and by the Act 6 & 7 Vict. c. 83, every county coroner, and, later, by the Coroners Act, 1892 (55 & 56 Vict. c. 56, s. 1), every coroner, whether for a county or a borough, shall appoint a competent person not being an alderman or councillor, approved by the chairman of council or mayor to act as his deputy in office. The duties of the office of coroner may be summed up as follows:—(1) To hold inquests on the bodies of persons who die by violence, accidental or otherwise, on the bodies of those who die suddenly under suspicious circumstances, or of those who die in prison; (2) to prepare and make a return annually of the inquests he holds; (3) to apprehend persons charged with murder or manslaughter, and to bind over for further attendance at the assizes, prosecutors and witnesses; (4) to attend the trial of prisoners charged under inquisitions held by him; and (5) various other duties in which, however, medical men ordinarily have no interest. In these days, in view of the movement toward filling the offices of coroners by medical men, it is essential that aspirants to the office should be fully acquainted with the statutory enactments and duties attaching thereto.

In holding an inquest upon a body, the duties of the coroner are

defined by the Act 4 Edw. I. c. 2, *De Officio Coronatoris*. According to this statute the coroner and jurors must "view" the body and the nature of the injuries by which the death has been caused, and, if necessary, the body must be exhumed for this purpose. By the Coroners Act, 1887, sec. iii., his duty is so defined :[1]

"Where a coroner is informed that the dead body of a person is lying within his jurisdiction, and there is reasonable cause to suspect that such person has died either a violent or unnatural death, or has died a sudden death of which the cause is unknown, or that such person has died in prison, or in such place or under such circumstances as to require an inquest in pursuance of any Act, the coroner, whether the cause of death arose within his jurisdiction or not, shall, as soon as practicable, issue his warrant for summoning not less than twelve, nor more than twenty-three good and lawful men to appear before him at a specified time and place, there to inquire as jurors touching the death of such person as aforesaid."

After the "view" the coroner is to inquire as to the cause of death, and to effect this is empowered to summon such witnesses as may be able to aid him toward that end. It is within the option of the coroner not to summon a jury or hold an inquest where the evidence as to the cause of death in any given case is otherwise sufficient.

Relation of Medical Men to Coroner and Inquest.—There are certain questions which affect the medical profession with respect to their relation to the coroner's office. Of these, probably the most important is that with respect to whether it is the duty of a medical practitioner in attendance upon a person who has died from a violent or any unnatural cause to report the fact to the coroner. It does not appear that there is any statutory obligation upon a medical man, as such, to do this ; but it is a question whether at common law, he, as a member of the community, ought not to perform this duty. In view, however, of the strong statements of Chief-Justice Hawkins in Kitson *v.* Playfair, with respect to professional secrecy, and also of the undesirability of the medical profession, without compulsory requirement, acting in any manner which would seem to desecrate the confidential relationships which obtain between medical men and their patients, it is advisable that such information should not be conveyed, unless explicitly through the terms of a medical certificate of death, which such a practitioner may give in accordance with the terms of the Registration of Births and Deaths Act, 1874, sec. xxxix., or implicitly by withholding such certificate of death, which, under reasonable excuse, he is entitled to do, in which case the death would come under the cognisance of the coroner as an uncertified death, and thus would enable that official to exercise his office ; in any case, until legislation compels the members of the medical profession to send such information direct to the coroner, or a High Court gives such interpretation to the common law upon a stated case as will vindicate their action and thus protect them, it is better to proceed as has been indicated. Again, with reference to the "view" of the jury which the law presently compels, it may be considered whether such is not now an anachronism. The view was instituted when there were no medical witnesses summoned

[1] Coroners (Consolidation) Act, 50 & 51 Vict. c. 71.

and no post-mortem examinations were performed, and it may reasonably be urged that such a view will have but little significance, if, indeed, it be not in the main repugnant to the minds of ordinary lay jurors. There are no good grounds to be stated against an inspection by the coroner himself, who ought to be able to do this intelligently—particularly if a medical man—as an important part of his qualifications for the office, and, especially, as he is, for the time being, the legal possessor and custodian of the body. However, so long as the view by the jurors is part of the law, this duty must be fulfilled.

Apart from the purely criminal aspect of the office of coroner, it is probably true that the bulk of his labour consists in reporting upon the causes of death of persons regarding which no medical certificate has been granted, or, even where such a certificate is produced, where there are *primâ facie* grounds presuming criminal responsibility. There can be little doubt that the operation of his office is calculated to produce, as it has in the past effected, considerable reduction in the number of "uncertified" deaths in England as compared with Scotland.

The relation of the coroner to medical witnesses being of such importance, some attention to this is necessary. In summoning witnesses, the coroner may by virtue of statute 6 & 7 Will. IV. c. 89, sec. 1, and, later, by the Coroners Act, 1887, summon medical witnesses, and, if necessary, may direct such medical witnesses to perform a necropsy and to make a chemical analysis of the contents of the stomach. This summons the medical witness is bound to obey, otherwise he is liable to a penalty. The following is the scheduled form of summons :—

"London
to wit *To* Esq., Surgeon.

"Sir,—By Virtue of this my Order as one of His Majesty's Coroners for the *County of London* you are hereby required to be and appear before me and the jury on day, the day of at o'clock in the noon, at in the Parish of then and there to give evidence on His Majesty's behalf touching the death of , and to make or assist in making a post-mortem examination of the Viscera of the Head, Chest, and Abdomen of the body of the said with an analysis and report thereon at the said Inquest. And herein fail not at your peril.

"Dated the day of 191 ."
(Signature of Coroner.)

If the summons be not framed in these terms, it is simply an ordinary summons for which no expert fee can be demanded, but for neglect of which the same penalty of £5 carries.

Although the foregoing is the schedule form of summons of the Coroners Act, it is not expected that the doctor should actually make the analysis. His duty is, in suitable cases, to secure the viscera of the body under his private seal for the analyst to be named by the coroner, who, usually, by arrangement with the Home Office, is a Crown Office expert (*Home Office Circular*, Jan. 7, 1903).

With certain exceptions, attendance after summons at an inquest, according to the Act quoted, entitles the medical witness to a fee of £1, 1s., and if a post-mortem examination be made by direction of the coroner, with or without an analysis of the viscera, to a fee of £2, 2s. The exceptions to this rule are defined in the Coroners Act, 1887, sec. 22, as follows :—

" Where an inquest is held on the body of a person who has died in a county or other lunatic asylum, or in a public hospital, infirmary, or other medical institution, or in a building or place belonging thereto, or used for the reception of the patients thereof, whether the same be supported by endowments or by voluntary subscriptions, the medical officer whose duty it may have been to attend the deceased person as a medical officer of such institution as aforesaid, shall not be entitled to such fee or remuneration."

This provision is in consonance with section 5 of 6 & 7 Will. IV. c. 89, except that it has been broadened by the words used—" or other medical institution," for the words " or other public medical institution " of the older statute. This provision is held to be a hardship upon those medical men who hold the office of medical officer to cottage hospitals, or infirmaries attached to public schools, training colleges, and the like. The case of Horner *v.* Lewis (67 L. J. 524), in which the honorary medical officer of a cottage hospital sued the coroner for his fee for a post-mortem examination of the body of an inmate, was lost by the plaintiff because Justices Wright and Kennedy ruled that the hospital was a public institution. The same disability to claim fees falls upon army medical officers for attendance at inquests upon the bodies of persons who have died in military hospitals.

When a coroner and his jury have concluded the hearing of evidence, it becomes the duty of the latter to return a verdict in accordance with the evidence. Where the duties are performed intelligently, such verdicts may, in the main, be considered satisfactory ; on the other hand, occasional verdicts may be not only unsatisfactory, but may truly be called amazing. Before the Committee of the House of Commons on Death Certification, Dr Ogle [1] stated that one verdict came before him in his official capacity that was of the latter character. It was this : " A man died from stone in the kidney, which stone he swallowed when lying on a gravel path in a state of drunkenness." He further added that he thought that some joke had been played, but that, having written to inquire about it, he found the verdict to be as stated. Another verdict, he stated, was as follows :—" Child, three months old, found dead, but no evidence whether born alive." It would be difficult to conceive the mental qualifications for such a duty of those who returned such verdicts. Further detailed information on the coroner and his office may be obtained by perusal of " The King's Coroner " in two volumes, published in 1906, by R. Henslowe Wellington, M.R.C.S.

In any case, where a medical witness has given evidence in which an accused person is committed for trial, he, in common with other witnesses, is bound over to give evidence at the assizes or other

[1] Report of Committee, p. 8.

court at which the trial is to take place. Accordingly, he is summoned to do this in terms of the following summons :—

" Edward, by the Grace of God, of the United Kingdom of Great Britain and Ireland, King, Defender of the Faith, To Greeting : We command you, and every of you, that all business being laid aside, and all excuses ceasing, you do in your proper persons appear before our Court of Quarter Sessions of the Peace [or other Court], assigned to L.S. keep the peace in the City [or Borough] of , and also to hear and determine divers Felonies, Trespasses and other Misdemeanours in our said City [or Borough] committed, to be holden within the , in the said City [or Borough], on the day of now next ensuing, at the Hour of Ten of the Clock in the Forenoon, of the same Day, to testify the truth and give evidence, on our behalf, against in a case of ; and this you and every of you are in no wise to omit, under the Penalty of twenty pounds for you and every of you. Witness, Esq., our Recorder at aforesaid, the day of in the year of our reign.

" (Signed) Clerk of the Peace."

REMUNERATION FOR MEDICAL STATE SERVICES

As difficulty is experienced by young practitioners in obtaining information regarding the fees to which they are entitled for services performed to the State, the following statement of statutory fees may prove of service :—

If the police call a medical practitioner to perform professional services to anyone between the hours of 8 A.M. and 10 P.M., he can claim a fee of 3s. 6d., and between the hours of 10 P.M. and 8 A.M. of 7s. 6d. To entitle him to receive the fee the practitioner must obtain a certificate of such attendance from the police inspector on duty.

The fees in police courts are as follows :—

First.—Where the accused is committed for trial, the magistrate certifies to the clerk of arraigns that a fee is due for each day of attendance—viz. 10s. 6d. if witness live within two miles of the court, and £1, 1s. if beyond two miles.

Second.—Should the prisoner not be committed for trial, the witness should ask the magistrate for a certificate of attendance, which will entitle him to payment on the above scale.

Provision for such payments in magistrates' courts is made by the Criminal Law Prosecution Expenses Act (29 & 30 Vict. c. 52, sec. 2), which provides that where magistrates sign such certificates, and where such are sent to the clerk of the peace to be laid before courts of quarter sessions, the expenses may be allowed in whole or in part, according to the scale fixed under sec. 5 of the 14 & 15 Vict., and the court may issue orders for the payment thereof.

The attendance of medical witnesses before courts of summary jurisdiction is affected by the Indictable Offences Act, 1848, sec. 16, by which a justice has the power to compel by subpœna the attendance of any person whose evidence is material in the case, and while there is nothing enacted therein with regard to tender of expenses, and the medical witness, therefore, ought to obey irrespective of such a tender, it would seem from the opinion expressed by Mr Justice Hawkins, R. *v.* Osmond, *Times*, Sept. 6, 1893, that solicitors have no right to bring a witness a long way upon subpœna without such a tender of expenses. By the Summary Jurisdiction Act, 1848, sec. 7, a justice is empowered to compel the attendance of an unwilling witness on proof put before him that, despite the tender of expenses, the witness has refused to come. It would appear, however, that such expenses would not include moneys for loss of time, but for outlays consequent only upon the attendance.

Before Courts of Quarter Sessions and the Central Criminal Court of London, witnesses may be subpœnaed in criminal cases without tender; but should a witness be summoned from another part of the kingdom in terms of 45 Geo. III. c. 92, sec. 3, a sufficient tender must be made to defray his expenses. Apart from such a case as the latter, the State is under no legal obligation to pay fees to witnesses; but the Secretary of State, under the powers of 14 & 15 Vict. c. 55, has ordered for medical witnesses the following scale of remuneration—viz. for each day of attendance £1, 1s., and for each night 2s. ; and if attendance is from a distance, travelling expenses, 3d. per mile each way. It is very advisable that witnesses should obtain their fees at the conclusion of the case for which they have been subpœnaed, to save further trouble.

By the County Courts Acts, sec. 111, it has been decided that a witness, even after having been sworn, may decline to give evidence until his expenses have been paid. (In *re* Working Men's Mutual Societies (1882), 21 Ch. D. 831.)

Attendance by a medical witness before the High Court of Justice or the Assizes cannot be made compulsory, in terms of 17 & 18 Vict. c. 34, until a tender of expenses has been made. The following is the part of the Act on this subject:—"None of the said courts shall proceed against any person for making default by not appearing to give evidence unless it shall appear that a reasonable and sufficient sum of money to defray the expense of coming and going was tendered to the witness." Such expenses ought to include cost of travel and of residence while in attendance on the case. Again, it has been decided in the case of Allen *v.* Yoxall (1844, 1 C. and K. 316), that a witness subpœnaed by both plaintiff and respondent is entitled to expenses from both, even though only called by one to give evidence.

The fees in County Courts are regulated by scale for ordinary and for expert and scientific witnesses; as ordinary witness, for time, 15s., and for hotel expenses, if from home, £1, 1s. per day; as expert and scientific witness, for qualifying to give evidence, time, £1, 1s. to £3, 3s., and expenses £1, 1s. to £5, 5s. per day, and for attendance at court, time, £1, 1s. to £2, 2s., and expenses, £1, 1s. to £3, 3s. per day. In Admiralty Courts, and where the medical witness lives

within a distance of five miles, for time £1, 1s. to £3, 3s., and if a greater distance, £1, 1s. to £3, 3s., not inclusive of travelling expenses. In the Court of King's Bench and Chancery Divisions, if the witness be resident in the town where the cause is tried, £1, 1s. per day, if at a distance £2, 2s. for time, and £3, 3s. for expenses per day, not inclusive of travelling expenses. In the House of Lords, the medical witness receives, for time £2, 2s., and for expenses £1, 1s. per day, exclusive of travelling expenses, which in no case "shall exceed 1s. per mile one way."

Little need be said on the subject of expert evidence called in civil actions, as the fees are usually arranged after the witness has decided that he can appear and give evidence. Should, however, such fees afterwards be disputed, it is well to bear in mind that "just and reasonable charges and expenses as appear to have been properly incurred in procuring evidence and the attendance of witnesses" allowed by Order 65, r. 27 (9) of the Rules of the Supreme Court, has been interpreted to mean in the case of an expert witness £7, 7s. per day for reading up a case in order to give evidence.

II. In Scotland.—The prominent characteristic of criminal procedure in Scotland is the existence of the office of public prosecutor.

The Lord Advocate is the chief public prosecutor; then, in a descending scale, advocates-depute, and procurators-fiscal.

The duty of bringing all accused persons to a bar of justice, and at the public expense, falls primarily upon the Procurator-fiscal as public prosecutor. In addition, he is charged with the duty of inquiring into the cause of sudden or suspicious deaths, which inquiry takes the form of precognition of witnesses—lay and medical. This is ordinarily a private inquiry. After he has performed this duty he is further charged under the Registration Act (17 & 18 Vict. c. 80, sec. 40), to report and certify the cause of death to the registrar of the district in which the death took place. But he is also charged statutorily with the duty of making public inquiry into the causes of fatal accidents, and, in special circumstances, of sudden deaths. The former is held under the Fatal Accidents Inquiry (Scotland) Act, 1895 (58 & 59 Vict. c. 36), and the latter as well as the former under the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act, 1906 (6 Edw. VII. c. 35). The Procurator-fiscal presents a petition to the Sheriff craving him to hold a public inquiry in regard to the cause of the death and the circumstances of the accident (Fatal Accidents Act, 1895, s. 3), and the Sheriff in granting the petition pronounces an order, directing that a public inquiry be held, and grants warrant to cite witnesses and havers, at the instance of the Procurator-fiscal. In the latter Act it is enacted by sec. 3, that "in any case of sudden or suspicious death in Scotland, the Lord Advocate may, whenever it appears to him to be expedient in the public interest, direct that a public inquiry into such death, and the circumstances thereof shall be held"; such inquiry shall take place according to the forms and procedure prescribed by the Fatal Accidents Act, 1895, except as altered by the Act of 1906. The inquiry is held by a Sheriff and jury, the jury consisting of five common and two special jurors, of which neither an employer of the person regarding whose death the inquiry is held, nor any person engaged under the

same employer as the dead person, shall be a member. After hearing the evidence, of which part is almost certain to be medical, and after the summing-up of the Sheriff, the jury shall return a verdict which shall set forth when and where the accident and the death took place, and the cause or causes of the accident or death, and other facts as to fault or negligence of anyone or defects in mode of working in the case of accidents, if any. The verdict is usually unanimous, but it may be returned by a majority "at any time not less than one hour after it [the jury] has been enclosed." For this duty each juror is remunerated at the rate of 5s. for each day, or part of a day, and by travelling expenses. It is the duty of the Fiscal at the close of the inquiry to transmit all the documents, including reports or productions, with a copy of the verdict, "*together with the usual schedule for the registrar of deaths*," to the Crown Agent. His duties, therefore, include the sphere of action of the coroner in England. In carrying out the criminal part of his office, his instructions are, when serious cases of crime are reported to him, to proceed to the *locus* with the Sheriff and make an examination for himself; in such cases as rape, child-murder, or concealment of pregnancy, where invaluable evidence of the commission of the crime may be lost by delay, he is expected to secure early medical examination of the assaulted person and of the accused; where death results from violence, to see that a post-mortem examination is made by medical men of skill, who shall, as soon thereafter as possible, furnish him with a report of the said examination, and of their opinion as to the cause of the death; in the event of a serious assault to the extent of danger to life, and where death after an interval takes place, he is expected to obtain accurate evidence respecting the treatment of the injured person during the said interval; and to be prepared when called upon, in the event of assaults of the above kind likely to prove mortal, to proceed with a magistrate and take the deposition of the dying person upon oath, which deposition should be signed when possible by the said person and the magistrate in attendance; or he may instruct the medical attendants of the injured person how to proceed in this direction in the event of such a sudden change occurring in the condition of the person as would not permit of time for the legal authorities to be summoned. It may be said, too, that inquiry into the causes of sudden deaths is also prompted from the point of view of crime, since it is the suspicion of culpability which initiates his action. In such cases, in deaths from accident, and in all cases of sudden deaths reported to him by the police, or otherwise, he shall precognosce witnesses, among whom a medical witness shall be one, and from whom he shall have asked and received a proper medical report as to the cause of death, without a post-mortem examination where the cause of death can be ascertained without it, otherwise after a post-mortem examination.

As a medical witness may require to appear in any of the criminal law-courts, the following indicates the names of these courts, and, to some extent, the class of cases which are tried therein :—

I. Burgh Police Court: for trifling offences, or as the court of first instance, in remands to a higher court.

II. Justices' Court, in Counties: for like offences.

III. Sheriff Court: in which the Sheriff of the county, or his substitute, may act by himself, or with a jury—for crimes of a more severe character than the former, and graded in severity in respect of a jury acting along with the Sheriff.

IV. The Circuit or High Court: which meets quarterly or oftener in certain populous towns, and which deals with major and other serious crimes, and in which after conviction, in a charge of murder, a sentence of death may be pronounced.

V. The High Court of Justiciary: which sits in Edinburgh, and which is the highest criminal court in Scotland.

In order to better follow the procedure, let it be assumed that a crime is alleged to have been committed which involves the need of medical testimony—say, murder, or rape, or concealment of pregnancy; and what follows will be generally the procedure.

The police lay information of the crime before the Procurator-fiscal—the prisoner meanwhile either being still at large, or having been apprehended—and provide him with a list of the witnesses in the case. The prisoner on apprehension is first of all brought before a police magistrate on the given charge, by whom, however, he is remanded to the Sheriff. The Fiscal then proceeds to precognosce the witnesses, having also made arrangements for the making of a necropsy, if a case of murder or culpable homicide, or an examination of the body of the living person, if obtainable, in the case of rape, or concealment of pregnancy, by medical men, who shall report to him in due course. The Sheriff or his substitute gives the prisoner an opportunity—in the presence of his law agent if such have been employed—of emitting a declaration anent the charge preferred against him, after the prisoner has been duly warned that he may not, if he like, say anything, but that if he choose to do so the same shall be written down, and used at his trial. The Summary Jurisdiction (Scotland) Act, 1908 (8 Edw. VII. c. 65, s. 77), has amended the Criminal Procedure (Scotland) Act, 1887 (50 & 51 Vict. c. 43), with respect to declarations by prisoners, as follows:—where the accused is brought before the Sheriff for examination on any charge, and he or his agent intimates that he does not desire to emit a declaration in regard to such a charge, it shall be unnecessary to take a declaration.

By this time the Fiscal has finished his inquiry; the precognitions of witnesses have been taken, the medical reports are in his possession, and these together are forwarded to the Crown Agent, by whom they are placed before one of the advocates-depute, who, after review of the documents, makes an order on one or other of the following lines—viz. (1) that no further inquiry is necessary; (2) to continue the inquiry; (3) to prosecute in the manner suitable to the circumstances of the crime. Depending upon the nature and gravity of the crime, where a prosecution is determined upon, the order may be "Sheriff summarily"—which involves, upon conviction after trial, a maximum sentence of sixty days' imprisonment; or "Sheriff and Jury," which extends the limit of possible sentence to two years' imprisonment; or "Indict," which indicates trial before the Circuit Court or the High Court of Justiciary. Let it be assumed that the last

is the form of direction; then a "diligence" under the hand of the clerk of justiciary is sent to the Crown Agent, who, in his turn, causes it to be forwarded to a macer of the High Court of Justiciary. This diligence authorises that official to summon the accused to appear to meet the charge against him before the court, and also to summon the witnesses whose names have been supplied to him. Having fulfilled his duty, the macer returns to the Crown Agent a certified copy of the names of the witnesses summoned. The indictment is carefully drawn as to its terms, in respect of the character of the crime, the place and time of perpetration, the "productions"—(that is, garments, weapons, or documents) in the case which are to be used as evidence against the accused being detailed, and to it is also added a list of the witnesses summoned to give evidence. Up to the year 1887 the drawing of an indictment was a ponderous affair, but by the Criminal Procedure (Scotland) Act, 1887 (50 & 51 Vict. c. 35), sec. 2, it has been, with advantage to all concerned, much simplified. Now, it substantially consists of the following parts, viz. :—

I. (*a*) Designation of accused; (*b*) designation of prosecutor; (*c*) the charge, which condescends upon (1) time, (2) place, (3) and manner; (*d*) aggravations.
II. List of productions.
III. List of witnesses.

All three sections are signed by the prosecutor.

Of the productions it must be said that they usually bear labels when produced in court, upon which witnesses have, after identification of the article on a previous occasion, signed their names; therefore all that the witness has to do to identify the article while giving his evidence is to look for his signature on the label.

The indictment is, therefore, the accusation which is served upon the accused when he is to be tried, and along with it must be served a notice calling upon him to appear and answer thereto.

The precognitions and reports in the case form the "brief" of the Lord Advocate, Advocate-Depute, or the Procurator-fiscal, who acts as prosecuting counsel at the trial of the accused, from which he leads evidence of the witnesses.

Procedure at Trial in Scotland.—Procedure at the trial of a prisoner, or accused person, differs in Scotland from that in England.

After the court has assembled, the diet is called against the prisoner, who is asked by the judge to plead to the indictment against him, which has been read to the prisoner in court by the clerk. If he plead not guilty, then a jury of fifteen men is impannelled, of whom the first person balloted for is the foreman. The Advocate-Depute then calls the first witness, examines him or her, at the conclusion of which examination-in-chief he or she is cross-examined by counsel for the prisoner at the bar, or "panel," as he is commonly called; the witness may then be re-examined by the Advocate-Depute on points brought out on cross-examination; thereafter, the judge himself may now (as at any time during the course of the preceding examinations), and any juror, through the medium of the judge, may

ask questions of the witness. In this manner witnesses for the Crown give their evidence, and after hearing the last of them the case for the prosecution is finished. Thereafter, witnesses for the defence, including, it may be, the prisoner himself, are called, or not, as the case may be: if called, the position of the respective counsel is reversed with respect to the leading of evidence; and at the conclusion of all the evidence, the Advocate-Depute addresses the jury, then the counsel for the prisoner; then follow the summing-up of the judge, and the verdict of the jury. Counsel for the prisoner is entitled to have the last word to the jury before the summing-up of the judge. Notes of the evidence must be taken by the judge during the trial (23 Geo. III. c. 45; and 9 Geo. IV. c. 29). The jury may give a verdict without retiring from the box (54 Geo. III. c. 67), or after retiral, and the verdict is given verbally by the foreman.

From what has been said it will be apparent that procedure in Scotland differs substantially from that of England. But there are additional differences. An English jury is composed of twelve men, a Scottish jury of fifteen. The former may fail to return a verdict, or, if a verdict be returned, it must be one of two only—viz. Guilty or Not Guilty; the latter must return one of three verdicts—viz. Guilty, Not Guilty, or Not Proven; the English jury can only convict or absolve when unanimous, the Scottish jury may by a majority.

In England, juries are those of the grand jury, of the petty jury, and of the coroner's inquest. In the first the number may not be less than twelve nor more than twenty-three; in the second not more than twelve, and in the last as in the grand jury. In Scotland, an ordinary jury, no matter in which court, criminal or civil, the jury may be called upon to act, numbers fifteen, with the exception of that which sits with a sheriff as a public inquiry in regard to fatal accidents occurring in industrial employments or occupations, by virtue of the Fatal Accidents Inquiry (Scotland) Act, 1895 (58 & 59 Vict. c. 36, sec. 4, sub-sec. 5), when it is composed of five common and two special jurors—seven in all.

The following are the forms of the summons to appear before the High Court of Justiciary, and at an Inquiry into a fatal accident:—

(1)

"*To*

"You are hereby lawfully cited to attend a Sitting of the High Court of Justiciary within the Criminal Court , upon the day of Nineteen hundred years, at o'clock noon, as a Witness in the case against , Prisoner in the Prison of , and that under the pain of One Hundred Merks Scots.

"(Signed)

"Sheriff-officer."

"NOTE.—Any Witness failing to appear in terms of Citation not only forfeits the penalty, but is liable to be apprehended and imprisoned.

"(Preserve and bring this Copy with you.)"

(2)

"*Under the 'Fatal Accidents Inquiry (Scotland) Act*, 1895.'
"*To*

"You are hereby lawfully cited at the instance of the Procurator-Fiscal to attend and give evidence as to the death of , at a Public Inquiry under the provisions of the above-mentioned Act, to be held within the Criminal Court House of upon the day of 19 , at o'clock forenoon, and that under the pain of One Hundred Merks Scots.

"(Signed) Sheriff-officer."

Warning of penalty on failure to answer is appended in identical terms to those of the previous summons.

The fee for attendance at court of a medical witness is £1, 1s. per day; for a post-mortem examination and report, £2, 2s.; for an analysis of blood or other stains on clothing, £2, 2s. to £4, 4s. depending upon amount of work to be done. Should the witness travel a distance to obey the summons, he receives first-class return fare by railway.

Under the Workmen's Compensation Act, 1897 (60 & 61 Vict. c. 37), practitioners are appointed, by the Secretary of State for the Home Department in England, and by the Secretary for Scotland, in Scotland, in each sheriffdom, for the purpose of acting as medical referees in cases of accidents to workmen out of which actions for compensation may arise. The medical referee appointed may be consulted by any workman who declines to be examined by the medical man engaged by the employer, or insurance company as indemnifier of the employer, either on the ground of initial objection or of dissatisfaction, in which case the workman himself shall pay the medical referee. But a reference may be made to the medical referee on the part of the court, and in such a case the medical referee shall not accept the reference unless signed by the Magistrate or his clerk, in England, or by the Sheriff or his clerk, in Scotland. A scale of fees is appended to the Act as the remuneration of said medical referees, as follows:—

(1) For a first reference, which includes examination of the injured workman, and a written report thereof	£2	2	0
(2) For a further statement, which includes matter not covered in original reference . .	1	1	0
(3) For a second, or any subsequent reference to the same referee in a further arbitration, in the same case, including an examination and report	1	1	0
(4) Where the medical referee attends the arbitration at the request of the Sheriff; for attendance	3	3	0
(5) For travelling a distance beyond two miles in order to examine the injured workman, the medical referee is entitled, for each mile beyond the said two miles, to a fee of	0	5	0

The medical referee shall be paid the above fees quarterly, on

presentation of a statement in the form prescribed in the schedule of the Act, to the Home Office, or the Scottish Office, as the case may be.

By the Workmen's Compensation Act, 1906 (6 Edw. VII. c. 58), the Acts of like title of 1897 and 1900 are repealed.

The Act of 1906 extended the application of the principle of compensation for accidents to (*a*) seamen, with the exception of such members of the crew of a fishing vessel as are remunerated by shares in the profits or the gross earnings of the working of such vessel, and to (*b*) the victims of certain industrial diseases, these being, according to the Third Schedule of the Act, the following—viz. anthrax; lead poisoning or its sequelæ; mercury poisoning or its sequelæ; phosphorus poisoning or its sequelæ; arsenic poisoning or its sequelæ; and ankylostomiasis in mining. According to section 8, where a certifying surgeon, appointed under the Factory and Workshop Act, 1901, certifies that a workman is suffering from one of the foregoing diseases, and is thereby disabled from earning full wages at the work at which he was employed, or where a workman, in pursuance of any special rules or regulations made under the Factory and Workshop Act, 1901, is suspended from his usual employment on account of having contracted any such disease, or when the death of a workman is caused by any such disease, and the disease is due to the nature of the employment in which such workman was employed at any time within the twelve months previous to the date of his disablement or suspension, he or his dependants shall be entitled to compensation under the Act, as if the disease were a personal injury by accident arising out of, and in the course of, that employment.

According to sub-section 6 of the same section, the Secretary of State may make orders for extending the provisions of this section to other diseases, and other processes, and to injuries, due to the nature of any employment specified in the order, not being injuries by accident.

Section 10 enacts that the Secretary of State "may appoint such legally qualified medical practitioners to be medical referees for the purposes of this Act as he may determine, and the remuneration of, and other expenses incurred by, medical referees under this Act shall, subject to regulations made by the Treasury, be paid out of moneys provided by Parliament." Where a medical referee has been employed as a medical practitioner in connection with any case, he shall not act as medical referee in that case.

Since the question of compensation to workmen for accidents is now so general, and is liable to become the subject of litigation, it will be well that a few data should be set down for the guidance of the practitioner.

Section 2 declares that proceedings under this Act for the recovery of compensation for an injury shall not be maintainable unless notice of the accident has been given as soon as practicable after the happening thereof and before the workman has voluntarily left the employment in which he was injured, and unless the claim for compensation with respect to the accident has been made within six months from the occurrence of the accident causing the injury, or, in case of death, within six months from the time of death, provided that the failure to make the claim within the period above specified shall not be a bar to the maintenance of such proceedings, if it is found that the failure was due to mistake, absence from the United Kingdom, or other reasonable cause.

According to paragraph 4 of the First Schedule of the Act, where a workman has given notice of an accident, he shall, if required by the employer, submit himself for examination by a medical practitioner provided and paid by the employer, and if he refuses to submit himself to such examination, or in any way obstructs the same, his right to compensation, or to take proceedings in relation thereto, shall be suspended until such examination has taken place; to paragraph 14, any workman receiving weekly payments shall, if so required by the employer, submit himself from time to time for examination by a medical practitioner provided and paid by the employer. If the workman refuse or obstruct such examination, his right to his weekly payments shall be suspended until such examination has taken place; to paragraph 15, a workman shall not be required to submit himself for examination under paragraph 4 or 14, otherwise than in accordance with regulations made by the Secretary of State, or at more frequent intervals than may be prescribed by such regulations. When a workman has so submitted himself for examination by a medical practitioner, or has been examined by a practitioner selected by himself, and the employer or the workman, as the case may be, has within six days after such examination furnished the other with a copy of the report of that practitioner as to the workman's condition, then, in the event of no agreement being come to between the employer and the workman as to the workman's condition or fitness for employment, the registrar of a county court [in Scotland, the sheriff-clerk], on application being made to the court by both parties, may, on payment by the applicants of a prescribed fee not exceeding one pound, refer the matter to a medical referee.

The medical referee in the case, in accordance with regulations made by the Secretary of State, shall give a certificate as to the condition of the workman and his fitness for employment, specifying, where necessary, the kind of employment for which he is fit, and that certificate shall be conclusive evidence as to the matters so certified.

Where no agreement can be come to between the employer and the workman as to whether, or to what extent, the incapacity of the workman is due to the accident, the provisions of this paragraph shall, subject to regulations made by the Secretary of State, apply as if the question were a question as to the condition of the workman.

If a workman, on being required so to do, refuses to submit himself for examination by a medical referee to whom the matter has been referred as aforesaid, or in any way obstructs the same, his right to compensation and to take proceedings shall be suspended, until such examination has taken place.

According to the Second Schedule, paragraph (5), a judge of county courts [in Scotland, the Sheriff or his Substitute] may, if he thinks fit, summon a medical referee to sit with him as an assessor, and he may submit to a medical referee for report on any matter which seems material to any question which arises in the arbitration (Schedule II. [15]).

After July 1, 1907, employers are liable for compensation for all injuries which disable a workman for a week or longer, instead of a fortnight as in the Act of 1897.

By the present Act, the indemnifiers of the employer—any insurance

company—have no right to examine the disabled employee or workman as they had under the Act of 1897.

Section 8 (5) empowers the Secretary of State to confer upon any practitioner the powers and duties of a certifying surgeon under the Factory and Workshop Act, 1901.

By paragraph 14 of the First Schedule, a workman must, if so required by the employer, submit himself for examination to a medical practitioner; and by paragraph 15, if he has done so, and has furnished the employer within six days after such examination with a copy of the report of that practitioner, failure to agree can only be determined *by application of both parties* to the official of the court to refer the matter to a medical referee. Here, it will be observed, if the workman do not become a party to the application, he cannot be compelled so to become; in which case, however, his right to compensation and to take or prosecute any proceedings shall be suspended, until such examination has taken place. The practical effect, therefore, of this paragraph is to compel the workmen to submit himself for examination to a medical referee. When, however, the matter is referred, the medical referee shall have to determine (1) as to the condition of the workman relative to his fitness for employment, (2) the kind of employment for which he is fitted, and (3) to what extent the incapacity was due to the accident.

A medical referee, in terms of section 8 (1) (*f*), may also be asked to review the decision of a certifying surgeon relating to a workman who is alleged to be suffering from any of the industrial diseases named in the Third Schedule, or of those which have been added since the passing of the Act.

A certifying surgeon is empowered to certify that a workman is suffering from an industrial disease and is thereby disabled from work, and an employer or a workman may appeal from his decision on these points. If the medical referee grants a certificate of disablement on such appeal, the date of such disablement shall be such date as the medical referee may determine (sect. 8 [4] [*a*]).

A medical referee may be called upon to decide whether the incapacity of a workman from an injury is or is not likely to be of a permanent character, so as to enable the court to determine the amount of compensation to be paid (Schedule I. [18]).

In the appointment of medical referees, the Secretary of State for the Home Department has laid it down as a condition of appointment that the person to be appointed shall not retain any appointment which would be likely to interfere with his duties as referee, or to bias his judgment. Where a medical referee has been employed as a medical practitioner in connection with any case, he shall not act as a medical referee in that case.

Under ordinary circumstances, certifying surgeons are appointed by the Home Secretary in accordance with regulations made under sect. 122 of the Factory Act of 1901, but if there be no certifying surgeon for a factory, the poor law medical officer, in terms of sect. 123 of that Act, acts as such.

Any practitioner who acts in terms of the Workmen's Compensation Act, 1906, should take notes of the condition of the workman at the time of examination, and should send a written report of the examination to

the employer, retaining a copy of the same, since such report may be made the basis of an agreement between employer and workman for compensation to be paid.

Definition of "Accident." The law of this country does not define what is an "accident." Neither does French law define it. In official circulars this may be seen: "Accident in our sense consists in a bodily injury arising from the sudden occurrence of an external cause." The German definition reads thus: "An accident is an abnormal and strange happening in the course of the employment which occurs suddenly, and the consequences of which are injurious to life and health."

The meaning of the word or term "accident" in British law, as interpreted by the courts, seems to be covered by the following case—viz.

1. Hughes *v.* Glover, Clayton & Co. In this case the workman was engaged in tightening a nut with a spanner when his foot was seen to slip forward, and the workman himself to fall on his back. He was found to be dead. Post-mortem examination showed that death was due to rupture of a very large aneurysm of the aorta. Medical evidence was to the effect that death might have happened from very slight exertion, or without any unusual exertion, as in a natural act.

The County Court judge held, and the Court of Appeal upheld the decision, that death was due to an accident.

The Master of the Rolls based his judgment upon the decision of the House of Lords in a case in which a workman in a weak state of health was allowed to try to work his way home in the stokehold of an Atlantic steamer, wherein he succumbed to heat stroke while acting as a stoker. In the judgment on that case the Lord Chancellor said: "To my mind the weakness of the deceased which predisposed him to this form of attack is immaterial. The fact that a man who had died from a heat stroke was by physical debility more likely than others so to suffer can have nothing to do with the question, whether what befel him is to be regarded as an accident or not. . . . It was an unlooked-for mishap in course of his employment; in common language, it was a case of accidental death." [1]

In Stewart *v.* Wilsons and Clyde Coal Company (Court of Session, Edinburgh), Lord M'Laren said: "if a workman in the reasonable performance of his duties sustains a physiological injury as the result of the work he is engaged in, this is an accidental injury in the sense of the statute." [2]

It ought to be kept in mind that, according to the terms of the Act of 1906, the report or certificate of a medical referee is final. In Ferrier *v.* Gourlay Bros. the Court of Session held that the report of the referee was conclusive evidence of the workman's condition at the date of the report.[3] In the Court of Appeal, London, Nov. 26, 1907, in the appeal on the part of Bromilow & Co. against a decision of the county court judge on this point, the court held that the lower court was in error in holding that the certificate of the referee was not conclusive of the condition of the workman.

[1] *Lancet*, vol. ii., 1909, 488.
[2] 5 F. 120.
[3] 4 F. (5th series) 711.

CHAPTER II

MEDICAL EVIDENCE

MEDICAL evidence resolves itself into three forms—viz.

(*A*) Documentary.
(*B*) Parole, Oral, or *Viva Voce*.
(*C*) Experimental.

The two forms A and C, however, must eventually be deponed to on oath in the witness-box; and, therefore, the classification is more academic than practical.

In respect that a medical witness is more likely in his first connection with a case to be called upon to present a report of some kind, we shall discuss the various forms of documentary evidence which may be presented to a court of law.

(*A*) **Documentary Evidence.**—This may take the following forms —viz.

(1) The Medical Certificate.
(2) The Medical Report.
(3) Notes or Memoranda.
(4) Dying Declarations.

I. The Medical Certificate is the simplest form of documentary evidence, and may consist in the certification by a duly qualified and registered practitioner of the inability of attendance in court of a witness or juror, by reason of illness. In England no particular form of words is required. A simple statement of facts, embodying the name, address, designation, and nature of the illness of the witness or juror, signed by a practitioner, qualified as such, is all that is necessary. It ought to be remembered that the mere possession of a qualification to practise is not enough, for the possessor is not legally competent to sign certificates until his name is on the Medical Register of the General Medical Council, production of which is legal evidence of his status of qualified practitioner. In Scotland, on the other hand, something more is necessary to constitute the certificate legal. The statement of facts must be attested "on soul and conscience"; without these words, no certificate or report in a Scottish court is legal, and their absence from a certificate renders the witness or juror liable to be amerced in the fine of one hundred merks Scots; indeed we have seen such happen. Certificates of death do not require such form of attestation, as they are in accord with the form scheduled in the Registration Act.

Regarding this attestation "on soul and conscience" of certificates and reports for legal purposes, which is peculiar to Scots law, a word from the historical side will be of interest. How far back into the centuries this practice extends, it is, perhaps, now impossible to discover, but our researches show that it was the rule by the middle of the

seventeenth century. In "A Treatise of Mutilation and Demembration," by Sir Alexander Seton of Pitmedden, one of the Lords of Session, which in the copy we possess was printed as an appendix to the "Laws and Customs of Scotland in Matters Criminal," by Sir George Mackenzie of Rosehaugh (who was then King's Counsel), printed in 1699, may be found the following:—"The *Justices*, with us, do never accept of the single *Testimonies* of Physicians and Chirurgeons, but oblige them to depone or declare upon *oath*, notwithstanding they have often contended that the oath *de fideli administratione* they gave at their *Admission* was sufficient for all; and for the same cause the *Justices* do reject *Testificats* subscribed by them, unless bearing upon *Soul* and *Conscience*. So they did 7 *Novem.*, 1621, *Williamson* against *Paton*; and 15 *Decem.*, 1630, *Barclay* against *Kennedy* in *Mayboll*, in which last case the *Testificat* was subscribed by the *Deacon* of the *Chirurgeons* of *Edinburgh* and other two of the trade, and the like objection was made 12 *January*, 1642, against a *Testificat* produced by *Taylor* against *Norie* to prove the *Lybel*, notwithstanding it was written by the *Clerk* of the *College* of *Chirurgeons*, and subscribed by four of them; and that this agreeable to the opinions of the Doctors of Law and Practice of *Forraign* Courts." Respecting the practice, then, of testification on soul and conscience it is safe to conclude that it prevailed in Scotland, at least as far back as the latter part of the sixteenth century.[1]

II. The Medical Report.—This form of evidence is given at the instance of the Procurator-fiscal by a medical witness in circumstances such as the following:—

(*a*) In a case where injuries have been inflicted upon an assaulted person by a prisoner, or accused person.

(*b*) As the result of post-mortem examination of the body of a person who has died suddenly, or under suspicious circumstances, or from culpable violence, of from any other form of violent death, such as poisoning.

(*c*) For the purposes of the Fatal Accidents Inquiry (Scotland) Act.

(*d*) For the purposes of an inquest regarding the death of a person while in prison, under the Prisons (Scotland) Act, 1877.

(*e*) As the result of the examination of a body after exhumation.

(*f*) As reports as to stains upon clothing.

(*g*) As reports of analysis in cases of poisoning.

All such documents must, in Scotland, be signed "on soul and conscience."

In the first class of cases, all that is required in the report is a narration of the character, number, situation, dimensions and kind of lesions found upon the person—using accuracy in every particular—and a statement of opinion of the class of weapon which has been used in their production.

In the other cases, where a post-mortem examination of a body is required, procedure differs in England and Scotland. In England the summons of the coroner to perform a necropsy is the warrant for performing it. In Scotland the procedure is so different that some detailed consideration is necessary.

[1] Author. *Med. Times and Gazette*, May 8, 15, and 22, 1897: "The History of Medical Jurisprudence, etc., in Mediæval Times."

In every case in which there is reason to believe that a person has died from violence at the hands of another, or from any culpable act, or omission, the Procurator-fiscal must see that a post-mortem examination of the body is made, in order to ascertain the exact cause of death. Accordingly that official presents a petition to the Sheriff, as follows :—

"GLASGOW, , 191 .

"Unto the Honourable the

SHERIFF OF THE COUNTY OF LANARK.

"The Petition of Writer in Glasgow, Procurator-Fiscal of Court for the Public Interest,

"*Humbly Sheweth,*

"That from information received by the Petitioner it appears that died at or in on the day of under circumstances calling for investigation.

"That a precognition in the premises and a post-mortem examination of the body of deceased seem necessary :

"May it therefore please your Lordship to grant Warrant to cite witnesses for precognition in the premises, and to remit to Drs , to make a post-mortem examination of deceased's body, and to report as to the cause or probable cause of death. According to Justice.

"(Signed)

"Procurator-Fiscal."

" 191 . Having considered the foregoing Petition, Grants Warrant and remits all as craved.

"(Signed) , Sheriff."

The above warrant is forwarded to the medical man or men named in it, with an intimation where the body is lying, and it enables him or them to make the necessary examination without contravention of the Anatomy Act, which prevents dissection being made in places other than those licensed for the purpose. Armed with the warrant, he or they proceed to the place where the body is lying, where they are met by a sheriff-officer who has the witnesses in attendance to identify the body. The warrant entitles those named in it to take, if need be, forcible possession of the body. This is, however, rarely needed, and has never arisen in our experience. But in a case which occurred in Port-Glasgow, although a warrant had been isssued for the post-mortem examination of the body of a child by the Sheriff of the county, the parents obstructed, and the funeral cortege was on its way to the graveyard when the police stopped the funeral, and removed the body to the mortuary, where the dissection was to be carried out. The parents appealed to the Sheriff-principal against the warrant of the Sheriff-substitute. In his judgment, the former decided that "the application for the post-mortem examination was competent, and to bury a body for the purpose of obstructing an inquest or legal proceedings might be criminal, but in respect that no further motion had been made to carry out the examination, and that the body had been buried," he recalled the warrant of the Sheriff-substitute. It has to be noted

that the motion for a warrant was made by a private person who had reason to believe that he would afterwards be sued for damages for the death of the child, which, it was being averred, was caused by an accident. It is absolutely necessary where death has been due to culpable violence by an assailant, that two medical men should be named in the warrant, that both together should perform the examination, and that both, if agreed, should sign the report; or, if failing to agree, that each should send a separate report.

Before beginning the examination of the body, the first duty of the medical examiners is to secure identification of the body in the legal sense—for this identification it is not necessary that the name of the deceased be known—by at least two competent witnesses, whose names, designations, and addresses must be fully noted by the examiners. Thereafter, and before the necropsy is begun, the room is cleared of all persons save the examiners.

The latest pronouncement of the Lord Advocate on this point is as follows (May 1899):—"No person except the medical men instructed to conduct the necropsy is allowed to be present at a post-mortem examination except with consent of Crown counsel or on order of the Sheriff. Crown counsel may, in their discretion, sanction the presence of a medical man who has attended the case or in the interests of the accused, but this is done only on condition that he is to be present merely as an onlooker, and is not to interfere in any way with the Crown examination. No formal intimation is given that the necropsy is to be held, but in all cases where any person is in custody on suspicion of causing death a necropsy is made as a matter of course, so that an accused person or his advisers cannot be in doubt as to the necessity of making immediate application for permission to send a medical man to witness the necropsy if they so desire it. The quarter to which application should be made is the Procurator-fiscal, whose duty it is in all cases of urgency to communicate by telegraph with the Crown Agent for the instructions of Crown counsel. If an independent post-mortem examination is desired it can be made after the Crown examination."

It will be found of much advantage that one examiner should do the manual work of examination and that the other take notes, after verification, of the facts observed, during the currency of the examination, which should be conducted in a systematic and methodic fashion. While different examiners may adopt different modes, the following, from long experience, has commended itself to ourselves.

External Examination.—The reporters should make a careful external examination of the body with reference to (*a*) appearances indicative of the time of death and the position in which the body has lain for some time after death; and (*b*) marks of violence, or any other marks, from any cause whatever, pointing to the cause of death.

It will be obvious that, with respect to this part of the examination, the extent of the objects to be observed must depend in great measure upon the fact whether the body has or has not been identified in the individual sense. For example, if the body has been identified by the witnesses as that of A. B., it will be unnecessary for the

examiners to give any attention to marks upon the body which would establish identity: but, on the other hand, if the body has only been identified for legal purposes as that of a given body to be examined, but without establishment of identity of the body as that of a named person, all appearances, normal and abnormal—such as (*a*) height, determined by measurement; (*b*) age, approximately arrived at by condition of bones, state of teeth, height, weight, and other factors; (*c*) sex; (*d*) colour of the eyes, and of the hair; (*e*) condition and number of teeth; (*f*) bodily deformities or abnormalities; (*g*) scars and tattoo marks (*vide* p. 88)—must be carefully noted, so that, if possible, identity may be established afterwards. In ordinary cases, even in such circumstances, the medical examiners need not extend their observations to the clothing, as that is the duty of the police, but it would fall within their duty to carefully note, for example, the wrappings in which the body of an apparently newly-born child was enveloped, or the clothing or wrappings of a body which has been discovered in an advanced state of decomposition, in some secret place, such as a trunk or bag. Clothing ought to be examined separately for stains, or for cuts, or perforations in cases of stabbing, shooting, etc.; and it is better that each examination should form the subject of a separate report.

Assuming the body to have been fully identified, the points to be attended to with respect to the *time* of death, are (*a*) the presence and extent, or absence of *rigor mortis*; (*b*) the incidence, extent, and colour of post-mortem lividity: and (*c*) the presence, character, and extent of putrefaction. The value of these observations will be discussed later. With respect to the *cause* of death the following points among others of a like character ought to be noted—viz. (*a*) all marks indicative of violence. All wounds and bruises are to be *accurately* measured as to their dimensions, their situations and character to be noted with respect to the class of weapon which has produced them, and in this connection, marks of scorching, engraining of skin with carbon particles, or of smoke, to be carefully noted in relation to the question of suicidal or homicidal infliction; (*b*) marks on the neck of ligature, or from any other constricting cause; (*c*) condition of the hands, or feet, with respect to weapons or other objects grasped in hands, ligaturing, blood stains, or other markings; (*d*) marks of burning from fire, scalding fluids, or corrosives, their incidence, character, extent, and degree; (*e*) the condition of the natural orifices of the body so far as they can be examined externally; (*f*) external examination of the vertebral column, with respect to fracture or dislocation; (*g*) condition of the limbs, with reference to the same.

Where wounds are situated in the line of the usual incisions in such examinations, such incisions must be deviated to enable the wound or wounds to be examined in their entirety with respect to extent of penetration. Where bruises or other like markings are present, all of them, after measurement, ought to be incised, to verify the presence of extravasated blood, as questions may arise in court regarding their possible confusion with post-mortem lividity.

Internal Examination.—The external examination being completed, the examiners next proceed to the internal examination. At

the very outset it is all-important for the young practitioner to remember that in every case of post-mortem examination *all the organs of all the cavities of the body* must be carefully inspected, even although the apparent cause of death has been found in one of them, since evidence contributory to the cause of death may be found in one or more of the others. The importance of this cannot be too strongly insisted upon, as inadvertent omission of a complete examination will tend to invalidate the report, or even may tempt a witness, while closely pressed by cross-examining counsel, to make statements which a re-examination of the body will disprove, and thus, very properly, make him the victim of a charge of perjury. There can be no possible excuse for a man who certifies a death to be due to "Congestion of the Lungs," who has not taken the trouble, by opening the air-passages, to find the true cause, found by others later on re-examination of the body—viz. impaction of a foreign body in the larynx; nor for the man charged to make an examination of a body in terms of the coroner's warrant already quoted, who neglects to examine all the organs of the body, and states falsely that he has made a complete examination. Such a state of things unfortunately has been too common. In a comparatively recent case a medical man was asked to examine the body of a man for whose death two men were in custody on the charge of feloniously murdering the deceased. He stated that he found certain marks about the head and upper part of the body, but notwithstanding, he attributed death to "failure of the heart's action, due to shock." Owing to the unsatisfactory character of the evidence, a re-examination of the body was made by the witness and a colleague, and the former had to admit that in the first examination he had omitted to observe a dislocation of the first and second vertebræ with fracture of the odontoid process and rupture of the lateral ligaments. In another recent case which came under our personal observation, two medical men had made a post-mortem examination of the body of a woman who had died under very suspicious circumstances, but they had failed to recognise the odour of carbolic acid when they opened the stomach, and to perceive the marks of corrosion about the mouth. These cases indicate this lesson—viz. that every post-mortem examination for medico-legal purposes must be completely as well as carefully performed.

An incision in the middle line of the body from chin to pubes (avoiding the umbilicus) having been made, the examiners, in the usual methods of the post-mortem room, throw open the chest and abdomen. Division of opinion exists among experts as to whether, in such cases, the head should be first examined or the chest and abdomen. The argument in favour of the former course is that a better idea of the condition of the circulation of the meninges and brain is obtained, since, it is urged, the blood-vessels are apt to be drained more or less, if the large blood-vessels of the chest be severed in a previous examination of the chest organs. Whatever force there may be in this argument, it may be overcome by opening the head after the organs of the chest have been exposed, and before they have been touched *in situ*, or, at least, before the heart itself has been touched, although the pericardium be opened. The examiner may,

thereby, by palpation, form some opinion of the amount of blood contained in the respective cavities of the heart, and observe, alongside of this, the blood-condition of the brain-membranes and of the brain itself, after removal of the membranes. After removal and examination of the brain, the meninges ought to be stripped in their entirety from the bones so as to reveal the presence or absence of fractures of the base of skull. It is a good plan, thereafter, to open the windpipe with a view to observe its contents, if any, and its conditions; next to proceed to the individual examination of each organ of the chest and then to a like examination of the abdominal organs. In cases where there are *a priori* grounds of suspicion of poisoning being the cause of death, careful attention ought to be paid to the condition of the mouth and the whole intestinal tract. In such cases it is undoubtedly the best practice to remove the whole of the parts of this tract—viz. by the usual incisions along the inner side of the lower jaw, and by further dissection to free the whole of the soft parts of the mouth and œsophagus, prior to removal of which the lower end of the œsophagus, about three inches above the cardiac orifice of the stomach, should be tied in a double ligature, then separated between the ligatures, and the parts so removed placed in a clean glass jar, duly marked and noted; then by a double ligature at the pyloric orifice of the stomach, to remove that organ with its contents and place them in a second jar; then, next, the whole of the large and the small intestine, into a third jar; and, in further jars, the liver, the kidneys, the spleen, and the urine. All of which jars must be carefully covered and sealed and kept in a lockfast place by one of the examiners until they have been formally handed over, after receipt given and the labels have been signed, to an officer who has been charged to convey them to an analyst. The necessity of taking all the important parts of a body in a case of poisoning will be obvious when it is explained that after analysis by the Crown experts, the remainder may be requested by the accused for examination by experts nominated by him for his defence. After the thoracic and abdominal cavities have thus been cleared, it will be a simple matter to inspect the anterior surfaces of the spinal column and the inner surfaces of the ribs with reference to their condition.

If any doubt be entertained as to the integrity of the spinal column, after examination by the finger in the foramen magnum and as indicated above, the bodies of the vertebræ should be cut open by V-shaped incisions with a saw so that the cord be fully exposed. Cases have been recorded where dislocation of the neck has been reported to be present by a medical examiner, owing to which persons have been arrested, but in which further examination has proved the statement to be unfounded.

The student will be well advised if he makes himself familiar with post-mortem room technique, and with the naked-eye appearances of healthy and diseased bodily organs.

The examiners are entitled to remove such parts of the body as they may deem essential for further use; when preservation of such removed parts is thought advisable, alcohol alone should be used.

In every case of fatal wounding, especially where the wound is a

penetrating one, great care must be exercised not only in the measurement of its dimensions, but in truly tracking its direction, as throwing probable light upon the relative positions of assailant and assaulted at the time when the deed was committed. Where blood has been effused into a cavity of the body actual measurement of its quantity should be made.

From the result of the post-mortem examination is the report of the examiners framed, in regard to which certain important matters must be borne in mind by the reporters.

First.—The notes made during the currency of the examination should be looked over by the examiners prior to the body being sewn up, lest, perchance, any point has been overlooked, and so that omissions may be supplied.

Second.—The opinion expressed by the examiners in their report must be founded solely on the facts comprehended within the report, and not upon facts which are not specified in detail in the description of the organs as found.

Third.—The examiners must deliver to the law authorities, within two days after the examination, their report of the examination, with their opinion of the cause of death, and the reasons for their opinion, which ought succinctly but clearly to be stated therein.

In addition to the foregoing, it may be said that the examiners should aim, above all, to couch the language of the report in the simplest but clearest terms, keeping in mind that it may afterwards have to be read in open court for the information of the court, counsel, and jury. Moreover, the report ought to be as brief as possible, compatible with clearness. It is not necessary to describe each organ in detail; it is enough to say, where the organs of a cavity have been found healthy, after examination, that "all the organs of this cavity were examined, and were found healthy." Should one or more organs only be found diseased or injured, after description of the facts found with respect to these, then it is better to say that "the other organs of this cavity were examined and were found healthy," than to describe their normal appearances. While in certain circumstances it may be impossible to avoid the use of technical words in a report, the examiners should try in popular language (within brackets) to give them popular interpretation. This conciseness, brevity, and clearness of language are of greatest value in the statement of the opinion, for, otherwise, the issues become confused, and the report will probably give rise to much unnecessary dubiety, and, perhaps, cross-examination.

Examiners should avoid the use of such terms as "about," or "nearly," when measurement is in question, or of comparative or superlative adjectives with respect, for example, to amounts of fluid or blood, when such can be exactly computed. In short, the whole report should be as exact as possible in its terms. Last of all, the examiners should keep the original notes as made at the examination, and a copy of the report as sent to the authorities, against the time of future possible use.

As the framing of the terms of the report is often a matter of difficulty to the beginner, the following will form a skeleton basis of report upon which any report may be founded :—

Form of Medical Report

I. *Preamble*—

1. Date and place from which report is written.
2. The warrant for the examination, and by whom granted; and the place of examination.
3. The names, designations, and addresses in full of the witnesses who have, in the presence of the examiners, spoken to the identity of the body.

II. *External Examination*—

4. The external appearances of the body indicative of the time of death.
5. The presence or absence of external marks of violence; and if such are present, their site, character, dimensions, and relation to each other, and of any other markings which have a bearing upon the cause of death.

III. *Internal Examination*—

6. Description of result of examination of—
   (*a*) Brain, and its membranes; condition of bones of calvarium, and of base of skull;
   (*b*) Spinal column, and, if necessary, condition of spinal cord and its membranes.
7. Description of result of examination of organs, and contents of thoracic cavity—
   (*a*) General disposition of organs *in situ*;
   (*b*) Condition of pericardium, heart, and large blood-vessels;
   (*c*) Condition of lungs, larynx, trachea and gullet, and ribs, etc.
8. Description of result of examination of organs, and contents of abdominal cavity—
   (*a*) General disposition of organs *in situ*;
   (*b*) Condition of liver, spleen, kidneys, urinary bladder, stomach, pancreas, intestines; and, in a female, of the uterus and its appendages, and vaginal tract;
   (*c*) Examination of contents of stomach and urinary bladder;
   (*d*) Examination of internal aspect of intestines;
   (*e*) ,, ,, ,, uterus and ovaries;
   (*f*) ,, ,, abdominal blood-vessels.

IV. The reasoned opinion of the cause of death, based upon the foregoing facts found.

V. (In Scotland) The attestation of the foregoing "on soul and conscience."

VI. Signatures and medical qualifications of examiners.

Note.—(*a*) *In all reports, all numbers, except the date of the report, should be put in writing, and not in figures.*

(*b*) *All interpolated words, or deleted words, ought to be initialled by the signators*; and at the end of the report, the number of words deleted should be stated, *and this statement should also be initialled by the signators.*

(*c*) *It is also advisable when the report occupies more than one page for the signatures of the examiners to be adhibited to each page.*

The following, but for the omission of the names, is one of many reports which we have had to present to the law authorities, and gives technical details which the foregoing does not show :—

" Place.
" Date.

" By virtue of a warrant of the Sheriff of , and at the instance of , Esquire, Procurator-Fiscal of the said County, we, the undersigned, on this date and within the mortuary of (*here name institution or police station*), made a post-mortem examination of the body of (*here fully name person, if known*), which was identified in our presence by the following persons —viz.

" 1. A. B., son of the deceased, residing at 24 High Street ;
" 2. B. C., confectioner, of 261 Eglinton Street ; and
" 3. D. E., inspector of police, F Division ; all of Glasgow.

" External Examination.—The body was that of a well-nourished person, somewhat inclined to stoutness. It was stiff from death-stiffening. The only mark of violence visible on the body was a clean-cut wound situated one and a half inches below the level of the left collar-bone, and two and a quarter inches from the middle line of the breast-bone. It measured eleven-sixteenths of an inch in length and five-sixteenths of an inch in breadth, and was of an ovoid shape. In the neighbourhood of the wound there were some thin smears of blood on the body.

" Internal Examination.—

" *Head Cavity.*—The brain and its coverings were found normal.

" *Chest Cavity.*—On the chest being opened in the usual method a considerable quantity of clotted blood (ten ounces by measure) was found lying below the breast-bone and extending into the left side of the chest. On the bag which contains the heart being opened, fluid and clotted blood, to the amount of nine ounces by measure, was found within it. There was, in addition, about six ounces of blood by measure in the left cavity of the chest. Before the organs of the chest were removed, careful inspection was made to see if the wound on the front of the chest was continued through the chest wall into the chest. This inspection showed that the wound had a direction downwards and from the left toward the right, that it had penetrated the chest wall, and that it was continued into the flesh below the chest wall between the first and second ribs. After removal of the parts, entire, from the chest, and after further inspection and dissection, the wound was traced from the point where it had entered the flesh beneath the ribs, through the heart-bag, and into the main artery of the body which leads from the left chamber of the heart. The wound had penetrated this blood-vessel at a point one and a quarter inches above the point where the vessel leaves the heart. The wound on the inside of the wall of the heart-bag measured five-sixteenths of an inch in length, and in the blood-vessel nine-thirty-secondths ($\frac{9}{32}$ ths) of an inch. These two wounds lay within relation to one another in a slightly slanting line, the one below the other. From these wounds the blood found in the heart-bag and in the chest had escaped. The structure of the heart itself was normal. The lungs were healthy.

" *Abdominal Cavity.*—The organs of this cavity were all examined, and, with the exception of the liver, which was somewhat fatty, were found healthy.

" *Opinion.*—From the foregoing examination we are of opinion : (1) that the cause of death was the wounding of the main blood-vessel from the heart, and the internal bleeding consequent thereupon ; (2) that the wound produced on the wall of the chest and continued through the wall, through the heart-bag, and into the said main blood-vessel, was caused by a sharp-pointed, sharp-edged instrument of some inches in length ; and (3) that the blow must have been inflicted with considerable force.

" These are attested on soul and conscience.

" (Signed) "

Reports regarding the nature of stains upon clothing or other material may be required of the examiner. No warrant is required for this ; it is done in Scotland at the written request of the Procurator-fiscal, who sends to the residence or laboratory of the examiner an officer with the objects to be examined, who demands from the examiner a receipt for the articles before confiding them to his custody. This is for the purpose of maintaining their identity. The examination will depend on the substance to be examined for ; but, in any case, the investigation ought to proceed on systematic lines. This work is usually confided to experts, of whose capability no question is likely to be raised. The report of the examination is based upon like lines to that of a post-mortem examination, except that, after stating by whose instructions the examination was made, the reporter should state from whom he received the articles (giving full particulars as to his identity), then, generally, should describe the articles : after which the physical examination of the garments or weapons or other substance should be described with reference to (*a*) presence or absence of stains ; if present, (*b*) their number and situation, relative to their position on the garment and to one another ; (*c*) their shape ; (*d*) their colour ; and (*e*) other physical characteristics. With reference to the chemical, spectroscopic, or microscopic technique of the examination, it is not necessary to enter into details in the report ; it is sufficient to say that, after an examination by chemical analysis or microscopic or spectroscopic examination, certain substances were or were not found. Then follows the opinion of the reporter, the attestation " on soul and conscience," and signature. The following is an example of such a report :—

" Place.
" Date.

" I hereby certify that, on Wednesday the 24th July, I received from J. B., criminal officer of A Division of Police, a parcel containing a blue cloth jacket, with label attached, and a letter from J. M. R., Esquire, Procurator-Fiscal of the County of ——, which directed me to make an investigation into the character and composition of certain coloured stains thereupon.

" I found the following coloured stains upon the garment, viz :—

" 1. On the left lapel of the jacket—

" (*a*) A circular, red-coloured stain, situated close to the junction of the neck-seam and lapel, which measured five-thirty-secondths of an inch in diameter ;

" (*b*) A circular, red-coloured stain, situated one and a half inches lower down on lapel from the former stain, which measured three-thirty-secondths of an inch in diameter ;

"(*c*) A circular, red-coloured stain, situated close beside the last, and almost touching it, which measured one-sixteenth of an inch in diameter; and

"(*d*) Adjacent to the last named, seven smaller and less definitely marked stains.

"2. On left inner flap (which was marked with irregular-shaped splashes of mud, bearing the appearance of having been rubbed or partially wiped)—

"(*a*) A stain, shaped like an inverted soda-water bottle, situated three and one-eighth inches above the level of the first button-hole, and a like distance from the free edge of jacket, which measured seven-thirty-secondths of an inch in length;

"(*b*) A stain, of similar shape to the last, situated seven-eighths of an inch above the level of the first button-hole, and two and a quarter inches from the free edge of jacket, which measured five-thirty-secondths of an inch in length;

"(*c*) A circular stain, situated seven-eighths of an inch from the last, which measured one-sixteenth of an inch in diameter; and

"(*d*) An irregularly-shaped stain, situated five inches from the free edge of jacket, which measured five-thirty-secondths of an inch at its point of greatest breadth.

"The foregoing stains were examined by different tests—microscopic, physical, and chemical—and from the results I am of opinion: (1) That the stains above described are composed of blood; (2) that the blood belongs to the class of animals—mammalian—to which man belongs; and (3) from the inverted soda-water-bottle shape of two of the said stains on the inside of the left flap of jacket, that the blood was forcibly projected against the garment from its source.

"These are attested on soul and conscience.

"(Signed) M.D."

Medical practitioners are sometimes called upon to make necropsies for other than the purposes of the criminal law, as, for example, in contested life insurance claims. In such circumstances, it is highly advisable that before the necropsy is commenced the written consent of the legal guardians of the body should be obtained, as this will protect the practitioner against possible subsequent actions at law. It is well that it should not be forgotten that such actions, based on point of consent, have been raised.[1]

III. Notes and Memoranda.—Notes or memoranda may be used in a court of law by a medical witness. Such are not, however, part of the *res gestæ*—they do not become documents in the case—but if they are used by the witness, they may be demanded by cross-examining counsel for scrutiny and perusal.

It not infrequently happens that a lapse of time intervenes between the event from which the notes originated and the trial of the accused, and it is hardly to be expected that a busy man could charge his memory alone during the interval with every single detail of the case in which he is now a witness; accordingly, a careful witness will have with him in the witness-box the notes or memoranda in which are written the facts of which he is about to give testimony. It is necessary therefore to know under what circumstances the use of such notes is allowable, and under what others they are not permissible. The law on this point is as follows: —*Such notes may be used by a witness for the purpose of refreshing the*

[1] *B. M. J.*, vol. ii., 1899, p. 1229.

memory : (*a*) If the said notes were made at the time of, or shortly after, the occurrence of the event ; and (*b*) if they were made by the witness himself, or by another and reviewed at the time by the witness. On the other hand, they may not be used : (*a*) if they were made only after a lapse of time after the event ; (*b*) if they were made by another and not supervised by the witness at the time ; or (*c*) if they are used for the purpose of bringing forward facts which the witness has forgotten. Therefore, a witness in using notes ought to remember that they are for the purpose of refreshing the memory, and that it is essential in order that his evidence be received that, having looked at the writing, he should then be able to swear to the point on which he is testifying *from his own recollection*.

IV. Dying Declarations.—As it may, at some time or another, become the duty of a medical witness to listen to statements made by persons who are dying from culpable violence or other culpable cause, and as such statements might be of great moment in the attainment of justice, it is necessary that medical men should know what their duty is in this particular. Should it happen under circumstances as the foregoing that death is likely to happen before a magistrate could arrive, it becomes a duty of a medical man to write down, before witnesses, such a statement as the dying person may voluntarily choose to make, and as far as possible *verbatim et literatim*. Should, however, any question have to be asked to make clear any statement which, without the explanation, would be obscure, both the question and the answer should be exactly written.

In English law, the following are the conditions necessary to constitute such a dying declaration legal—viz.

1. A prisoner must be on his trial for murder or manslaughter ;
2. The declarant, at the time the declaration was made, must have been in complete possession of his senses, have been in actual danger of death, and must have given up all hope of recovery ; and
3. The declaration must have reference to the circumstances causative of the impending death of the declarant.

To all intents and purposes, the law of Scotland is identical with that of England. The reception of a dying declaration in a court of law—for, after all, it is but hearsay evidence—is based upon the presumption that a statement made while a person knows himself to be dying is of equivalent value to evidence given upon oath. It is, indeed, supposed that the solemnity of the circumstances, and the absence of causes which might incite to false witness, so act upon the mind of the dying person, that his sole aim and intention will be to speak the truth. Should a person in making such a declaration let fall any utterance that betokens any hope of recovery—even should he die later—the declaration becomes invalid. But the question arises, Must the person, in making the statement, definitely declare his belief of impending death, and of no hope of recovery, in order that the declaration be valid ? According to Scots law, it would appear that the sense of impending death may be inferred as well from the actions of the person as from his verbal utterances. But the question does not seem to be so

easily determined in the law of England, as is shown by the following facts :—In November, 1906, a man was charged at one of the Metropolitan police courts with the murder of a woman, the cause of death being said to be blood poisoning following an alleged illegal operation. Shortly before she died, deceased made a declaration before a justice of the peace which was subsequently repeated to the accused, who made a reply. Counsel for the prosecution declined to tender the statement of the deceased on the ground that, unless a person was certain that he or she was about to die, no statement which he or she might make would be admissible as a dying declaration, and it could not be brought within sections 6 and 7 of Russell Gurney's Act (30 & 31 Vict. cap. 35) unless a person was charged who could be brought to the place to hear the statement made.[1] In any case, after the declaration has been made it ought to be signed by the medical man, the witnesses, and, if possible, by the declarant himself.

The following are examples of rulings on such points :—

In R. *v.* Foster, 6 C. & P. 325, it was held in a trial for manslaughter that a statement made by the deceased as to the cause of the accident immediately after he was knocked down was admissible. In R. *v.* Barrett (Leeds Lent Assizes, 1869), Baron Cleasby ruled inadmissible as a dying declaration a statement in which the dying person said " she thought she should not recover." And in the case of R. *v.* Horsford, Mr Justice Hawkins remarked of the dying statements of the deceased woman : " I am quite satisfied myself that anything a suffering person says with regard to her bodily sensations, and questions touching the case, are admissible. . . . You must have evidence that she was in apprehension of death, that she was personally feeling that she was dying." The deceased said voluntarily to her medical attendant, " I believe I am poisoned." He asked her what she had taken, and her reply was, " I have taken a powder." In reply to the judge, the medical attendant stated that " no one in her condition could possibly entertain a hope of recovery. Her face bore a terrified expression, and her struggle showed the extremity of her condition." It was proved that the prisoner had sent her the powder, and that it contained strychnia (Huntingdon Assizes, 1899). The most recent authoritative legal pronouncement regarding the validity of a dying declaration was in 1909 by the Court of Criminal Appeal under the following circumstances :— At the Warwick Assizes a woman was charged with murder, it being alleged that she caused the death of a young woman consequent upon an attempt to procure abortion. The young woman, who was unmarried, and ~~when~~ about four months pregnant, fell ill on April 10, 1909, and the accused was called to her. Four days later, the young woman had a miscarriage, and on the night of the 15th she became seriously ill. On a doctor having been called, he said in a voice loud enough for the woman to hear, " There is very great danger. She may die at any moment." Next morning, the patient said to her sister, " Oh ! Gert, I shall go ; but keep this a secret. Let the worst come to the worst. That woman opened my womb with something like a crotchet hook on Good Friday. She told me to take a half-quartern of gin and a half-penny packet of salts, and sit on a chamber of hot water." Later, in

[1] *B. M. J.*, vol. ii., 1906, p. 1598.

the presence of a second doctor, she declared that the miscarriage was caused by the kick of a horse. She died the same day. The evidence at the trial was that the deceased had died from a punctured wound in the uterus followed by suppurative peritonitis, and that it was impossible for the wound to have been self-inflicted. The prosecutor at the trial held that the statement made by the deceased was admissible in evidence as a dying declaration. On appeal to the Court of Criminal Appeal, that Court sustained the view of the prosecutor, holding on the question, whether a statement made by a person since deceased was so admissible that the true test was not whether the declarant believed that he or she was just about to die, but that he or she had given up every hope of life; and for such a declaration to be admissible, it must be proved that death was "imminent," although it need not have been "immediate," and the declarant, at the time the declaration was made, under a settled and hopeless expectation of death.[1] Where a medical man is called upon to take such a declaration, he will do well to attend to the fulfilment of the following conditions—viz. (1) That the person expresses a conviction of impending death, or that such a sense of impending death, and that all hope of recovery is past may be inferred from the nature of the injuries; (2) that the mind of the patient is in a fit state for the purpose; (3) that the exact words used, and the order in which they were uttered, be put down; (4) that the statements were voluntarily made; (5) that no questions, other than those necessary for the explanation of obscure statements, should be put, and if such are put, the words of the question and answer are to be written down; and (6) that the dying person should, if able, sign the statement as well as himself and the other witnesses, or failing the ability of the person, to sign by himself and the other witnesses.

(*B*) **Parole, Oral, or "Viva Voce" Evidence.**—Whether medical evidence take originally the documentary or the experimental form, it must ultimately take the oral form before it can become valid evidence for or against an accused person at the trial for the offence. The only exception to its being given in court is where, for good reasons shown, it has been taken on commission, this being held equivalent to evidence given before the court, since the counsel for the prisoner will be present on the occasion.

Oral evidence can only be valid when given upon oath or affirmation. At the same time, it is within the option of a presiding judge, on being satisfied that the taking of an oath would have no binding effect on the conscience of a witness, to accept the evidence on a *promise* to tell the truth, which promise, with respect to the law of perjury, would have the binding effect of an oath or affirmation.

Up till the year 1888 the mode of administering the oath in England was very different from that obtaining in Scotland, and, unless on the option of a witness, even now is different. Apart from affirming, the witness formerly took, and may even yet take, the oath on bowing assent to the words that, "touching the death of

," the evidence he shall give "shall be the truth, the whole truth, and nothing but the truth, so help you God," and, thereafter, kissing the book. Since the above date, however, a witness has the

[1] *B. M. J.*, vol. ii., 1909, p. 1489.

option in *any* English court to take the oath after the Scots fashion, by virtue of the Oaths Act, 1888 (51 & 52 Vict. c. 46). The terms of this Act are as follows :—

"Section I. Every person upon objecting to being sworn, and stating as the ground of such objection either that he has no religious belief, or that the taking of an oath is contrary to his religious belief, shall be permitted to make his solemn affirmation instead of taking an oath in all places and for all purposes where an oath is or shall be required by law, which affirmation shall be of the same force and effect as if he had taken the oath; and if any person making such affirmation shall wilfully, falsely, and corruptly affirm any matter or thing which, if deposed on oath, would have amounted to wilful and corrupt perjury, he shall be liable to prosecution, indictment, sentence, and punishment, in all respects as if he had committed wilful and corrupt perjury.

"Section II. Every such affirmation shall be as follows :—'I, A. B., do solemnly, sincerely, and truly declare and affirm,' and then proceed with the words of the oath prescribed by law, omitting any word of imprecation or calling to witness.

"Section III. Where an oath has been duly administered and taken, the fact that the person to whom the same was administered had, at the time of taking such oath, no religious belief, shall not for any purpose affect the validity of such oath.

"Section IV. Every affirmation in writing shall commence: 'I, , of . do solemnly and sincerely affirm,' and the form in lieu of jurat shall be: 'Affirmed at this day of , 19 . Before me.'

"Section V. *If any person to whom an oath is administered desires to swear with uplifted hand, in the form and manner in which an oath is usually administered in Scotland, he shall be permitted so to do, and the oath shall be administered to him in such form and manner without further question.*"

Section VI. refers to the Acts which are repealed in the accompanying Schedule; and Section VII. to the short title of the Act—viz. The Oaths Act, 1888.

From the foregoing, therefore, it will be seen that any witness in any court in England may claim the privilege of taking an oath in the Scots fashion, which is not attended by any of the risks which are associated with the repetitive kissing of a book (the New Testament) by a variety of persons, some of whom may, at the time of kissing, be the actual victims of syphilitic or other infective disease.

That this is in the minds of medical persons who are, but for the risk of infection, willing and desirous of taking the oath by kissing the book, is evident from the following facts :—*The Times* of Jan. 23, 1908, reported an incident, occurring in the case Rabey *v.* Birch being tried at the Bloomsbury County Court, in which a medical witness refused to kiss the Testament used in court, but offered to kiss one of his own which he then produced. The judge refused to allow this, suggesting that the witness might take the oath after the Scottish manner. Upon declining to do so, the judge asked him to stand down. On appeal of the action to the Divisional Court, the non-acceptance of the evidence of the medical

witness was made a ground of complaint. After hearing a long argument, the Court dismissed the appeal. Mr Justice Phillimore made, among other remarks bearing on the point, the observation that " in the present case it might have been that the judge would have been wiser to look at the Testament." [1]

The foregoing Act assumes that those charged with the duty of administering the oath are conversant with the Scottish mode of administration, and the form of words used. In England, an official, usually the clerk of court, repeats the formula of words, and all the witness has to do is to " kiss the book." In Scotland, on the other hand, the oath is administered by the judge, who, standing in his place and speaking the words of the oath, requests the witness to repeat the words after him, clause by clause. The words of the oath in Scotland are as follows :—

" I swear by Almighty God, as I shall answer to God at the great Day of Judgment, that I will tell the truth, the whole truth, and nothing but the truth."

Certain judges omit the words, " as I shall answer to God at the great Day of Judgment " for the sake of brevity. These words are repeated clause by clause, by the witness after the judge or magistrate, his right hand being uplifted all the time. A few years after the passing of this Act we had occasion to give evidence before an English stipendiary magistrate in a summary prosecution under the Foods and Drugs Act, and we claimed the privilege of Section V. of the above Act. The magistrate frankly owned that he did not know the form of words, which, however, we supplied ; and thus the difficulty was got over, and a precedent established in that court. Medical witnesses, therefore, should understand that they possess this privilege, and no judge or magistrate may gainsay the claim ; we believe further, that it is the duty of the medical profession, from a hygienic point of view, to secure full establishment of the Scots mode of administration. Both in respect of its being more in accordance with sanitary principles, and of its greater solemnity, this mode is to be preferred.

By the passing of a new Oaths Act, entitled " An Act to amend the Law as to Oaths " on November 25, 1909, which came into operation on the 1st day of January 1910, Parliament has entirely freed witnesses in English law-courts from the need to kiss the book.

This Act (9 Edw. VII. c. 39) has for its short title " Oaths Act, 1909." It does not apply to Scotland.

Section 2 enacts (1) " Any oath may be administered and taken in the form and manner following :—

> " The person taking the oath shall hold the New Testament, or, in the case of a Jew, the Old Testament, in his uplifted hand, and shall say or repeat after the officer administering the oath the words, 'I swear by Almighty God that . . . ,' followed by the words of the oath prescribed by law."

(2) " The officer shall (unless the person about to take the oath voluntarily objects thereto, or is physically incapable of so taking the oath) administer the oath in the form and manner aforesaid without question : provided that, in the case of a person who is neither a Christian nor a Jew, the oath shall be administered in any manner which is now lawful."

[1] *B. M. J.*, vol. i., 1908, p. 280.

The ceremony, as sanctioned by the Lord Chief-Justice, of taking the oath under this Act, has been described by an official of the High Court as follows :—

Officer of the Court : What is your name ?

(*Witness having given his name*)

Officer : Take the Book in your right hand and raise your hand (*indicating by gesture what is meant*).

(*This being done*)

Officer : Repeat after me the following words :—" I swear by Almighty God that the evidence I shall give to the court (and jury) touching the matters in question shall be the truth, the whole truth, and nothing but the truth."

This Act does not repeal the provisions of the Oaths Act, 1888.

It will be observed that by the provisions in section 2 of the 1909 Act, the oath shall be administered to any person who is neither a Christian nor a Jew *in any manner which is now lawful*. That is to say, any witness who objects to being sworn on the ground either that the taking of an oath is contrary to his religious belief or that he has no religious belief, shall still be entitled to make a solemn affirmation instead ; and any foreigner, such as a Chinaman, shall still be sworn either by the solemn act of breaking a saucer or cutting off the head of a live fowl, as he is at present.

Medical Testimony.—In giving evidence in the witness-box, as in documentary evidence, there are certain principles which should never be forgotten by the medical witness. In the first place, the language of the witness-box should be as *simple* and *as untechnical as possible*. Let it be borne in mind that, although the technical speech used in conversation among medical men may be well understood by themselves, the same relationship does not obtain in the law-courts. The witness is there for the purpose of affording the court and the jury such information as medical knowledge is able to give on the facts of the case ; therefore, he fails in his purpose if he be unable to convey such information to men of differing grades of education, and men who, though skilled in the law, do not necessarily possess any knowledge of medicine. Let technical expressions, therefore, be dropped, and let as plain English as possible be substituted. Such terms as " syncope," " comatose," " highly vascular," " œdematous," and the like ought never to be used. It is impossible to expect a jury to know what is meant by the terms " pericardium," " meninges," " calvarium " ; and it is quite as easy to say " heart-bag," " brain-coverings," and " skull-cap " or " vault of skull." In the second place, the language should be *concise*. The witness will be well advised who does not use a dozen words to express what could be equally well done in half that number. Let adjectives of degree, and especially superlatives, be as scarce as possible, since the use of the latter may easily be interpreted to mean partisanship, and nothing discounts the value of any evidence so much as a suspicion of this. Moreover, the voluble witness is often a god-send to an opposing counsel with a weak case, since the witness in saying more than he ought is apt to say more than he means ; hence the greater number of opportunities for interpreting double meanings

in answers. Categorical answers, when possible, are the best; and when impossible, answers should be concise, but luminous. In the third place, the language should be *courteous*. This is not difficult during the examination-in-chief of a witness, because the witness and the examiner are in accord; it becomes less easy, however, during cross-examination, since the object of the cross-examiner is to weaken, water down, or, if possible, to negative the former evidence. If the witness keep in remembrance, however trying the situation, that he is there solely for the purpose of speaking the whole truth, he has but consistently to hold by what he has formerly said, and to give fully the reasons for his belief to convince the court of his *bona fides* as a witness. It is usually with reference to opinions or inferences that differences between counsel and witness arise. Further, it may be of assistance to the witness in taking a charitable view of his cross-examination, if he bear in mind that it is the business of the cross-examiner to make the best case he can for his client. Calm, patient, but persistent restatement of former evidence will sooner or later break down even the most urgent cross-examiner. There are but few members of the bar, we believe, who wilfully play the bully. Bullying a witness is, however, recognised by the bar to be quite legitimate under certain circumstances. But even that will fail by maintenance of temper and a courteous, but firm, attitude on the part of the witness. He may rely upon the judge interfering when he thinks counsel oversteps the bounds of legitimate cross-examination. In short, if the witness can preserve himself free of the assumption that cross-examining counsel is his natural enemy, and if he does not, therefore, assume the mental attitude appropriate to that view, he will leave the witness-box, if otherwise he has been well prepared, with credit. There are occasions, however, upon which it is absolutely necessary for a medical witness to maintain a very firm attitude, and to decline firmly, but pleasantly, to have words put into his mouth which he had not uttered. Unwittingly or intentionally—we believe, in most cases, the former—cross-examining counsel may ask a question of a witness which is based upon a statement which he desires the witness to understand he has already made in reply to a previous question, and the answer to which tends to put an entirely different complexion upon the tenor of his testimony. If the witness be cool and self-possessed, he will detect the mis-statement and at once challenge it. Should the counsel persist in stating that the witness made the statement, the witness should appeal to the notes of the judge, from which the matter will soon be settled. More than once have we had to take this step.

The only additional point to be attended to by the witness, and it is also an important one, is *to speak distinctly, deliberately, and audibly* while in the witness-box. It has often been said by judges that no witnesses are so difficult to be heard and to be understood as medical witnesses—difficult to be heard from want of clearness of articulation, and difficult to be understood by reason of the nature of the evidence they alone are able to offer, aided, not infrequently, by the technical language they are apt to use.

Respecting evidence-giving in general, there are certain points to

be borne in mind. The general rule is that witnesses must speak only to matters of fact and not of opinion. But a medical witness, in his usual capacity as such, speaks both to matters of fact and of opinion, and therefore he is deemed by a court of law to come within the category of expert or skilled witnesses; at the same time, he may only be called upon to give evidence on matters of opinion and not of fact. As a general rule, subject to certain exceptions, such as in the case of dying declarations, hearsay evidence is not valid evidence; therefore the witness must speak only to facts which come within his own personal knowledge. Further, any opinion which he gives from any given series of facts must only be his own opinion. He is not entitled, for example, to cite the opinions of others as corroborative of his own, since the persons holding such opinions cannot be available for cross-examination in open court. At first sight this would seem incongruous, for of all places in the world there is none in which such deference is paid to authorities and opinions as a court of law. And some medical men have had the courage to point this out. In the famous trial of Spencer Cowper, narrated in Hargrave's "State Trials," Dr Crell, one of the medical witnesses, referred in his evidence to the then authorities on the subject of drowning, but this was objected to by the court. To this the witness replied: "My lord, it must be reading, as well as a man's own experience, that will make anyone a physician; for without the reading of books in that art, the art itself cannot be attained to. I humbly conceive that in such a difficult case as this, we ought to have a great deference for the reports and opinions of learned men; neither do I see any reason why I should not quote the fathers in my profession in this case, as well as you gentlemen of the long robe quote Coke upon Littleton in others." The witness was allowed to proceed. We have quoted from authorities, not, however, in a criminal case, but in one pertaining to a question in public health. The difficulty, however, may be got over by adopting as your opinion the opinions of others whom you are entitled to name. Besides, it is by no means an uncommon practice in criminal cases for cross-examining counsel to read certain passages from a standard book on the subject, with the intention of rebutting evidence given by the witness in his examination-in-chief, and to ask the witness if he agree or disagree with the author. In such a case, our advice to a witness is never to offer any reply until he asks to be allowed, and has been permitted, to peruse the quotation as given in the book for himself, and even then not to answer *until he has carefully read the passage quoted and the context.* Any statement which a witness has made on precognition, but which he has modified in the witness-box, cannot be challenged on the ground that he made a different statement on a former occasion unless it amounts to wilful perjury, when he may be arrested on leaving the witness-box. Again, the character of a witness cannot be attacked in the witness-box; at the same time, it is competent for counsel to ask a witness if he has been convicted, or then stands indicted, for a crime.

In the giving of testimony, there are certain privileges and disabilities associated with that duty. Of the former, it may be stated that the pertinent evidence which a witness gives in the witness-box

is absolutely privileged [1] (*see* p. 53). Again, as a general principle in witness-giving, it may be said that no witness can be compelled to answer any question which may have the effect of incriminating himself, or which would tend to degrade his character socially or professionally. To this general rule there is an exception. By the Criminal Evidence Act, 1898 (61 & 62 Vict. cap. 36, s. 1) (*e*), a person charged and being a witness may be asked any questions in cross-examination notwithstanding that it would tend to incriminate him as to the offence charged; and by s. 1 (*f*), every person charged with an offence is a competent witness for the defence at every stage of the proceedings upon his own application. Such a person charged and called as a witness shall not be asked, and if asked shall not be required to answer, any question tending to show that he has committed or been convicted of or been charged with any offence other than that wherewith he is then charged, or is of bad character, unless the proof of such is admissible evidence to show that he is guilty of the offence wherewith he is then charged, or has personally or by his counsel asked questions of witnesses for the prosecution with a view to establish his own good character, or has given evidence of his own good character, or the nature or conduct of the defence is such as to involve imputations on the character of the prosecutor or his witnesses.

In Paris and Fonblanque's work on Forensic Medicine [2] are narrated the facts of a case, tried at the Old Bailey Sessions in June 1821, in which a man was being tried for the murder of another in a duel, and in which Mr Pettigrew, a surgeon, was called as the first witness. The witness, on entering the witness-box, was thus cautioned before giving his evidence by Mr Justice Bailey: "Mr Pettigrew, I think it necessary to give you the caution, if you think the evidence which you are about to give likely to expose you to a criminal prosecution, you are not bound to give it." Whereupon Mr Pettigrew very properly declined to answer any questions, since duelling being an offence against the law, any evidence which would have indicated his presence there, even in a professional capacity, would have rendered him *particeps criminis*. Cases in the latter category are, fortunately, rare. In one case, however,[3] a medical witness, in a trial for rape, was asked, on cross-examination, if he had been in the way of having connection with the woman said to have been ravished. He hesitated for some time whether to answer or not, when it occurred to him to ask if he must answer the question, and on being assured that he need not do so unless he chose, he said, as if feeling relieved, "Then I refuse to answer."

The above case of Mr Pettigrew practically illustrates the only circumstances in which a medical man may refuse to disclose information to a court of law. No witness, medical or other, is obliged to give evidence which would tend to incriminate himself. In view, however,

[1] *Cf.* Dawkins *v.* Rokeby (1875) L. R. 7 H. L. 744 *et seq*; Williamson *v.* Umphray and Robertson (1890) 17 R. 905, 901; Muster *v.* Lamb (1883) 11 Q. B. D. 588; Rome *v.* Watson (1898) 25 R. 733; Seaman *v.* Netherclift (1876) 2. C. P. D. 53; Hassan *v.* Paterson (1885) 12 R. 1164; M'Intosh *v.* Weir, 2 R. 877.

[2] Page 165.

[3] Ogston's "Lectures on Medical Jurisprudence," p. 21.

of the very important question and all-reaching character of the subject of professional privilege, detailed consideration must be given to it.

Professional Privilege.—It is the law in Great Britain and Ireland *that secrets of patients obtained by medical men in the course of their profession cannot be withheld from a court of law if their revelation be necessary for the purposes of the law.*

There are some, however, who are inclined to dispute the wholesomeness of such a law, and who point to the practices of the law of other countries in maintaining that any information acquired by a medical attendant in attending a patient should not be compulsorily disclosable, and that it ought to be privileged; and it is but recently that an example has offered of a medical witness who was willing rather to suffer the pains of law than reveal such secrets. The question may be looked at from two points of view—viz. the moral or ethical, and the legal.

MEDICAL OATH

Since the days of Hippocrates down to the present, medical men have bound themselves not to reveal such professional secrets. The oath of Hippocrates reads as follows:[1]—"I swear by Apollo, the physician, and Esculapius, and Health, and All-Heal, and all the gods and goddesses, that, according to my ability and judgment, I will keep his oath and this stipulation—to reckon on him who taught me this art equally dear to me as my parents, to share my substance with him and relieve his necessities if required; to look upon his offspring in the same footing as my own brothers, and to teach them this art, if they shall wish to learn it, without fee or stipulation; and that by precept, lecture, and every other mode of instruction I will impart a knowledge of the art to my own sons and those of my teachers, and to disciples bound by a stipulation and oath according to the law of medicine, but to none others. I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous. I will give no deadly medicine to anyone if asked, nor suggest any such counsel; and in like manner, I will not give to a woman a pessary to produce abortion. With purity and with holiness I will pass my life and practise my art. I will not cut persons labouring under the stone, but will leave this to be done by men who are practitioners of this work. Into whatever houses I enter I will go into them for the benefit of the sick, and will abstain from every voluntary act of mischief and corruption; and, further, from the seduction of females or males, of freemen and slaves. Whatever, in connection with my professional practice, or not in connection with it, I see or hear in the life of men which ought not to be spoken of abroad I will not divulge, as reckoning that all such should be kept secret. While I continue to keep this oath unviolated, may it be granted to me to enjoy life and the practice of the art respected by all men in all times. But, should I trespass and violate this oath, may the reverse be my lot."

[1] *Vide* The Sydenham Society edition of the Works of Hippocrates.

In the Scottish Universities up till the year 1868, each graduate in medicine had to take an oath in Latin, which generally embodied these principles with reference to his relation to the sick; but on the passing of the Promissory Oaths Act in that year, a declaration in English was substituted therefor, which is in the following terms:— "I do solemnly and sincerely declare, that, as a Graduate in Medicine of the University of ——, I will exercise the several parts of my profession, to the best of my knowledge and abilities, for the good, safety, and welfare of all persons committing themselves, or committed, to my care and direction, and that I will not knowingly or intentionally do anything or administer anything to them to their hurt or prejudice, for any consideration, or from any motive whatever. And I further declare, that I will keep silence as to anything I have seen or heard while visiting the sick which it would be improper to divulge. And I make this solemn declaration in virtue of the provisions of the Promissory Oaths Act, 1868, substituting a declaration for oaths in certain cases."

In like manner, the medical and surgical Corporations exact a declaration of their licentiates, which, however, is not couched in like terms. The licentiate promises to maintain and defend the rights and privileges of the corporations of which he is about to become a member, to obey all the laws made by the said corporations, and he further promises, under pain of forfeiture of his diplomas, that he shall not advertise nor employ any other unbecoming method of obtaining practice, nor allow his name to be connected with anyone who so acts, or who is engaged in any discreditable kind of medical work.

From the ethical side, therefore, it may be taken that there exists every reason why a medical practitioner should not only entirely dissociate himself from any discreditable conduct or conduct infamous in a professional respect, but also that he should keep inviolate all secrets which may be imparted to him by his patients, or to which he may attain in the course of his professional association with them. This is not only right and proper, but violation of such a trust is justly visited by the pains of law.

PROFESSIONAL SECRECY

From the legal side, however, the question must be viewed differently. In the first place, any rules, such as the foregoing, which a corporate body may make for the maintenance of its honour by those who are members of it, or any rules which such a body may impose on its members by virtue of any Act of Parliament, can only have validity so far as they are in consonance with the law of the land. Such, therefore, are subservient to the law. It is because it is a statutory enactment (16 & 17 Vict. c. 83, s. 3) that the communications between husband and wife are privileged. By section 1 (*d*) of the Criminal Evidence Act, 1898, it is enacted that "nothing in this Act shall make a husband compellable to disclose any communication made to him by his wife during the marriage, or a wife compellable to disclose any communication made to her by her husband during the marriage." Although it is not covered by statute, a rule exists whereby any communication between a legal adviser and

his client is also privileged. The settled law of this country is, that a medical witness cannot claim any privilege. This was first laid down by Lord Mansfield in the trial of the Duchess of Kingston for bigamy, before the House of Lords in 1776. Mr Cæsar Hawkins, sergeant-surgeon to the King, was asked whether he knew of any marriage between the accused and the Earl of Bristol, who was believed to be her husband when she went through the ceremony of marriage with the Duke of Kingston. To this he replied : " I do not know how far anything that has come before me in a confidential trust in my profession should be disclosed consistent with my professional honour " ; on which Lord Mansfield said, " I suppose Mr Hawkins means to demur to the question upon the ground that it came to his knowledge some way from his being employed as surgeon for one or both of the parties. . . . If no lord differs in opinion, but thinks that a surgeon has no privilege to avoid giving evidence in a court of justice, but is bound by the law of the land to do it, Mr Hawkins will understand that it is your judgment and opinion that a surgeon has no privilege, where it is a material question in a civil or criminal cause to know whether parties were married, or whether a child was born, to say that his introduction to the parties was in the course of his profession, and in that way he came to the knowledge of it. I take it for granted that if Mr Hawkins understands that, it is a satisfaction to him, and a clear justification to all the world. If a surgeon was voluntarily to reveal those secrets, to be sure he would be guilty of a breach of honour and of a great indiscretion ; but to give that information in a court of justice, which, by the law of the land, he is bound to do, will never be imputed to him as any indiscretion whatever " (20 S. T., p. 735 ; *vide* also Harg. S. T., 243). The same ruling was recognised in Wilson *v.* Rastall, 4 T. R., p. 760. In Rex *v.* Gibbons (1 C. P., 97) a surgeon, who was called to prove confessions made to him by a female prisoner who was being tried for the murder of her child, objected to give evidence on the ground that he obtained what knowledge he had from his professional attendance on the prisoner ; but Park, J., overruled the objection, saying, " that is no sufficient reason to prevent a disclosure for the purpose of justice " ; and in Broad *v.* Pitt, 3 C. P., 518, Best, C. J., stated that " there is no privilege of this description in the case of a medical man."

Such instances suffice to show that a medical witness must disclose, when a judge so rules, any secret information of which he may be possessor by virtue of his professional relationship to a party in the case. The most recent development of the subject occurred (1900) in Nottingham, where a medical man, in an action by a man for nullification of a maintenance order on the ground of his wife's adultery, was summoned to give evidence touching the cause of an illness which the defendant had during the period of separation. The practitioner, who was a graduate of a Scottish university, and who had subscribed the declaration already given, declined to reveal the character of the illness on the following grounds—viz. first, that it would be a breach of professional secrecy, which the witness held to be inviolable ; second, that it would be an infringement of his academic declaration ; third, that by such infringement he might be rendered liable to pains and penalties by the General Medical Council ; fourth, that his answering

might render him subject to an action at law by the defendant in the case; fifth, that no high legal decision had hitherto been given as to the power of magistrates to compel answers to questions of professional secrecy in a civil court; sixth, that Mr Justice Hawkins, in Kitson *v.* Playfair, had said, "That he could quite understand a case, especially a civil cause, where a doctor was quite justified in refusing to divulge questions of professional secrecy"; and for other reasons, particularly that this was a question which ought to be decided by the highest law-court. The solicitor for the plaintiff asked the magistrates to commit the medical practitioner, in terms of Section 7 of the Summary Jurisdiction Act, 1848, which renders any person refusing to give evidence, unless he gave a just and reasonable excuse, liable to a term of imprisonment not exceeding seven days. The bench, after consideration, decided not to order the practitioner to answer the question, as they were of opinion that he had offered a just excuse for refusing; and that as the question was one of an interesting and novel character, they would be pleased to offer any facilities for appeal to a higher court.

The case of St Clair Gray *v.* The Northern Accident Insurance Company in the Scottish law-courts exhibits another aspect of the question. The pursuer alleged that he accidentally cut his finger while operating, and that later, while attending another patient, was infected specifically, in consequence of which he was laid off work for some time. He held a policy against accident in the defenders' company, and made a claim thereupon which the defenders resisted. He raised an action against the company in the local Sheriff-court for £123. After hearing evidence, in which he declined to reveal the name of the patient by whom he was infected, the Sheriff-substitute awarded him £78 in name of damages. This judgment was appealed to the Sheriff-principal, who reversed the decision of the Sheriff-substitute on the ground that the pursuer had failed to prove that the poisoning was communicated as stated by him, or was the result of an accidental injury, within the meaning of the policy. Pursuer appealed against this decision to the Court of Session, which affirmed the decision of the Sheriff. The Lord Justice-Clerk, who gave the leading judgment, said "that there was no reason to doubt the *bona fides* of the pursuer, who had acted in an honourable manner in not disclosing the name of the patient whom he was attending." While that was so, however, his Lordship was bound to conclude that the pursuer had not proved his case.[1]

It is interesting to note that medical men in certain parts of the world are in a different position; for example, by the Evidence Further Amendment Act, New Zealand, 1885, it is provided, *inter alia*, that (*a*) all communications made to a physician or surgeon in his professional character by any of his patients shall be privileged, and shall not be admissible in evidence in any civil or criminal proceedings, except with the express consent of the person alleged to have made such communication. The word "communication" in the Act includes all information acquired which is necessary to enable a physician to prescribe, or a surgeon to do any act, for his patient, but it does not include any communication made for a criminal purpose, nor does the above section prejudice the right to give evidence respecting statements made

[1] *B. M. J.*, 1896, vol. ii., p. 1809.

for the purpose of effecting insurance on the life of any person. In America also, in seventeen different States and territories, Statutes have been passed which enact that such professional secrets shall be deemed privileged, overriding the rule at common law; in the State of Connecticut, however, the common law rule prevails, and disclosure is compelled when necessary. In France, moreover, medical witnesses claim the same privileges of secrecy as the priests.

On this point, therefore, medical men in this country must reckon upon their liability to be called upon to make such disclosures when necessary. At the same time, a medical witness should always be reluctant in a court of law to disclose such secrets, and he should ask for a ruling of the court before he makes disclosure. Such action will, at least, convince the public that the medical profession jealously guards that which has been committed to the members of it as confidential, and that it is loth to make revelation unless compelled by law to do so.

The other aspect of professional privilege arises in the question, *Whether a medical man may, under any circumstances, be permitted legally in the ordinary relations of life to divulge confidence obtained in the practice of his profession?* In the Court of Session (A. B. *v.* C. D., 14 Dunlop, 2nd Series, 177) it has been decided that "secrecy is an essential condition of the contract between a medical man and his employers, and breach of secrecy affords a relevant ground for an action of damages." This, therefore, may be taken as a general expression of the law. Out of this broad question has arisen the specific one, *May a medical man for the protection of the honour of his wife and children violate confidence which he has received as the medical attendant of his relative?* While the question must be answered on the merits of each particular case, perhaps no more pertinent case, involving the above issues, will offer than that of Kitson and Wife *v.* Playfair, which was tried in 1896 before Sir Henry Hawkins and a jury. The charge against the defendant was that he had published a statement concerning the pursuer that she had "had a miscarriage under such circumstances that her pregnancy could not have been of a legitimate character." The principal defence was that, as the statement was made to a brother-in-law of one of the plaintiffs by the defendant on behalf of his wife, who was a sister of one of the plaintiffs, it was a privileged statement. The substance of the defendant's statement being one in which the family honour was involved, and having been made to a member of that family, there was much apparently to remove it from the category of ordinary slander, and to justify it being reckoned among privileged statements. According to the law, however, any statement is either privileged, or it is not. Mr Justice Hawkins in his summing-up tersely defined a statement of privilege in the following way:—"The rule was, that if a man made a charge derogatory to the character of another, if he could show that it was made upon an occasion upon which he was privileged in speaking out, or writing the words if they were contained in a letter, and that he made it honestly and *bona fide*, and merely in the discharge of a duty which he felt was incumbent upon him, without any sinister motive, and without any ill-feeling, it might happen that he would be entitled to say words, even though they did great injury, under the plea of privilege. . . .

"The plea of privilege could not prevail if a man did not really make the communication under a sense of duty and obligation cast upon him to make it. If he did it for the mere purpose of doing a bad turn to a man, or getting gain for himself, or putting pressure on a man he had no right to put, or in a spirit of irritation or anger, or for anything of that sort, it was not privileged." The female plaintiff at the time she called for the professional assistance of the defendant was in the enjoyment of an allowance of £400 a year from the brother of her husband. After the statement complained of was made, this allowance was stopped. She thereupon asked for an interview with the defendant, but for answer she was advised by him "to make her illness an excuse for leaving London, so that their families should not be brought into contact, otherwise he would have to place the matter in the hands of his wife." The questions which the learned judge put to the jury for answer were these—viz. "(1) Were the words uttered as alleged? (2) Did the defendant believe the words to be true? (3) Were they uttered in good faith and without malice? (4) Were they uttered not from a mere sense of duty, but from some indirect motive, or to gratify feelings of ill-will, anger, or irritation against the plaintiff or her husband? (5) If verdict for the plaintiff, what were the damages?"

From the summing-up of the judge, and from his remarks when a stay of execution was discussed before him, it was obvious that he did not think the statement was a privileged one. The jury answered the queries against the defendant, and returned a verdict for the plaintiff, naming the damages at £12,000.

From the general statement of Mr Justice Hawkins regarding statements of privilege, it is evident that, where privilege is claimed, the facts alone must determine the issue; hence no more definite rule than that offered by him could safely be given.

The cases of Ensor *v.* Wakefield [1] and Cassan *v.* Fyfe [2] afford illustration of this uncertainty. In the former case the slander consisted in the defendant communicating to his assistant the statement that the plaintiff was drunk while attending a patient who afterwards called in the defendant. Mr Justice Ridley said "he was quite clear that there was no duty upon the defendant to make a communication of the sort to his assistant. . . . However, it might be that the communication could be divided into two parts, and he was quite willing to let the case go to the jury upon the question as to whether the defendant had or had not exceeded privilege when he informed his assistant of the reason alleged for the former doctor ceasing to attend the patient." The issue, however, did not go to the jury, as the case was arranged.

In the latter case it was alleged that the defendant said to friends of a patient that the plaintiff "had very much crushed and ill-used the man; that he had put an instrument into him by force; and that this had injured the neck of the bladder." It was proved in

[1] *B. M. J.*, vol. ii., 1899, p. 60.
[2] *Ibid.* vol. ii., 1884, p. 329.

evidence that the defendant had made certain statements to the executive officials of a club of which the plaintiff was medical officer with a salary of £360 per annum, in consequence of which plaintiff was dismissed from the post. Mr Justice Lopez ruled on a point of law that it had not been proved that the defendant had slandered the plaintiff; and that, in regard to the communication made to the officials of the club, although proved, it was a privileged communication. It appeared in evidence that the statement in question consisted of replies to queries which were put to defendant by these officials.

This ruling is quite in accordance with the following general definition of a privileged communication—viz. "that a communication made *bona fide* upon any subject matter in which the party communicating has an interest, or in reference to which he has a duty, is privileged, if made to a person having a corresponding interest or duty, although it contain incriminatory matter which, without the privilege, would be slanderous or actionable." [1]

In the remarks of the judge on the general question of professional secrecy as interpreted by the evidence of medical witnesses called to speak upon this, several important *dicta* must be noted. For example, he said, "It must be remembered that the medical profession had no right to legislate on the matter [as to the rule of inviolable secrecy]. They might make their own rules—and, he dare say, did to the best of their ability—for their guidance as professional men, but they could not impose upon the public their self-made laws as being binding upon them. The medical gentlemen called on behalf of Dr Playfair said that they were only rules by which they regulated their own conduct. They mentioned two exceptions. In the case of a witness being called into the witness-box in a court of justice, and asked to divulge a professional secret, they held that under those circumstances they were bound to give utterance to it. He would not himself discuss that point, because he had a little doubt whether the rule could be stated so generally as that. Although the judge was the person who had to rule whether or not a witness was to answer a question—and if a witness did not answer according to that ruling he might be committed for contempt of court—yet one would suppose that a judge would exercise discretion in ordering a witness to answer or not. Having regard to a variety of circumstances, there might be some matters which the judge might think most unreasonable to be divulged by a professional man, and therefore he might refuse to permit it, and allow the witness to say, 'I refuse to answer.' Each case must be considered by its own particular circumstances, and by the ruling of the judge who happened to preside on the occasion. It must be taken for granted that the judge would decide according to law. It could not be presumed otherwise, as in that case the court's law would get into sad disorder. There was always a rule to set a judge right if he went wrong; on the occasion, however, on which he was ruling, his ruling would have to be taken as law. It was also said by the medical witnesses that if in the course of professional practice they came across a case which indicated either that a crime had been committed, or was about to be committed, that under these circumstances

[1] Glenn: "Manual of Laws affecting Medical Men," p. 230.

they were bound to divulge it. To whom ? To the Public Prosecutor ! If a poor, wretched woman committed an offence for the purpose of getting rid of that with which she was pregnant, and of saving her character, her reputation, and, it might be, her very means of livelihood, and if a doctor was called in to assist her—not in procuring abortion, for that in itself was a crime—but called in for the purpose of attending her and giving her medical advice—how she might be cured so as to go forth about her business—he doubted very, very, very much whether he would be justified in going forth and saying to the Public Prosecutor, 'I have been attending a poor young woman who has been trying to procure abortion with the assistance of her sister. She is now pretty well, and is getting better, and in the course of a few days she will be out again, but I think I ought to put you on to the woman.' To his mind, a thing like that would be monstrous cruelty. He did not know what the jury's view would be ; he spoke only of his own. Therefore, when it was said that there was a general rule existing in the medical profession, that whensoever they saw in the course of their medical attendance, that a crime had been committed, or was about to be committed, they were in all cases to go off to the Public Prosecutor, he was bound to say that it was not a rule which met with his approbation, and he hoped it would not meet with the approbation of anybody else. There might be cases when it was the obvious duty of a medical man to speak out. In a case of murder, for instance. A man might come with a wound which it might be supposed had been inflicted on him in the course of a deadly scuffle. It would be a monstrous thing if the medical man might screen him, and try to hide the wound, which might be the means of connecting the man with a serious crime. That was a different thing altogether. . . . Communications between a doctor and his wife, or children, were said to be privileged where it was necessary to reveal them in order that the wife or children might be protected. He thought that that required a great deal of limitation, because cases might be imagined where the wife might be living under circumstances in which she did not want any such protection at all, and giving to her a secret belonging to a patient would be only a wanton violation of the rule. However, it was a very delicate question, and would have to be argued some day." For further details of this interesting judgment, the reader is referred to the verbatim account in the *British Medical Journal*.[1]

Compare with this opinion that expressed by Lord Justice-Clerk Inglis regarding the conduct of Dr Paterson, one of the medical witnesses in the Pritchard poisoning case. Dr Paterson, who was a witness for the Crown, stated in the witness-box that he formed the opinion the first time he was called to see Mrs Pritchard in consultation with her husband, the prisoner, that she was under the depressing influence of antimony. His Lordship gave expression to his view of Dr Paterson's attitude and action as follows :—" He [Dr Paterson] said, in answer to the questions put to him, that his meaning was—what he intended to state in the box was—that he was under the decided impression when he saw her [Mrs Pritchard] on these occasions, that

[1] *B. M. J.*, vol. i., 1896, pp. 815, 882.

somebody was practising upon her with poison. Now he thought it consistent with his professional duty, and, I must also add, in his duty as a citizen of this country, to keep that opinion to himself. In that I cannot say that he did right. I should be sorry to lead you [the jury] to think so. I care not for professional etiquette or professional rule. There is a rule of life and a consideration that is far higher than these—and that is the duty of every citizen of this country —that every right-minded man owes to his neighbour, to prevent the destruction of human life in this world, and in that duty I cannot say but Dr Paterson failed." These two opinions expressed by the highest criminal judges demand the serious consideration of the medical profession, although it is difficult, if not, indeed, impossible, to reconcile the two views.[1]

Another of the important *causes célèbres* of recent years involving the subject of professional secrecy and privilege was that of Mrs M. and her father, J. J., against the late Sir Patrick Heron Watson in 1904, for damages for alleged slander.

The question at issue was this: *Does the privilege which protects a witness from an action of slander in respect of his pertinent evidence in the witness-box also protect him against the consequences of statements made to a solicitor and counsel in preparing the proof for trial?*

The issues proposed in the Record were as follows:—

1. Whether on or about 22nd October 1901, the pursuer employed the defender as her private and confidential medical adviser to advise her as to her state of health and in the matter of an action of judicial separation proposed to be instituted by the pursuer against her husband, and, in pursuance of that confidential employment, communicated to the defender the evidence proposed to be led on her behalf, and submitted herself on or about 24th October 1901, to an examination by the defender at her father's house; and whether the pursuer, having raised an action of separation and aliment against her husband, which was defended by him, the defender, in breach of his confidential employment, on or about the 22nd, 23rd, or 24th October, 1903, voluntarily disclosed to her husband and her husband's legal adviser, and to the counsel engaged therein on her husband's behalf, or to one or more of them, matters relative to the pursuer and her state of health ascertained in the course of said confidential employment, and the nature and result of the examination of the pursuer made as aforesaid, to the loss, injury, and damage of the pursuer.
2. Whether, on or about 24th October 1903, in the course of the trial of the action, the defender, in breach of said confidential employment, voluntarily gave evidence on behalf of her husband, and publicly disclosed the matters mentioned in the preceding issue, to the loss, injury, and damage of the pursuer.
3. Whether, on or about the said dates in October 1903, the defender falsely and calumniously stated to her husband, his law agent, and his counsel engaged in said action on behalf of her husband, or to one or more of them, of and concerning the pursuer that the pursuer at the time of the examination of her by defender in October 1901, was bent upon inducing premature labour so as to free her of any permanent reminder of her marriage with her husband.
4. Whether, on or about the 24th October 1903, the defender voluntarily gave evidence as a witness on behalf of her husband in the course of the trial of said action, and falsely and calumniously stated in open Court of and concerning the pursuer that the pursuer at the time of the

[1] Author. Trans. Med. Leg. Soc., 1907.

examination of her by defender in October, 1901, was bent upon inducing premature labour.

It was contended for defender that testimony given in open Court was privileged, and further that what was spoken or written in precognition as an inherent part of the evidence was likewise privileged, although counsel had to admit that there was no legal authority in support of a statement in precognition being privileged, for the reason that an action involving such an issue had never before been raised.

Lord Kincairney, before whom the case was first heard, allowed the first and third issues, but refused the second and fourth issues.

A reclaiming note was presented to the Second Division of the Court of Session against the judgment of the Lord Ordinary. After hearing, judgments were given on 19th November of same year by the Lord Justice-Clerk, and Lords Young, Trayner, and Moncrieff. The finding was that the Court—Lord Young dissenting—disallowed the first issue approved by the Lord Ordinary, but allowed the other—viz. the third of the original issues. It is profitable as well as instructive to consider the views of these different judges on the matters at issue. The Lord Justice-Clerk entirely concurred, as did also the other judges, with the decision of the Lord Ordinary to reject the second and fourth of the original issues which involved the important question whether evidence given in a Court of law was actionable. On this point the Lord Justice-Clerk said: Nothing was more clearly settled in our law than that a witness was absolutely privileged in giving his evidence pertinent to the issue and could not be subjected in damages for slander for what he said in the Court of Justice. Lord Young emphasised the well-established rule that a witness examined in a Court of justice, admissible as a witness, and who answered questions which were permitted to be put to him, was privileged, and that it was in the interests of justice and of the public, for whom justice was administered, and of the Courts of justice, who administered it, that evidence should not be given under any fear or apprehension of an action of damages for slander. Lord Trayner agreed that it was well settled that what was stated by a witness in the witness-box was undoubtedly privileged, except in the case where the witness gave expression to a calumnious statement altogether irrelevant to the subject matter of the case in which he was being examined, or to questions put to him. The present defender's statements did not fall within that exception.

The question now narrowed itself to the actionability of a witness for statements made in precognition.

The Lord Justice-Clerk was of opinion that the third issue must be allowed. The words of the alleged slander complained of seemed to be such as fairly to bear the innuendo that the pursuers put upon them, and if the innuendo were made out to the satisfaction of the jury under the direction of the judge at the trial, there would be a case for damages. He had only to add that he did not see at present sufficient ground for inserting a statement of malice in the issue. Lord Trayner agreed in disallowing the first issue. In coming to the conclusion that the issue should be disallowed, he was not influenced to any extent by the consideration that the statement complained of was made to the pursuer's husband. In the position in which the pursuer and her husband stood towards each other, and that in the knowledge of the defender, he thought the defender had no right to make to the pursuer's husband any statement which he could not justify, or, without incurring liability for damages, have made to a stranger. But he agreed with the Lord Ordinary in thinking that the pursuer was entitled to the third issue. Lord Moncrieff was not prepared to hold that statements voluntarily given in answer to questions in precognition were necessarily privileged. But the pursuer was bound to specify and put in issue the statements complained of. She had not done so, and did not propose to do so; and he was not surprised, because, apart from the alleged slander at the conclusion of the defender's notes, there was nothing in them to warrant the large claim made. He reluctantly agreed with the majority of their Lordships that the second of the two issues allowed by the Lord Ordinary should be allowed as it stood, and the case go to trial.

Lord Young in his judgment dissented from the others in allowing the third issue in the Record. He said the case presented questions of very general interest and importance. Still, like most cases it had its own

specialities and peculiarities, and the chief speciality and peculiarity here was that the whole matter arose out of a disagreement between a husband and a wife. The wife believed that she had been cruelly ill-used by her husband, or that his cruel ill-usage broke down her health, so that she could not endure its continuance, and she left her husband's society and his residence, and went to reside with her father at some distance. Then with the view of securing her separation from her husband and her support by him without the necessity of living with him and submitting to the continuance of that ill-usage, she was advised that her proper course was to raise an action of separation and aliment. With a view to that, she resorted to the defender—a well-known, eminent member of the medical profession in Edinburgh—to get his testimony that her broken health was attributable to such cruel ill-usage as she alleged her husband had subjected her to. Sir Patrick Heron Watson examined her and questioned her, and the result was contained in a note made by him, and dated October 25, 1901. He (Lord Young) saw no impropriety in the defender making that record of the woman's habits, and the impression made upon him, and the advice which he gave her. The action of separation and aliment was brought by the wife against her husband. She was, of course, at perfect liberty to call Sir Patrick Heron Watson as her witness ; and no doubt he would have been called by her if he had not most distinctly given her advisers to understand that his opinion was not favourable to her view. Therefore she did not call him. It so happened that about two years after this examination, the defender was consulted by the husband. The defender stated, and nobody would doubt quite truly, that when called by the husband and asked by him to examine his wife, he did so without any recollection whatever of having examined her before, but that he was informed then that she was the same lady. Then he was asked by the husband what had passed between them on the previous occasion. His Lordship did not think it doubtful that Sir Patrick Heron Watson acted quite legally and with perfect propriety in giving the husband information of what had passed between him and Mrs M., the condition in which he found her, and the opinion which he had formed of her condition and how it had been brought about. Sir Patrick Heron Watson was called as a witness by the husband in the action of separation. They must hold that he was an admissible witness, because he was admitted, and they could not hold that the less because no objection was taken to his admissibility. It was stated, and not disputed, that all the evidence which the defender gave was in answer to questions which were not objected to by either party or by the learned judge. His Lordship must therefore hold that Sir Patrick was a competent witness, and that what he gave evidence upon was legal, admissible evidence, upon which the Court could and should and must proceed in determining the facts according to which the case had to be determined. His opinion upon the whole matter was that there was here no relevant case whatever, for sending to a jury against the defender, and he thought it only just and fair to him to state that, so far as his opinion went, nothing which the defender was alleged to have done or said was at all improper or discreditable to him or any member of his profession.

In view of the judgment of the Second Division of the Court of Session, Sir Patrick Heron Watson appealed to the House of Lords.[1]

House of Lords Appeal, July 28, 1905.[2]

The main question raised on appeal was, whether the averment of the respondent in the appeal, Mrs M., that the statements made in the witness-box were previously communicated to her husband and his agent and counsel formed a ground of action against the appellant, Sir Patrick Heron Watson.

It was argued for appellant that the information given to the law agent of the husband before going into the witness-box was strictly reserved to what the witness was prepared to prove in Court and was absolutely privileged, and that this privilege was founded on grounds of public policy, in order to protect witnesses from being harassed by actions of damages and thereby deterred from speaking with that free and open mind which the administration of justice demands.

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[1] 1904. 42 S. L. R. 213 ; 7 Fraser (Court of Session), 72.

[2] Law Reports (Appeal Cases) 1905, p. 480; 7 Fraser (House of Lords), p. 109.

It was argued for respondents that the appellant was retained by the respondent as a medical man, received a fee and came to see her for the purpose of her litigation, and that the information he obtained was for her benefit; that when a witness is consulted and forms an opinion, that opinion is the property of the client or person who employs him, and he is not at liberty to give it to the other side, so if a solicitor acquires knowledge of a flaw in his client's titles he is not bound to let the other side know of it; that the appellant here, in making disclosures to the respondent's husband, did what was contrary to his duty; and that while there was no doubt that a witness is protected from the consequence of going into the witness-box, it was clear that the appellant was not protected for what he did outside the box.

Lord Chancellor Halsbury, in giving the leading judgment, said: "When one examines with care the different allegations made in the condescendences and the answers, I do not think any question arises as to the confidential nature of the employment between patient and medical man. I do not propose to express any opinion upon what might be the legal determination of that question if it arose. . . . The broad proposition I entertain no doubt about, and it seems to me to be the only question that properly arises here; as to the immunity of a witness for evidence given in a Court of justice, it is too late to argue that as if it were doubtful. By complete authority, including the authority of this House, it has been decided that the privilege of a witness, the immunity from responsibility in an action when evidence has been given by him in a Court of justice, is too well established now to be shaken. Practically I may say that in my view it is absolutely unarguable—it is settled law and cannot be doubted. The remedy against a witness who has given evidence which is false and injurious to another is to indict him for perjury; but for very obvious reasons, the conduct of legal procedure by Courts of justice, with the necessity of compelling witnesses to attend, involves as one of the necessities of the administration of justice the immunity of witnesses from actions being brought against them in respect of evidence they have given.

"But then comes the question which, so far as I know, has been raised for the first time in this case. The ingenious suggestion has been made that although it is true that a witness is protected from an action in respect of evidence actually given in a Court of justice, yet no such protection exists in respect of his attendance before the solicitor at what is called apparently in Scottish law his precognition, what we call the interview between the intended witness and the solicitor who takes from him what we call the proof—that is to say, reduces to writing the evidence which the witness is about to give. One very serious element of difficulty which those who insist upon such a liability have to meet is manifest—namely, that in the whole course of the diligent inquiry that the learned counsel on both sides have made into the matter they have not found that any such liability has ever been sought to be established before. So far as I know personally in my experience no such question has ever arisen. The learned judges who have allowed these issues have done so apparently for the first time in this case.

"It appears to me that the privilege which surrounds the evidence actually given in a Court of justice necessarily involves the same privilege in the case of making a statement to a solicitor and other persons who are engaged in the conduct of proceedings in Courts of justice when what is intended to be stated in a Court of justice is narrated to them—that is, to the solicitor or Writer to the Signet. If it were otherwise, I think what one of the learned counsel has with great cogency pointed out would apply—that from time to time in these various efforts which have been made to make actual witnesses responsible in the shape of an action against them for the evidence they have given, the difficulty in the way of those who were bringing the action would have been removed at once by saying, 'I do not bring the action against you for what you said in the witness-box, but I bring the action against you for what you told the solicitor you were about to say in the witness-box.' If that could be done, the object for which the privilege exists is gone, because then no witness could be called; no one would know whether what he was going to say was relevant to the question in debate between the parties. A witness would only have to say, 'I shall not tell you anything; I may have an action brought against me to-morrow if I do; therefore I shall not give you any information at all.' It

is very obvious that the public policy which renders the protection of witnesses necessary for the administration of justice must as a necessary consequence involve that which is a step towards and is part of the administration of justice —namely, the preliminary examination of witnesses to find out what they can prove. It may be that to some extent it seems to impose a hardship, but after all the hardship is not to be compared with that which would arise if it were impossible to administer justice, because people would be afraid to give their testimony. The hardship to which I refer is this: that although when a witness does give evidence which is wilfully false you can indict him for perjury, on the other hand, if he makes the same statement not upon oath to a person taking down the evidence he is prepared to give, it seems to be very difficult to devise anything that would bring him to justice for that false statement. The answer, of course, dealing with it as a matter of convenience and indeed of necessity for the administration of justice, I suppose, is this: unless he does give evidence in a Court of justice, in which case he can be indicted for perjury if his evidence is wilfully false, nobody knows anything about it—it slumbers, I suppose, in the office of the solicitor, and nobody hears or cares anything about it. Practically, I think that would be the answer. But whether that be a good answer or not, what seems to me to be an overwhelming consideration in the determination of this case is that a witness must be protected for his preliminary statement or he has no protection at all, and that there is that protection established is, as I have already said, beyond all possibility of doubt.

"Now, my Lords, the reason why I think that this is the only question that arises is this: It is true that the gentleman sued is an eminent medical man, and that there is a mixture of the points both in the condescendences and in the answers which has rather tended to confusion: but if one comes to look with care at the different forms of procedure one sees that everything that passed, everything that is alleged to have passed, passed between the defender and those who were engaged in the legal business. The communication complained of was no communication to strangers—to persons outside the litigation. The communication such as it is was made to the counsel and to the solicitor who was taking down the evidence. Under those circumstances it seems to me that it comes within the whole mischief of the supposed liability of a witness for what he had stated. I do not care whether he is what is called a volunteer or not; if he is a person engaged in the administration of justice, on whichever side he is called his duty is to tell the truth and the whole truth. If he tells the truth and the whole truth, it matters not on whose behalf he is called as a witness; in respect of what he swears as a witness he is protected—that cannot be denied—and when he is being examined for the purpose of being a witness he is bound to tell the whole truth according to his views, otherwise the precognition, the examination to ascertain what he will prove in the witness-box, would be worth nothing.

"Under those circumstances, my Lords, it appears to me that there is but one point in the case, namely, whether the preliminary examination of a witness by a solicitor is within the same privilege as that which he would have if he had said the same thing in his sworn testimony in Court. I think the privilege is the same, and for that reason I think these judgments ought to be reversed, and I move accordingly."

This judgment was concurred in by Lords James and Robertson. The case was then remitted back to the Court of Session to dismiss the action with costs, and to find Sir Patrick Heron Watson entitled to expenses in the Court of Session, and to costs in the actions in the House of Lords.

Rules regulating Presence of Medical Witnesses in Court.—From this discussion we turn to note the rules which regulate the presence of medical witnesses in court during the hearing of a trial. The rule with reference to witnesses who are to speak solely as to matters of fact—medical or lay—is, that they should not be present in court when other witnesses are deponing to matters of fact. Medical witnesses for the defence who are to speak to matters of fact and of opinion

should not be present while medical witnesses for the Crown are giving evidence. Expert witnesses who are to speak of matters of opinion may remain in court while witnesses are deponing to matters of fact, but they are not permitted to remain while expert witnesses are giving evidence on matters of opinion. On a special motion, however, a medical witness may be permitted to remain in court, although he is to speak only to facts, provided he is withdrawn when other witnesses who are to speak to the same facts are giving evidence (Pritchard, H.C., 1865; 5 Irv. 88). After they have given their evidence—and this applies to all witnesses except in very special circumstances—they are entitled to take a seat in court and hear the conclusion of the case. It is somewhat difficult to say, regarding the evidence usually given by medical witnesses, how far they are witnesses to fact and how far to opinion. In deponing to the correctness and truthfulness of a report, for example, they testify in both directions: they testify to the facts relative to the condition of the person or the body which they have examined—so far they are witnesses of fact; but they also testify regarding the causes of wounds or other lesions found on the body, which are matters of opinion. The purely scientific or expert witness, on the other hand, may speak only with respect to matters of opinion, and any questions put by counsel to such witnesses must relate purely to professional opinion; indeed, questions relating to inferences which may be deduced by the jury from the facts are not relevant, and are therefore disallowed.

Attitudes of Medical Witnesses regarding Precognitions.—What attitude ought a medical witness to assume toward counsel of the opposite side?

This is a question which often puzzles young medical men, and the following advice may save them much mental worry. If a medical witness could always remember that his duty is to aid the ends of justice, his path of duty would appear plainer. He is not a witness for one side; he certainly ought not to constitute himself a partisan. Should, therefore, counsel for the prosecution or the defence desire to precognosce a medical witness who has been called by the defence, or the prosecution, he should not have the slightest hesitation in putting at his disposal any report which he has furnished, or his views on the case at issue, just as he has done for the side for which he has been engaged. The only stipulation which the witness should make is that he shall be remunerated for his trouble. Our practice is to put the same facilities at the command of the prosecuting or defending side, as the case may be, as we have done to the other.

This question arose during the currency of the trial of the Ardlamont case (*vide post*) in the cross-examination of the principal medical witness for the defence, who, when asked by the Solicitor-General if, by the express direction of the prisoner's adviser, he had refused to give any information to the Crown, replied that he had. The Solicitor-General said that it had always been the practice for both prosecution and defence to lodge lists of witnesses with the Crown office on a given day before the trial for the express purpose of obtaining information, and believing that the action of the defence in this case might become a precedent in the absence of any opposition or

protest on his part, he desired the Lord Justice-Clerk—Lord Kingsburgh—to make some authoritative statement on the point. His Lordship said that nothing could be more prejudicial to either side of the case than that the legal adviser should direct one of the witnesses not to allow himself to be precognosced. He thought it a very grievous mistake. He believed that it had been done, no doubt, in this case from conscientious motives, but he had also no doubt about this, that, in criminal prosecutions, witnesses were not only bound to submit themselves to be precognosced, but were liable to imprisonment if they refused to give evidence. Counsel for the defence pointed out that the witness was not to blame, to which his Lordship replied that he did not blame the doctor, but he affirmed the principle that, in criminal cases, it was the duty of every good citizen to give every information in his power, and, therefore, it was a most unwise thing for any judicial adviser to give that advice.

By the Summary Jurisdiction (Scotland) Act, 1908 (8 Edw. VII. c. 65), s. 36, any witness who, after being duly cited according to s. 21 of the Act, fails, without reasonable excuse, after receiving at least twenty-four hours' notice, to attend for precognition by a Procurator-fiscal or burgh prosecutor at the time and place mentioned in the citation served on him, or refuses when so cited to give information within his knowledge in regard to any matter relative to the commission of the offence in regard to which such precognition is taken, shall be deemed guilty of contempt of court and be liable to be summarily punished forthwith for the same by fine or imprisonment.

Medical witnesses are entitled to entertain different views on problems put before them, equally with gentlemen at the bar, despite the criticism which has been launched at the former by judges. This difference usually arises on questions of opinion, and but rarely on matters of fact. Not infrequently this difference of opinion arises in criminal cases from the fact that the prosecution have bound themselves down to too narrow an issue, or to a particular theory, regarding the production of certain marks of violence. In such cases reasonable differences of opinion may legitimately emerge. We are bound to confess, however, that upon occasion differences are so radical as to be absolutely irreconcilable. Such, however, more frequently occur in civil actions; and so far as can be judged from reports of cases, it is not to be wondered that judges make scathing remarks regarding the evidence tendered. While it might be utopian to expect that medical witnesses for both sides should confer together regarding every kind of cause, there can be little doubt that benefit would result if the witnesses were reasonable men. In view of such divergence of evidence, the appointment of medical assessors has been seriously proposed, for it is impossible to expect a body of plain men as ordinarily constitutes a jury, or even for a judge, to follow intelligently the perplexing theories and doctrines occasionally propounded in the witness-box.

(*C*) **Experimental Evidence.**—This form of evidence is sometimes used in court, in cases such as the following—viz.

(*a*) Where the precise mode of inflicting certain injuries found upon a body is not readily apparent from the facts as known,

or where the theory for the prosecution is combated; for example, whether, in a case of death from a gun-shot wound, the shot was fired from a particular place or direction, or, whether, from a particular distance, the injury found could have been so caused.

This kind of evidence was used both by the prosecution and defence in the famous Ardlamont case.

(*b*) Where a poison, not easily detected by chemical means, is found in the organs of a person who, before death, suffered from symptoms of poisoning, and of which the effects have been tried upon animals or man.

This was resorted to, for example, in the Pritchard (Glasgow) case by Drs Penny and Maclagan upon rabbits, and in the Lamson case by Dr [the late Sir Thomas] Stevenson, both in experiments upon himself and upon mice, the poison being aconitin.

(*c*) Or, where a medical witness or chemist is asked to produce, in the witness-box, the evidence upon which, by chemical or other examination, he relied in coming to a certain conclusion to which he has deponed.

Such examples will suffice to indicate what is, or what ought to be, meant by the term experimental evidence.

General Relations of Medical Witness to Assaulted and Accused Persons.—In connection with evidence-giving there are certain other points on which something falls to be said.

What is the attitude which a medical man ought to assume in the examination of a person who, it is alleged, has been assaulted? His duty, obviously, has direct relation to the evidence of the assault, as exhibited on the body of the person under examination, and it is not his business to play the part of detective by asking questions of the person. His office consists in carefully noting the nature, character, extent, situation, and dimensions of the lesions found on the person, and the effect thereof upon the person; further, it would be his duty to form an opinion, from such examination, of the cause of the injuries with respect to the class of weapon which has produced them. He will be well advised, if, during the examination, he keep his thoughts to himself; thinking aloud is dangerous at such a time, since if he inadvertently give expression to any view which afterwards he may see reason to change, he may find it confront him when he appears in the witness-box. In examining a dead body upon which injuries are found, he will be further well advised if he do not allow his judgment to be coloured by statements which are made to him regarding their cause, as further investigation may reveal that a different view may arise on the subject. If he has embodied his views in a report, and has to resile from his original opinion after such further investigation, his evidence is practically negatived at the trial as that of a man of unreliable judgment. It is the business of the detective to find out how such injuries have been caused; it is, therefore, only the duty of the medical man to state what he has seen regarding the injuries and their relation to the death or their effects upon the person, without, then, committing himself to any particular theory or view, the reliability of which he has no means of testing, except

by the statements of persons who may, perhaps, be interested in concealing the true cause.

Again. *What is the position of a medical man, whose services may afterwards be demanded as a witness with respect to the examination of an accused person?* This relation may arise in case of rape, criminal abortion, or of infanticide with respect to recent delivery. Here a medical man must proceed with the utmost caution and frankness. In the first place, it is established law that no legal authority, however high, can compel an accused person to say anything respecting his relation to the crime with which he is charged. When a prisoner, by the criminal law of Scotland, is given an opportunity of emitting a declaration, after his apprehension, it is the duty of the Sheriff to warn him that he need not say anything unless he chooses, but that if of his own free will and accord he desires to make any statement, such will be written down, and will be read at his trial. This rule of law applies equally to police officials in their quest for information, and for the like reason. The object of the law, therefore, is to inform the prisoner that he need say nothing which may incriminate himself. We have already seen the application of the same principle with respect to a witness. It is equally good law also that there is no legal power which can compel any accused person to submit his or her body for examination, the possible consequences of which might be the discovery of facts which would probably be used against him as evidence at his trial. By keeping these facts in mind, a medical witness may avoid, on the one hand, a criminal action for assault, or, as it is termed in England, assault and battery, and, on the other hand, a civil action for damages. It is not enough, we believe, that the person to be examined offers no resistance or objection; for that may be determined solely by ignorance of his or her rights: it is necessary, just as in the foregoing case respecting speech, that the person should be cautioned as to the probable effects of the examination. The course which we pursue is the following:—To say to the accused in the presence of a third party, who acts as a witness, that we have been asked by the authorities to examine him or her, but that we can only do so after obtaining consent which he or she has a right to give or withhold, and that we will be bound to report the results of our examination whatever they may be. Should the consent be refused, then our simple duty is to report that we proceeded to make the necessary examination, but that consent was refused. Should, however, consent be given, we may then proceed to make the necessary examination, being protected by the corroboratory evidence of the witness.

In the Police Orders to the Metropolitan Police, under the heading of "Medical Examination of Prisoners," the following explicit instructions are laid down, which we summarise:—

I. It is expedient that a medical examination of prisoners charged with rape, or any offences under the Criminal Law Amendment Act, 1885, should be made, and inspectors of police must see that such is made where the *prisoner consents*.

II. If the prisoner consents, he is to be told that he is entitled to have present on his behalf a medical man, and if he

desires such attendance, then the examination shall only be made under these circumstances by arrangement.

III. An entry is to be made and signed by the inspector of police at the time of every such proposal for a medical examination, and of the fact of consent or refusal by the prisoner in his presence, also of the offer to the prisoner of medical attendance on his own behalf, and whether the prisoner accepts or rejects the offer—all of which entry shall be read over to the prisoner.

IV. If an examination be made, and the prisoner be committed for trial, the inspector of police must attend the trial, and have the entry with him to prove consent, if necessary.

V. The divisional surgeon, who is charged with the duty of making said examination for the police, must make a separate entry in his private memorandum-book of the results of said examination, and he must be informed when and where he shall be required to give evidence before the magistrate.

VI. Where a prisoner is in custody on any charge in which a personal medical examination may be material to him—except in the fore-mentioned crimes—and if he or his friends expressly desire that such should be made, it must be done by the divisional surgeon, or if by another qualified medical man, in the presence of the divisional surgeon; and the fact of the request being made, and of compliance therewith, shall be entered in the Occurrence Book by the officer in charge, who shall thereafter report the facts.

The legal consequences of want of knowledge of, or inattention to, the necessity of obtaining consent may be serious. Two illustrative cases will sufficiently indicate this. In a case tried before Mr Justice Denman, at Manchester, in 1878, where a woman—the complainant—was accused of abandoning her infant a few hours after its birth, the judge, on the above point, said in his summing of the case "that no medical man may suppose himself armed with authority to proceed contrary to the express will of the person he is instructed to examine."[1] In the other case, Weir and Wife *v.* Hodgson, which was tried at the Liverpool Winter Assizes, in 1861, the defendant, a surgeon, acting on the verbal request of the coroner and an inspector of police, proceeded to examine Mrs Weir, as to whether or not she had recently been delivered of a child—since the dead body of a child had been found near her house. Although the woman refused to be examined by the defendant, and offered to send for a medical man whom she knew to make the examination, the defendant did examine her in spite of her protestations. The jury returned a verdict for the plaintiff, and assessed damages at £200, which, it is said, ruined the defendant.[2]

Medical practitioners are not infrequently asked by ladies to examine

[1] *The Lancet*, vol. i., 1878, p. 137.

[2] *Liverpool Medico-Chirurgical Journal*, Jan. 1890; Lowndes on "Medico-Legal Responsibilities."

their female domestic servants whom they suspect of being pregnant. Sometimes out of a desire to oblige, medical men have unthinkingly made the required examination, have informed the lady of the result of the examination as confirmatory of her suspicion, and the servant, in consequence, has been dismissed. Such an action is quite contrary to law, inasmuch as, consent not having been expressly given, a technical assault has been committed, and in respect that the practitioner has revealed the servant's secret, he has violated the law of professional secrecy, for which he may be made defendant in an action at law. The safer and legal course to pursue, under these circumstances, is to advise the employer of the girl to frankly tell her servant of her suspicion, and to ask her to consult a medical man of her own choosing, or to offer the girl the services of the family doctor, who then could advise the girl to quit service. In no case should a medical man proceed surreptitiously to examine a girl for such a purpose, by making pretence to examine her heart or lungs, while his intention is only to discover the condition of the mammæ. Should the unfortunate girl, moreover, be under the age of thirteen, even consent would be no defence to an action for indecent assault, in terms of 43 & 44 Vict. c. 45. It will be obvious, besides, that in the relationship of master and servant, employer and employed, medical men must act cautiously, especially where their action may end in the dismissal of the servant or employee on the ground of unfitness through ill-health, since it is so easy to traverse the law of privilege.

CHAPTER III

PERSONAL IDENTITY IN ITS MEDICO-LEGAL BEARINGS

THE question of personal identity has frequently forced itself upon courts of law: not only in the detection of criminals, where it assumes a routine aspect, but also in the establishment of *bona fides* of the claims of individuals who assert certain legal rights.

Although in many of these cases the question is decided without the aid of the medical jurist, there are, at the same time, certain of them in which his assistance is sure to be invoked, and in which his services are likely to be valuable. In such cases the medical jurist is asked to advise as to the presence or absence of bodily defects, the presence or absence of bodily markings, such as scars, tattoo marks, or other marks due to heredity, accident, surgical treatment, or the effects of disease; or to determine, in cases of doubtful sex or hermaphroditism, to which sex the person actually belongs; or, in other cases, to pronounce an opinion relative to the physiological results of the natural growth of the body, or to the effects of time, the accidents of life, or of climate, occupation, or of mental shock in altering the personal appearance or impairing the mind or memory of a person; or in like contingencies. This subject may, therefore, be divided into two parts—viz.

(A) Identity for Criminal Purposes;
(B) Identity for Civil Purposes.

A. Identity for Criminal Purposes.—For the purpose of detecting criminals, the establishment of identity is of considerable importance. Up till a few years ago, in our law-courts, previous convictions for crime were proved in open court against a prisoner, and were deemed to be an aggravation of the offence for which the prisoner was undergoing trial. In order to prove these convictions, identity of the prisoner had to be established by personal recognition on the sworn testimony of criminal officers, who, not infrequently, had to detect the criminal from under a cloud of *aliases*, and whose means of identifying were very often solely confined to their memories, which, although remarkable, could not be considered infallible. By the Act 50 & 51 Vict. cap. 35, s. 67, such previous convictions are not now put before a jury, on the ground that they are apt to bias the minds of the jury respecting the guilt of the accused of the crime for which he is being tried. The words of the section are: "previous convictions against a person accused shall not be laid before the jury, nor shall reference be made thereto in presence of the jury before the verdict is returned," except in cases specially provided for by the existing law. They are, however, placed in the hands of the judge, who may, after conviction, reflect them in the kind and severity of the sentence which he pronounces. Formerly

and, to some extent, even now, the identity of criminals was accomplished in this country by means of written descriptions, with respect, among other things, to bodily defects and markings, along with photographs. A glance, however, over a few pages of a criminal " album " will suffice to show how valueless the latter were for the purpose, since the knowing criminal had only to throw his features into some grotesque shape to vitiate the intended result, which was, moreover, commonly done. It could not, therefore, be pretended that these means were scientific.

ANTHROPOMETRY

In foreign countries, on the other hand, and especially in France, the means of identification have gradually been developed, until now they may be said to have reached almost the dignity and accuracy of an exact science under the title of Anthropometry. Since the principles of anthropometry have now found a footing in this country, and are likely to become more extended for criminal purposes, it is necessary that medical men, who may occupy official positions in criminal prisons, should be acquainted with them. In the year 1894 the Secretary of State for the Home Department appointed a Committee to consider the best means for establishing identity in the detection of criminals, which Committee issued a report in the same year, in the form of a Blue-book, with the title, " Report of Committee appointed by the Secretary of State to Inquire into the best Means available for Identifying Habitual Criminals." After considering the means then in use, the Committee gave special attention to the methods of Bertillon and Galton, which, with the addition of other means, they recommended to be adopted in this country.

The Bertillon system of identification,[1] or, as it is called in France, " Bertillonage," from the surname of its inventor, M. Alphonse Bertillon, was decreed to be used in the French penal service of 1882, came practically into operation, in 1890, has since been extended to various countries of the continents of Europe and America, and is now in use, in a modified way, in Great Britain and Ireland, combined with the Finger-print system. Bertillon claims great accuracy for his method if it be faithfully followed. The system is that a record is taken of certain bodily measurements of each person, which measurements are noted upon cards which are kept in a specially arranged cabinet in the Bureau of Identification. The following are the measurements which are made :—

I. Height of person.
II. Span of outstretched arms.
III. Height of trunk (person sitting).
IV. Length of head.
V. Width of head.
VI. Length of right ear.
VII. Width of right ear.[2]
VIII. Length of left foot.
IX. Length of left middle finger.
X. Length of left little finger.
XI. Length of left forearm and hand, or cubit.
XII. Colour of the iris or irides.

[1] Consult Bertillon's writings: or " Signaletic Instructions," American edition, translated by McClaughry, 1896.

[2] Bertillon has now substituted for this measurement that of the *breadth of the face* between the outer surfaces of the zygomatic arches.

The five measurements which constitute the basis of *primary classification* are these—viz.

I. Length of head.
II. Width of head.
III. Length of left middle finger.
IV. Length of left foot.
V. Length of left forearm.

They are selected because (1), they are the most constant in each adult person ; (2), they are the most varied in different persons ; (3), they are the least correlated to one another ; and (4), they are the easiest for accurate measurement.

The mode of classification, which is, perhaps, the most admirable part of the system, is as follows :—

Bertillon starts from the assumption that he has to classify in one cabinet the recorded measurements put upon cards of 90,000—or any total figure divisible by three—male or female prisoners.

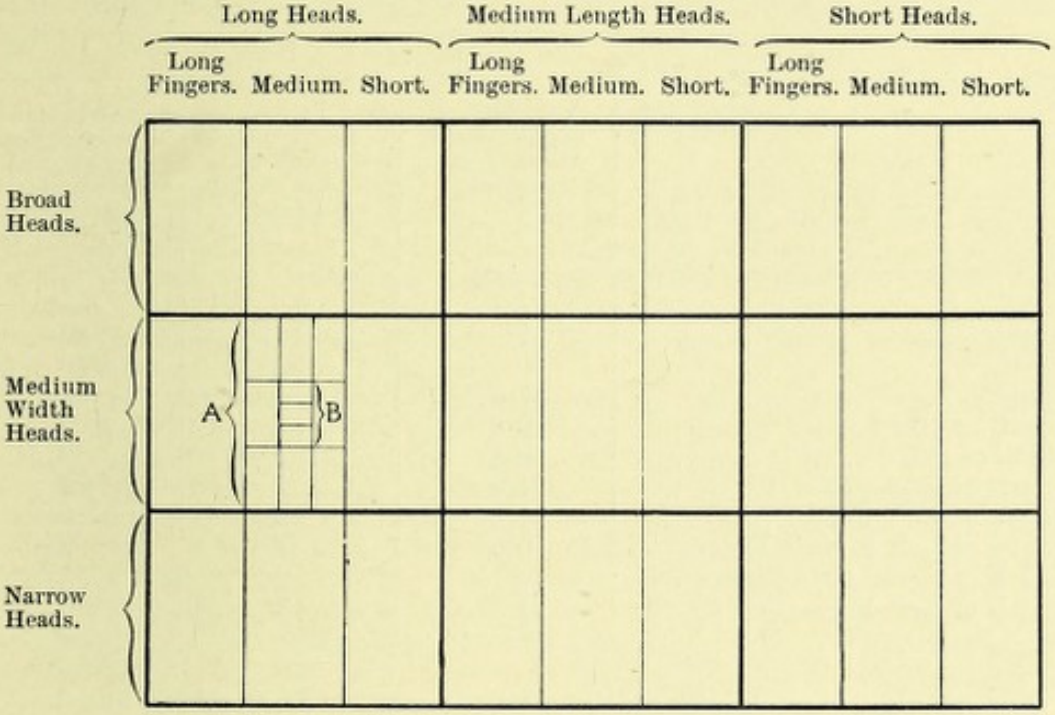


FIG. 1.—Plan of Bertillon's Cabinet for Classifying Identification Cards of Anthropometric System.

At A, each division is divided into three subdivisions by Length of Foot, Short, Medium, Long, from below upwards. Then each group is subdivided by Length of Forearm, at B, into Long, Medium, Short, from above downwards. In all, therefore, there are 243 compartments in the Cabinet.

First, this total of 90,000 is divided into three classes of 30,000 each, according as the head is *long*, *medium*, or *short*. He reckons as *short* heads those which measure 184 millimetres or under; as *medium* heads, those from 185-190 millimetres ; and as *long* heads, those from 191 millimetres and upwards.

Second, each class of 30,000 is again subdivided into three classes of about 10,000 each, according to the *width of the head*. Thus in the division for *long heads*, the limits of *medium width* are 155-159 millimetres ; in the division for *medium long heads*, 154-158 millimetres ; and in the division for *short heads*, 153-157 millimetres. The other measurements for these groups being similarly adjusted.

Third, each class of 10,000 is again subdivided into three classes of about 3300 each, according to the *length of the middle finger*.

Fourth, each class of 3300 is further divided into three classes of about 1100 each by the *length of the left foot* ; and

Fifth, each class of 1100 into three classes by the *length of the left forearm and hand or cubit*.

Thus starting with 90,000 persons, and using each of the five primary measurements for the purpose of tripartite division, 243 separate classes are formed, each of which contains approximately the record-cards of about 400 persons. But this number is too large for accurate and rapid identification, hence a plan of *secondary classification* had to be adopted—viz.

Sixth, each class of 400 is then still further subdivided into three groups of about 140 each by the *height of the person* ;

Seventh, each group of 140, into three smaller groups of unequal numbers by the *length of the left little finger* ; and

Eighth, each group of about forty-five is still further broken up by the *colour of the iris or irides*, and as Bertillon recognises seven colours, the number in each ultimate separate group varies from three or four up to fifteen or twenty ; and the resulting groups by the *length of the right ear*. In this way, therefore, a total of 90,000 is ultimately subdivided into small groups composed of these numbers. It is obvious that in order to secure accurate classification the highest accuracy in taking the measurements must be ensured. The following table will show at a glance the degree of accuracy demanded :—

	A	B	C
	Approximation theoretically requisite in + or −	Discrepancy beyond which *grave error* begins.	Serious mistakes, or discrepancies beyond which one is justified in declaring non-identity.
	mm.	mm.	mm.
Height	7	15	30
Reach	10	20	40
Trunk	7	15	30
Length of Head	0·5	1	2
Width of Head	0·5	1	2
Length of Right Ear	1·0	2	4
Length of Left Foot	1·5	3	6
Length of Left Middle Finger	0·5	1	2
Length of Left Little Finger ...	0·75	2	3
Length of Left Forearm ...	1·5	3	6

For sorting out or classifying the measurement cards, Bertillon has devised a special cabinet, Fig. 1. The cabinet is primarily divided into *three vertical divisions* by two partitions, for *long*, *medium long*, and *short* heads. By two horizontal partitions, these are divided each into *three* sections, for *broad*, *medium*, and *narrow* heads. Again, by two vertical partitions, each of these is divided into three smaller sections for *long*, *medium*, and *short left middle fingers* : thus making in all twenty-seven sections. Each of these sections is divided horizontally to form three shelves for the *length* of the *left foot* ; the *upper* shelf containing the *long*, the *middle* shelf, the *medium*, and the *lower*, the *short* feet. Then each shelf is divided into three compartments for the *length* of the *left cubit*, the *upper* compartment containing the *long*, the *middle*, the *medium*, and the *lower*, the *short* forearms. There are now in the cabinet 243 apartments or divisions, each of which contains one class of cards numbering approximately 400. Hence, when the five primary measurements, already named, of any prisoner have been correctly taken, the apartment, or division, or drawer in which his card will be found will be indicated by his remeasurement, should he give an *alias* instead of his proper name and surname.

In addition to these measurements, all scars or other marks upon the body are noted, with reference to (*a*) their nature ; (*b*) form ; (*c*) size ; (*d*) direction ; and (*e*) exact anatomical position.

Modus Operandi of the System in Paris.—All prisoners arrested daily in Paris and in the department of the Seine on any criminal charge, are brought every morning to the Depôt of the Prefecture of Police, whence they are passed on to M. Bertillon's Bureau for measurement. Each prisoner is asked if, on any

previous occasion, he has been measured. If he answers affirmatively and gives his name, then his identification card and criminal history are quickly forthcoming after a glance at the alphabetical register. If, however, he replies in the negative, and untruthfully, his measurements and description are then fully taken. Then by comparing his five primary measurements with those similar in the cabinet—since the particular group is quickly found—it is not difficult to pick out his card, confront him with his own photograph, perhaps, and recite his whole previous criminal record. If his reply be truthful, then his card is grouped in its proper place against future need.

Tests of Value of the System.—There are two ways by which the value of the method may be tested—viz. (1) by the number of mistakes of identification which are made ; (2) by the number of failures to identify. Bertillon claims that of all the identifications made by his office during the past eleven years not a single one has proved wrong ; and respecting the failures to identify, that while they were four in 1890, and six in 1891, there were none in 1892. The reader may pursue the subject further in the following works :—*Instructions Signaletiques*, 1893, of which there was an American edition published in 1896, *L'Anthropometrie Judiciare à Paris en* 1889, and *La Photographie Judiciare*, 1890.

FINGER-PRINT METHOD

The other method by which identification of criminals may be scientifically secured, is the Galton, or Finger-Print Method. Although this method was probably first used practically by Sir William Herschell, of the Indian Civil Service, for the purpose of identifying natives on account of the prevalence of personation in the law-courts, the credit of first making an attempt to work the impressions into a classified system must be accorded to Francis Galton, who, in 1892, published his work on the subject.[1]

The credit of having been the first to suggest the finger-bulb markings as a means of identification of criminals has been claimed by Mr Henry Faulds, L.F.P.S. Glas.[2] In an article in *Nature*, October 28, 1880, p. 605: "On the skin-furrows of the Hand," he remarks, "when bloody finger-marks or impressions on clay, glass, etc., exist, they may lead to the scientific identification of criminals. Already I have had experience in two such cases, and found useful evidence from these marks. In one case greasy finger-marks revealed who had been drinking some rectified spirits. The pattern was unique, and fortunately I had previously obtained a copy of it. They agreed with microscopic fidelity. In another case, sooty finger-marks of a person climbing a white wall were of great use as negative evidence."

The essential features of this system are the impressions which are taken from the bulbs of the fingers and thumbs. It is well known that the skin in these situations is thrown into ridges and hollows of various patterns, from which impressions may be taken on paper or cardboard, by means of printers' ink, which prints can be delineated by the aid of a hand-lens, or may be enlarged by photographic processes. These markings maintain their individual peculiarities in each person from infancy to old age, and, with probable exceptions, in which habitual friction or pressure, or wounds with resultant scars may affect their integrity, they also retain their definition and singularity. Galton has reckoned, owing to the individuality of the markings, that the chance of two prints being identical in individuals is less than one in sixty-four thousand millions, a figure which, roughly, is four times the population of the known world.

The patterns found on the bulbs of the digits divide themselves into three main types—the basis of Galton's scheme of classification—viz. (*a*), the arch ; (*b*), the loop ; and (*c*), the whorl.

In constructing the finger-print formula, Galton takes the impressions of the ten fingers in the following order—viz. (1), the first, second, and third fingers of the right hand ; (2), the like fingers of the left hand ; (3), the thumb and little

[1] "Finger-Prints," 1892.
[2] "Guide to Finger-Print Identification," 1905.

E History of the Finger-Print System - Lawson. Smithsonian Report. 1912, pp. 631-652

finger of the right hand; and (4), the same fingers of the left hand. The impressions are then translated into a formula of letters, based as follows :—

a stands for *arch* type;
l do. *loop* type;
w do. *whorl* type;
r do. loops coming from *radial* side;
u do. loops coming from *ulnar* side.

A typical formula—indeed, that of Galton himself—may read like the following :—*wll, wll; wl, wl.* The number of formulæ possible from this method of classification has been calculated to amount to 104,976; hence there would be as little difficulty in applying the principle to 100,000 prints as to 100,000 or 90,000 measurement records.

Objections which have been offered to the Finger-Print System.—These may be summarised as follows :—*First*, that the markings might be accidentally or intentionally altered or removed. Observation of large series of very different cases has demonstrated, however, that they could not be so altered as to cause misidentification, although they might be removed of set purpose, or by accident; but the resulting scar or deformity which would result would thereupon of itself become a distinguishing mark of identity. *Second*, they might be obscured or partially obliterated in the digits of manual labourers by friction or pressure, or both, especially in such employments as those in which rough materials are being more or less constantly grasped by the fingers, as in brick-laying, building, etc. While this is true in some measure, the extent of obliteration is not such as would altogether destroy the effectiveness of the resulting prints. From this point of view, the objection loses force when it is remembered that the habitual criminal is about the last person to engage in such manual labour as would seriously affect his finger-tips. *Third*, that such formulæ are too complicated, and the method of taking the imprints too difficult, for the ordinary prison official. That no value lies in this objection has been ascertained by putting the system into experimental use, when the opposite has been shown. *Fourth*, that such finger-prints could not be used in courts of law. This objection is of no value, since, like ordinary photographs, skiagraphs, drawings, etc., after their accuracy and truthfulness have been sworn to, they may become productions in a case, and therefore admissible as evidence.

The British Committee in their Report discussed the merits of both systems. Of Bertillon's method they declared their opinion that its method of classification was the strongest point in its favour. Provided that it could be ensured that the measurements in every case were properly taken and correctly recorded, they believed that the identity of a criminal who had previously been measured would be as rapidly effected, and as easily, as finding an accurately spelled word in a dictionary. Of the Finger-Print system they were "clearly of opinion that for the purpose of proving identity, the finger-prints examined and compared by an expert furnish a method far more certain than any other. . . . Considered merely as a test of identity and not as a detective agency . . . their use becomes at once extremely simple, and in the hand of an expert free from any danger of error."

It is obvious that the efficacy of the Finger-Print system must mainly depend upon the mode of classification adopted. What seems to have been lacking in Galton's mode of classification has been supplied by the system adopted in India.

Sir Edward R. Henry,[1] now Chief Commissioner of the Metropolitan Police, London, in his most interesting work on this subject, which was prepared by order of the Government of India, divides the question of identification by this method into two parts—viz. (1) the definitions by which the finger impressions may be described with accuracy, and by which dissimilarity of impressions may be shown; and (2) the system of classification by which the finger impressions taken may be grouped. In India, where so many natives are unable to read or write, and where identity from general likeness is more difficult on account of their colour, the system of finger-prints has come largely into vogue to prevent fraudulency. Moreover, by Act V. of 1899 (India

[1] "Classifications and Uses of Finger-Prints," 1900.



FIG. 2 illustrates the *Arch* type of impression, in which the ridges run from side to side without turning backward. (Henry.)

By permission of Sir E. Henry.



FIG. 3 represents a *Loop*. In this type, the ridges may take a backward turn, but do not twist. In the figure, the ridge AX bifurcates into the ridges XC and XD. The loops run towards the left. (Henry.)

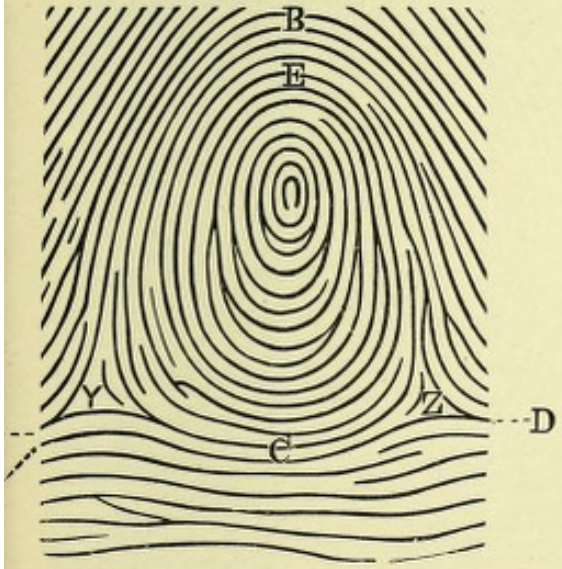


FIG. 4 is a diagrammatic drawing of a Whorl impression; a whorl being an impression in which some of the ridges turn through a complete circle. The ridge AY divides into the ridges YB and YC, and the ridge DZ into the ridges ZE and ZF, leaving in the centre of the impression a series of more or less circular ridges. (Henry.)

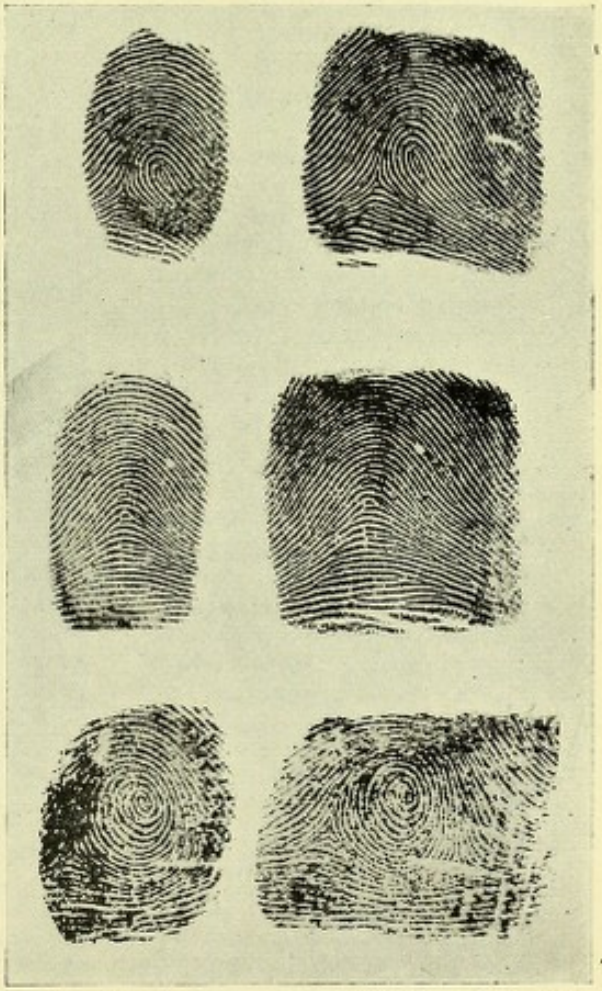


FIG. 5.—Actual Impressions of Digits, to illustrate Types of Patterns. The uppermost pair show a plain and rolled impression of a Loop; the middle pair, of an Arch; and the lowermost pair, of a Whorl. (Taken by Author.)

Council), the law of evidence was amended so as to admit, as relevant testimony in Indian law-courts, the evidence of finger-print experts.

Henry divides all finger-tip impressions into four types—viz. (*a*) *arches*; (*b*) *loops*; (*c*) *whorls*; (*d*) *composites*. In the *arch* type the epidermal ridges pass from one side to the other without making any backward turn; in the *loop* type, some of the ridges make a backward turn, but without any twist; and since in the impressions the downward slope may be toward the ulnar or radial side, loops are designated *ulnar* or *radial*; in the *whorl* type, some of the ridges make a turn through at least one complete circle; and in the *composite* class are included all impressions in which two or more of the above types are found in the impression. This class is subdivided into (*a*) central pocket loops; (*b*) lateral pocket loops; (*c*) twinned loops; and (*d*) accidentals. Of the above types, that of the *loop* is found to largely predominate; indeed, as Henry points out, two out of every three impressions belong to this type. It is necessary, therefore, to subdivide the loop group not only into ulnar and radial divisions, but also by counting the number of epidermal ridges, omitting the terminal points, between the core of the loop and the nearest "delta," that is, the point where a ridge bifurcates, or where two ridges which have been parallel for some distance suddenly diverge, by noting the ridge characteristics, and by observing the orientation of patterns. The following figure will serve to illustrate the above points:—

The symbols used in this classification, are, A = arch, T = tented arch; L = loop; W = whorl; C = composite; L P = lateral



FIG. 6.—A Lateral Pocket Loop impression. This is formed when the ridges of a loop bend suddenly downwards on one side before making the backward turn, and leave an interspace or pocket which is filled by ridges of another loop. (Henry.)



FIG. 7 represents a deviation from the normal loop in which the ridges near the core differ in their course from those surrounding them. It is, therefore, called a Central Pocket Loop. (Henry.)



FIG. 8.—Rolled Impression of Imprint of Loop (about double normal size), taken by the author. If of the Right Hand, it would be a radial loop; if of the Left Hand, an ulnar loop.



FIG. 10.—To illustrate *fixed* points in impressions. The small circle represents the "point of the core," or the "inner terminus"; X, the "delta" or "outer terminus." In this figure, the bifurcation is formed from the division of a single ridge. Where two or more bifurcations are present, the one nearest the point of the core is taken as the terminus. (Henry.)

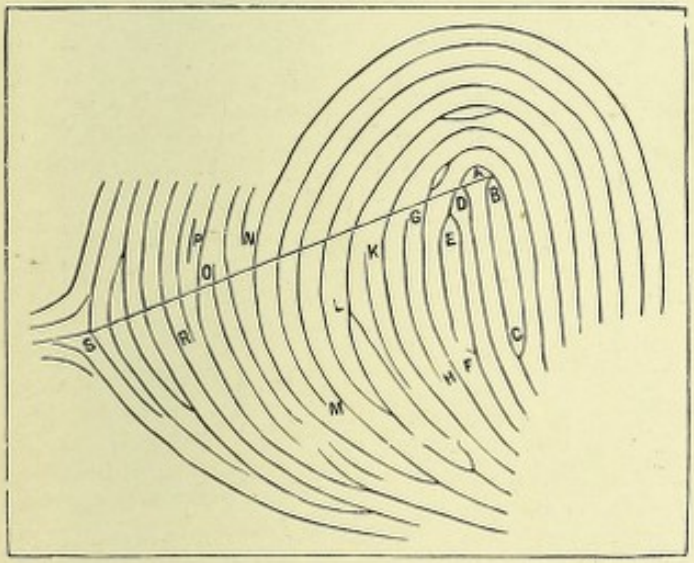


FIG. 9 shows diagrammatically Ridge-Counting, and Ridge-Characteristics. From the core to the outer terminus in the line SB, the number of ridges, excluding the two terminal points, is 17, which figure would be of value in classification. The chief characteristics of this impression are (1) the core, which forms a staple; (2) the islands above A, and to the left of A; and (3) the abrupt ending of ridges, as at G, H, K, and O, and the bifurcations at L and E. (Henry.)

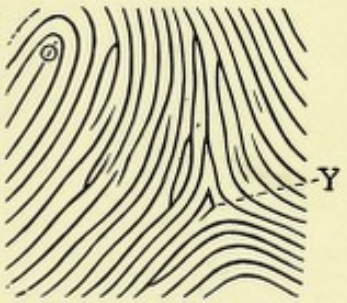


FIG. 11.—Here the circle represents the core, and Y the outer terminus; the rule being that where the upper and lower sides of the delta are formed by the sudden divergence of two ridges which up to the point of divergence have run parallel, the nearest ridge in front of the point of divergence is to be reckoned as the outer terminus, whether it is united or separate. (Henry.)



FIG. 12.—"Plain" Impression of Bulb of Finger. (Henry.)



FIG. 13.—"Rolled" Impression of Bulb of Finger. (Henry.)



FIG. 14.—Plain Imprints of Thumb and Fingers of Right Hand of Author; the thumb is lowermost, and the index finger, the first on the left of the Figure. It will be observed that the type of impression in the index finger is a whorl, and that those of the other digits are ulnar loops.

pocket; T L = twinned loop; C P = central pocket; Ac = accidental; I T = inner terminus; O T = outer terminus; U = \ = ulnar in right hand; R = / = radial in right hand; U = / = ulnar in left hand; R = \ = radial in left hand.

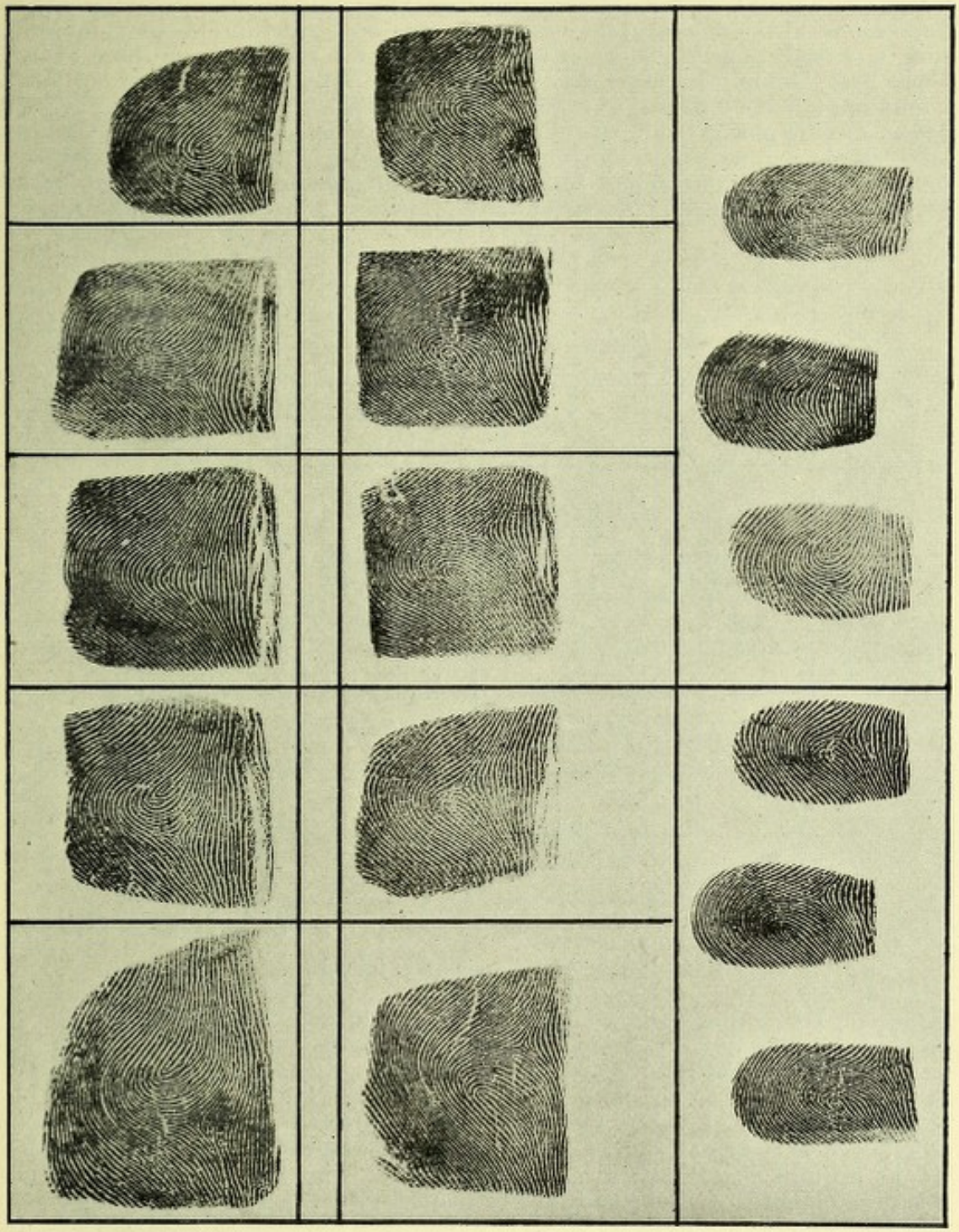


FIG. 15.

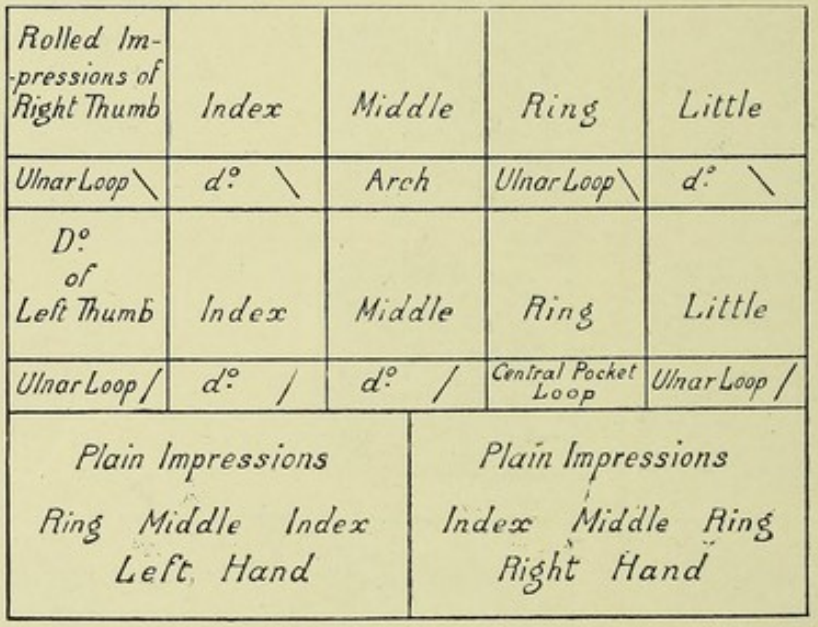
Rolled Impressions of Digits of Right Hand—Thumb to Little Finger.

Rolled Impressions of Digits of Left Hand in same order.

Plain Impressions (1) of Left Hand Ring, Middle, and Index Fingers; (2) The same of Right Hand, Index, Middle, and Ring Fingers.

Mode of Primary Classification in Henry's System.—The imprints of the finger bulbs are taken in two different ways, and from the method used are

called "*plain*" and "*rolled*" prints. In the former, the impression consists of the imprint of the bulb simply laid down on the impressing surface, and shows mainly the "core" of the pattern; in the latter, the impression consists of the imprint of the bulb which is rolled from one side to the other, and thus shows the whole imprint of the pattern. In the above classification, the "rolled" impressions of the fingers in their natural order are—viz. thumb, index, middle, ring, and little finger. Those of the right hand are placed above those of the left. The "plain" impressions of the index, middle, and ring fingers of both hands are taken by means of a guard, which ensures their being taken in this order, and are placed below the others. Both sets being, therefore, on one slip, are read for comparison. The impressions of the fingers are read off in pairs as follows—viz. *right thumb and right index*; *right middle and right ring*; *right little finger and left thumb*; *left index and left middle*; *left ring and left little finger*.



Key to Fig. 15.

Order of taking Finger-Print Impressions according to Henry's System of Classification. The formula for the above is: $\frac{L}{L} : \frac{L}{L} : \frac{L}{L} : \frac{L}{L} : \frac{L}{L}$, for Primary Classification. But for Secondary Classification, both Index Fingers being Ulnar Loops, the Formula would be $\frac{U}{U}$; and since the Right Middle Finger contains an Arch, the Formula then becomes $\frac{Ua}{U}$.

It will thus be seen that the construction of the finger-print formula in this system differs very essentially from that in the Galton system. Experience shows that of every hundred average impressions, sixty belong to the loop type, thirty-five to the whorls and composites, and five to the arch type. Therefore in the primary classification, arches are included among the loops, and composites among the whorls; so that two main divisions are instituted, *loops* and *whorls*. The next step to be taken is to consider the number of arrangements of these two types possible between the right thumb and right index finger. Obviously they are four—viz. (1) where thumb is a loop and index is a loop; (2) where thumb is a loop and index a whorl; (3) where thumb is a whorl and index a loop; (4) where thumb is a whorl and index a whorl; or, to put in a formula, where thumb is numerator and index finger the denominator:—

$$\frac{L}{L}; \frac{L}{W}; \frac{W}{L}; \frac{W}{W};$$

If the next pair—viz. right middle and right ring fingers—be taken, there are four possible combinations, which, if combined with the possible combina-

tions of the first pair, and of the pairs taken together, amount in all to sixteen possible combinations. Similarly, with the third pair, sixty-four ; with the fourth pair, 256, and with the fifth pair, 1024 total possible combinations. Therefore a cabinet with thirty-two sets of thirty-two pigeon-holes arranged horizontally would accommodate the 1024 possible different combinations.

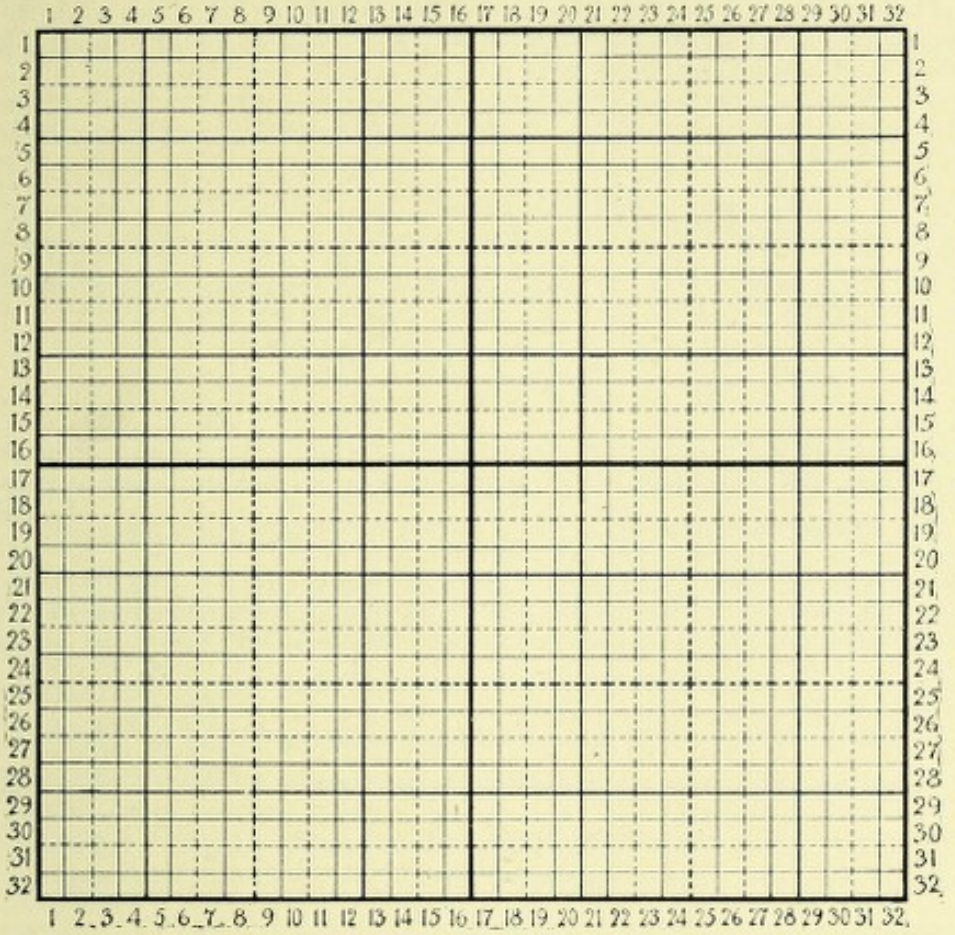


Fig. 16.—Plan of Henry's Cabinet for Classifying Finger-Prints.

Explanation of Fig. 16.

The finger-prints of ten digits are taken in pairs in the following order :— (1) right thumb and right index ; (2) right middle and right ring ; (3) right little finger and left thumb ; (4) left index and left middle ; (5) left ring and left little. All imprints are divided into two types : I. loops (including arches) ; II. whorls (including composites). In the above order of pairs, ten digits may have, as pointed out below, the following formula :— $LW - WL - LL - WW - LW$, where $L = loop$; $W = whorl$.

This key indicates the particular pigeon-hole of the total 1024 of the Cabinet in which a card with the above formula will be found.

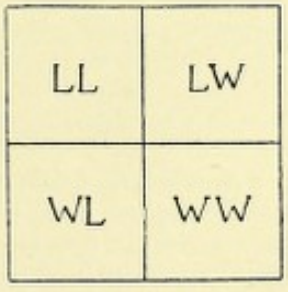


Fig. 17.—Key to Henry's Cabinet.

Following the Key, LW is in the top right-hand square, defined by the horizontal figures 17-32, and by the vertical figures 1-16. WL is in the bottom left of $\frac{17\text{-}32}{1\text{-}16}$ square, defined by the horizontal figures 17-24, and the vertical figures 9-16. LL is in the top left corner of this $\frac{17\text{-}24}{9\text{-}16}$ square, defined by the horizontal figures 17-20, and the vertical figures 9-12. WW is in the right-hand

bottom corner of this $\frac{17\text{-}20}{9\text{-}12}$ square, defined by the horizontal figures 19-20, and the vertical figures 11-12. The last pair *L W* is in the top right-hand corner of this $\frac{19\text{-}20}{11\text{-}12}$ square; that is, in the pigeon-hole $\frac{20}{11}$. Any other combination of impressions can be similarly found.

Besides the above Key, Henry has devised an arithmetical rule for determining this primary classification. The digits being taken in pairs, the first of the pair being taken as numerator and the second as denominator, and the formula found being the following:—

$$\frac{L}{W};\quad \frac{W}{L};\quad \frac{L}{L};\quad \frac{W}{W};\quad \frac{L}{W};$$

the rule is applied thus: When a *whorl* occurs in the first pair, it is given the figure value of 16; when in the second pair, 8; when in the third, 4; when in the fourth, 2; and when in the fifth, 1; but no figure value is given to a *loop*. Translated into figures, therefore, the above formula becomes—

$$\frac{0}{16};\quad \frac{8}{0};\quad \frac{0}{0};\quad \frac{2}{2};\quad \frac{0}{1}.$$

By next adding the numerators together, and then the denominators, a fraction is formed, *one* being added to the numerator and denominator respectively. Thus the above becomes $\frac{10}{19}+\frac{1}{1}=\frac{11}{20}$. By inverting this fraction, $\frac{20}{11}$, the pigeon-hole in which the slip with that formula is placed may be found; so that in this case the slip will be found in the twentieth pigeon-hole of the eleventh horizontal row. If the primary classification figure be given, the formula may be constructed. If the number be as before $\frac{20}{11}$—which is the inverted fraction of $\frac{11}{20}$—and remembering the figure values for whorls as they occur in sequence of pairs, and also that the figures in the Cabinet run from 1 to 32 in each horizontal row, the reasoning is as follows:—the figure 11 of the numerator is less than 32 by 21, which is equal to 16+4+1, hence whorls must be absent from the numerators of the first, third, and fifth pairs.

Thus: $\frac{0}{—};\quad ;\quad \frac{0}{—};\quad ;\quad \frac{0}{—}.$

The figure 20 of the denominator is less than 32 by 12, which is equal to 8+4; therefore whorls are absent in the denominators of the second and third pairs;

thus: $\frac{0}{—};\quad \frac{—}{0};\quad \frac{0}{0};\quad ;\quad \frac{0}{—}.$

Where whorls are absent loops must take their place. Therefore, by subtracting from each of the numerator and denominator figures, and applying the above facts, the figure formula is constructed

thus: $\frac{0}{16};\ \frac{8}{0};\ \frac{0}{0};\ \frac{2}{2};\ \frac{0}{1}$ = figure formula

$= \frac{L}{W};\ \frac{W}{L};\ \frac{L}{L};\ \frac{W}{W};\ \frac{L}{W}$ = letter formula.

Secondary Classification.—This becomes necessary when large numbers of filed imprints accumulate under certain file headings. It becomes necessary for rapid search, therefore, to subdivide these large groups into smaller. Keeping in mind that the imprints of the digits are taken in their natural sequence, and that those of the right hand are placed immediately above the corresponding digits of the left hand, the method of secondary or sub-classification is as follows:—The *index finger* of each hand is taken as a fulcrum, and the formula-letter given to it is the capital letter of its symbol, that of the thumb is the small letter of its

symbol which is placed to the *left* of the *fulcrum*, while those of the other digits are the small letters of their respective symbols and are placed to the *right* of the *fulcrum*. Those types which are of comparatively infrequent occurrence are taken for the purpose of subdivision, as *Arches, Tented Aches, radial Loops.* Thus, in the above way, are grouped the classification formulæ of both hands, that of the right hand forming the numerator, and that of the left hand the denominator; thus the formula $\frac{1\ a\ A\ r}{1\ r\ R\ a}$ indicates that the slip will be found under classification number $\frac{1}{1}$ in the collection of slips where there is an *Arch* in the *right thumb*, an *Arch* in the *right index finger*, and a *radial Loop* in *one* of the *other digits* of the *right hand*, and where there is a *radial Loop* in the *thumb*, a *radial Loop* in the *index finger*, and an *Arch* in *one* of the *other digits of the left hand.*

The classification number $\frac{1}{1}$ contains the slips the imprints upon which are loops, which include arches, tented arches, and *radial* and *ulnar* loops. Arches with radial and ulnar loops may be found in one or both index fingers in nine combinations. The horizontal letters signify the right index finger, the vertical, the left index finger, and A = arch; R = radial; U = ulnar.

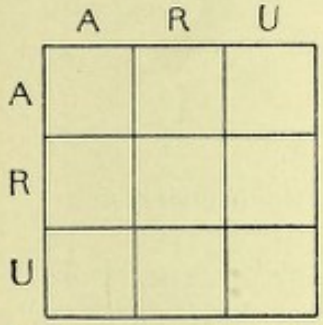


FIG. 18. — A = Arch, R = Radial, U = Ulnar. Showing possible number of combinations.

By extending this principle to the fingers of both hands 256 sub-groups may be formed; but experience has shown that such elaborate subdivision is not called for; it is sufficient to decide whether arches exist in one, two, or three digits to the right of the *fulcrum* or index finger. Therefore the groups formed are: *A*; *aA*; *Aa*; *aAa*; *A2a*; *aA2a*; *A3a*; *aA3a*; and constitute 64 groups. If the arch be a tented arch, the letter *t* would signify its presence; thus *aAt* would indicate that the arch of the middle finger was a tented arch. In this way the other groups $\frac{A}{R}$; $\frac{R}{A}$; $\frac{R}{R}$, etc., may be also subdivided. When the sub-class $\frac{U}{U}$ is dealt with—that is, where *ulnar* loops are present in both index fingers—it is subdivided into two by the presence or absence of *radial* loops or arches in the other digits. In the former group $\frac{aU}{U}$; $\frac{U}{aU}$; $\frac{Ua}{U}$, etc., which is called the "lettered" group, arches are found; in the latter it is called unlettered, because all the loops are ulnar loops. This unlettered sub-class $\frac{U}{U}$ may be further subdivided by ridge-counting, that is, by enumerating the ridges between the inner and outer terminus of the pattern, but not including these points in the count. Experience has shown that in the index finger the number of prints in which the number of ridges is between one and nine equals the number of prints in which the number of ridges is ten or more, and in the case of the middle finger, the number with one to ten ridges is equal to that with eleven or more ridges. Sixteen possible groups can be made out of these. In each of these sixteen groups the subdivision is made by the fact whether the number of ridges is high or low. If a count in a print falls near the boundary limit it is readily found, since in each of these groups the slips are arranged according to the number of ridges in the right little finger.

Whorls (including composites) also demand sub-classification, when under a classification number too large a number of slips for rapid search accumulates. This is effected by ridge tracing. In all whorl type patterns there are two deltas, and depending upon whether the ridge from the one delta *meets* the corresponding ridge from the other or is not separated from it by more than two intervening ridges, or that one delta ridge passes *inside* the other delta ridge with not less than three ridges intervening, or that one delta ridge passes *outside* the other delta ridge with not less than three ridges intervening, the

whorl is denominated *M*, or *meeting*, *I*, or *inside*, *O*, or *outside*. The accompanying figures illustrate better than words what is meant.

If this be taken as the method of subdivision, and the index and middle fingers of the right hand be utilised, each of these may be *I*, *M*, or *O*; consequently the total possible combinations from these factors is nine, and with the corresponding factors for the left hand eighty-one. The following diagram will exhibit the system of subdivision. The horizontal letters represent the right hand, the vertical the left, and the first letter of each pair the index, the last the middle finger.

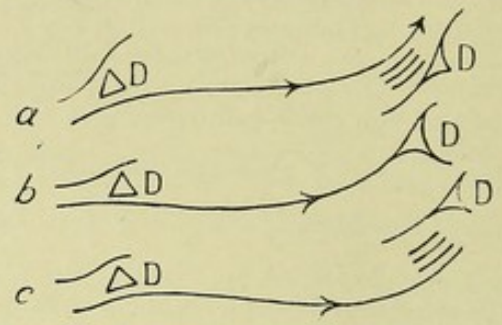


FIG. 19. — *a* = an Inside Whorl; *b* = a Meeting Whorl; *c* = an Outside Whorl; D = Delta of Whorl.

The full formula for an imprint, in which all the impressions are whorls, would be of any of the above combinations; for example, $\frac{32}{32}\frac{OI}{MO}$, or $\frac{32}{32}\frac{II}{OM}$, or any other combination, where $\frac{32}{32}$ is the primary, and $\frac{OI}{MO}$ or $\frac{7}{6}$, and $\frac{II}{OM}$ or $\frac{1}{8}$, the secondary classification, numbers. Hence, in figures solely, the foregoing formula would read $\frac{32}{32}\left(\frac{7}{6}\right)$ and $\frac{32}{32}\left(\frac{1}{8}\right)$ respectively.

	II (1)	IM (2)	IO (3)	MI (4)	MM (5)	MO (6)	OI (7)	OM (8)	OO (9)
II (1)									
IM (2)									
IO (3)									
MI (4)									
MM (5)									
MO (6)									
OI (7)									
OM (8)									
OO (9)									

FIG. 20.—Plan for Subdividing Whorl Imprints.

Arrangements must also be made in this system for damaged or missing fingers. The rule for a damaged or absent digit is to take the type of the corresponding digit of the other hand, where that is present; if both be amissing, the impressions are reckoned as whorls, and the formula arranged, calculated, and classified accordingly (*vide* Fig. 26).

The Finger-Print Method, based upon the above system of classification, was determined upon as the scheme of identification of criminals to be used in India, by a resolution of the Governor-General in Council in June 1897, to supplant the anthropometric system, which had been introduced in March 1892 into the province of Bengal, but which was found to be unreliable, owing, apparently, to faults of measurement believed to be due to the use of automatic measuring appliances. A Committee was appointed in India in March 1897, to inquire into and report upon the Finger-Print system, and because of their favourable report, it was, as stated above, decided to adopt it.

The report of the British Committee bore recommendations in favour of the adoption in Great Britain of the best parts of both Anthropometric and Finger-Print systems, and they advised the following scheme :—

First, To photograph criminals as at present—by means of a mirror—and that a side photograph should be taken which should show distinctly the profile of the face and the form of the ear ;

Second, To take the *five* primary measurements of Bertillon's method, in the same way, by the same instruments, and in the metric scale ;

Third, To take finger-prints as in Galton's method ;
Fourth, To make a written description of each person, noting accurately any and all kinds of distinctive marks in a certain definite order ; and
Fifth, That the result of the foregoing investigations be tabulated on a card, including Finger-Print formula and photograph, after the manner of the following :—

FIG. 21.—TABULATION CARD.

Head, Length. ,, Width. Left Mid. Finger. Left Forearm. Left Foot.	Name. Number. Date of Birth. Place of ,, Particulars of Conviction.	Finger-Print Formula.
Height . . . . Eyes . . . . Hair . . . . Complexion . . . Distinctive Marks— I. II. III. IV. V. VI.	....	Photograph.

System in Practical Operation in Great Britain and Ireland

The necessary information has been provided by Dr Garson, Government Adviser and Instructor on the Metric System of Identification.[1] The system is carried out in the prisons of England and Wales, of which there are sixty in number, by male and female warders, who have undergone a special training under Dr Garson to befit them for the work. The test of efficiency which must be exhibited by each official before being considered fit for this duty is to examine, measure, and arrange the data of eighteen prisoners, so that in the whole number of examinations there may not be more than eighteen errors. Any measurement in the head length and breadth, the face breadth, and finger length, more than one millimetre out, in the length of cubit and foot more than three millimetres out, and in the height of the person more than half-an-inch out, is reckoned as an error. Before, however, he is allowed to make measurements in his prison for permanent record, even after passing the foregoing test, he must perfect himself by practice, and then be set to work along

[1] "The Metric System of Identification of Criminals, as used in Great Britain and Ireland," Jour. Anthropol. Inst., vol. xxx., 1900, pp. 161-198, with Miscellanea, No. 101.

with a more experienced official. Such absolute accuracy is a *sine quâ non* of the system, which depends upon accuracy of measurement for accurate classification.

Measurements taken in Great Britain.—These consist of the following—viz. (1), *Length of head*, from notch at root of nose to the most prominent part of back of head, whether in the median line or not ; (2), *Breadth of head*, wherever it is greatest, but not including outer surface of mastoid processes ; (3), *Breadth of face*, between outer surfaces of zygomatic arches where greatest (Bertillon has substituted this measurement for the width of the ear, which he originally took) ; (4), *Length of left middle finger*, measured with finger bent at right angles to *metacarpus* ; (5), *Length of left forearm* or *cubit*, measured from extremity of olecranon, the forearm being bent at elbow, to the distal extremity of middle finger ; (6), *Length of left foot*, taken while person stands with whole weight of body resting on that foot only, the knee-joint being bent forward ; (7), *Height of person* when standing erect.

	SMALL.			MEDIUM.			LARGE.		
	Small.	Medium.	Large.	Small.	Medium.	Large.	Small.	Medium.	Large.
LARGE.	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	21	22	23	24	25	26	27
MEDIUM.	28	29	30	31	32	33	34	35	36
	37	38	39	40	41	42	43	44	45
	46	47	48	49	50	51	52	53	54
SMALL.	55	56	57	58	59	60	61	62	63
	64	65	66	67	68	69	70	71	72
	73	74	75	76	77	78	79	80	81

Large. Medium. Small. Large. Medium. Small. Large. Medium. Small.

FIG. 22.—Plan of Cabinet for Classifying Identification Cards in British System.

Other and Additional Data.—(1) Photographs of person, one-seventh of natural size, including (*a*), full-face view, and (*b*), profile face view ; (2) Scars or marks upon body ; particulars noted of these being (*a*), nature of scar or mark ; (*b*), form ; (*c*), size ; (*d*), direction ; (*e*), exact anatomical position ; abbreviation of terms being used in description thereof. Thus, after examination of a mark on face and neck—the other parts of the body plotted out being, left arm and hand, right arm and hand, chest, and rest of body which includes only the most marked appearances on abdomen and lower limbs—this apparently cryptographic sentence, *Nv hairy cir of* 1·0 *at* 3· *ab i pt l eb* may be formed which reads, *Naevus or hairy mole circular of* 1 *centimetre in diameter at* 3 *centimetres above internal point of left eyebrow.* A table of abbreviations is given. (3) Finger-Prints of the impressions of the digits of both hands. A double set of prints is taken of the digits of each hand—first " *plain* " impres-

sions, in which the core of the pattern is obtained; and second, "*rolled*" impressions, in which the whole pattern is displayed. But while these are taken, only the "*rolled*" prints of the thumb and two next digits of each hand are placed upon the identification card, as this has been found sufficient for identification purposes when taken along with the other data.

Metric and other descriptions are taken of the following classes of prisoners —viz. (*a*), those undergoing a term of penal servitude; (*b*), those undergoing a term of imprisonment, to be followed by police supervision; (*c*), those undergoing imprisonment after conviction on indictment of crime, against whom previous conviction has been proved at the trial.

Manner of Classifying Identification Cards.—This is done in a specially constructed cabinet, as shown in Fig. 22.

Its construction may be followed in the following description. It is divided, *first*, into three divisions by two vertical partitions, shown by the thick lines, each of which contains twenty-seven drawers; *second*, it is further subdivided by two horizontal partitions, similarly marked, into three subdivisions, each of which contains nine drawers; *third*, each of these three subdivisions is further subdivided by vertical, and then by horizontal partitions, into sets of three drawers each. Up to this point eighty-one drawers have been formed. By subdividing each drawer by two partitions, and thus converting it into three apartments, 243 apartments in all are formed. It will thus be seen that there are five grades of division in the cabinet, each of which is made to bear a definite relation to the first five measurements on the cards of identity. As there is, therefore, a tripartite system of division in the cabinet, so is there tripartite division of each of these five measurements according as each is *large*, *medium*, or *small*. The arrangement of sorting out or classifying the cards of identity is carried out as follows:—*First*, all the cards in which the *head length* measurement is *small* are placed in one or other of the twenty-seven drawers of the left vertical third of the cabinet, those in which that measurement is *medium*, into the middle vertical third and those in which it is *large* into the right vertical third. *Second*—The next classifying measurement is the *breadth of head*. If this is *small*, it is placed in one of the *lowest* sets of nine drawers; if *medium*, in the *middle* set of nine drawers; and if *large*, in the *uppermost* set of nine drawers. But the limits of *small*, *medium*, and *large head breadth* measurements are fixed in relation to the *head length* measurements; in other words, the *short* or small *heads* are divided into three equal groups according as the *head breadth* measurement is *small*, *medium*, or *large*; the *medium* heads are divided into similar groups, and the *large* heads also into similar groups; since the range of measurements of small, medium, or large head breadth is fixed with relation to whether the head length be small, medium, or large.

We come now to the arrangement in each set of nine drawers. The particular vertical row in which a card is to be placed is determined by the *face breadth measurement*. If that measurement be *small*, it will be placed in the *left hand vertical row*, if *medium*, in the *middle vertical row*, and if large, in the *right hand vertical row*. The *small*, *medium*, or *large* face breadth measurements bear a definite relationship to the *head breadth*, depending upon whether it be *small*, *medium*, or *large*, and, accordingly, into which set of vertical drawers a particular card is placed depends upon this relationship. Then the *left middle finger* measurement is employed to further subdivide the face breadth groups; and according as it is *small*, *medium*, or *large*, with relation to the *small*, *medium*, or *large* face breadths, is the particular drawer determined into which any individual card is to be placed. Thus, if the finger measurement be *short*, the card is placed in the *lowest drawer of the vertical row of three drawers*, if *medium*, into the *middle drawer of the row*, if *large*, into the *top drawer of the row*. Last of all, the *forearm* and *hand* or *cubit* measurement is utilised to further subdivide these groups. This measurement may be either *short*, *medium*, or *large*. If *short*, the card is finally put in the *front compartment of the drawer*, if *medium*, in the *middle compartment*, and if *large*, in the *back compartment*. Thus it works out that the five measurements provide 243 groups or classes.

For female criminals, who are relatively much smaller in numbers than males, one cabinet of twenty-seven drawers has been found sufficient in size for their classification. For identification of growing adolescent or young adult male prisoners, reliance is chiefly placed upon the finger-prints, owing to the

changes, by reason of growth, which are apt to occur in the various measurements.

Dr Garson has devised a scheme of classifying the finger-prints taken in the British scheme of identification, which is intended to be worked in conjunction with the foregoing metric measurements, and which may be described briefly as follows:—He divides the patterns of the bulbs of the digits into three types —viz.

1 = *Arches*—signified by the sign = ∧
2 = *Loops*—which open on the left = ⟋
Loops— ,, ,, right = ⟍
3 = *Whorls*—signified thus = 0

For this purpose, the patterns on the thumb and three or more of the succeeding fingers of the *right hand* are selected. The *thumb and index finger are always selected*, and when the numbers of cards, consequent upon their use alone, becomes large, the middle finger, or the middle and ring finger imprints are brought into requisition to reduce the numbers of these divisions.

For classification purposes, two types of patterns are first recognised—viz. (I.) *Arches, including loops*; (II.) *Whorls*. By these markings on the *right thumb*, therefore, two main divisions are created. Each of these divisions is then subdivided into four smaller subdivisions according as the pattern on the *right index finger* is (*a*), an arch; (*b*), a loop opening on the left (or radial); (*c*), a loop opening on the right (or ulnar); (*d*), or, a whorl. Thus eight divisions are formed. Of these eight divisions no further subdivision is necessary in six cases—viz. In (I.), *a*, *b*, and *d* divisions, and in (II.), *a*, *b*, and *c* divisions. In the case of *c* of division I.—that is, where there is an arch, or either form of loop on the right thumb, and an ulnar loop on the right index finger—subdivision is made further into two classes depending upon whether (*a*) there are *ulnar loops* on each of the four fingers, or (*b*) any combination of pattern in these fingers other than ulnar loops exists. In the case of *d* of division II.—that is, where a *whorl* exists on the right thumb and right index finger—subdivision is made further by the type of pattern of the right middle finger—viz. (*a*) those in which that pattern is a whorl, and (*b*) those in which it is any pattern other than a whorl.

From these subdivisions, then, *ten* groups of nearly equal size are formed, except that *a* group of division II. is the smallest. Garson equalises this with the others in point of numbers, by putting into it those cases in which one or more of the first four digits of the right hand has been damaged or is amissing, so that the imprint is indecipherable or unobtainable.

By the combination, therefore, of the tripartite classification of five metric measurements which gives 243 divisions, and of the finger-prints of the first four digits of the right hand, which gives ten divisions, no fewer than 2430 divisions are formed, from any one of which, by reason of the smallness and equality of numbers in each, search for any particular identity card is easy and rapid.

Apparatus used:

A. For Metric measurements:
- (*a*) Two callipers, or sliding compasses, for measurement of head and limbs.
- (*b*) A 30-centimetre rule for measurement of marks.
- (*c*) A standard rule and set square for height measurement.
- (*d*) The furniture for a measuring-room consists of (1) a stool, upon which the foot is rested while being measured, and which is used as a seat while head measurements are taken, and (2) a trestle table upon which the forearm is rested while the cubit measurement is made.

B. For photography: The usual outfit of good stand camera, etc.

C. For Finger-Prints:
- (*a*) A piece of flat sheet tin, or, better, of polished copper, about 25 centimetres square.
- (*b*) A printers' hand-roller, 15 centimetres long.
- (*c*) Printers' ink.
- (*d*) A good reading-glass for slight magnification of prints, when being deciphered.

(*e*) Teasing-needles, as used for microscopic sections, to act as pointers in ridge-counting or ridge-tracing.

(*f*) Ordinary white paper, not too highly glazed.

Note.—It is all-important, to secure good clean prints, that ink, copper plate, and roller should be preserved scrupulously free of dust.

A word or two must be said about the kind of callipers or sliding compasses to be used. The Bertillon instrument is of the compass pattern with the free ends curved, the measurement being made by the lines engraved on the arc of a circle which is attached to one of the compass limbs about midway between its extremities. The intervals of measurement are, therefore, graded by their position on the arc ; in other words, the distance named one millimetre is not in reality one millimetre but *represents* that distance in the movement of the free ends of the instrument. Thus, unless great care be exercised, errors of reading are apt to arise by reason of the smallness of the intervals. During the time the anthropometric system obtained in India automatic instruments were used, the pressure of which was kept constant by a spring along with a self-registering index. One of the chief reasons on account of which the system was abandoned was the unreliability of the measurements thus taken, due, it was believed, to the inaccuracy of action of the instruments. In the English system Garson has designed an instrument, figured here, by which the millimetric number recorded on the scale is the actual measurement in millimetres ; in other words, the distances marked as millimetres are *true* millimetres. It has been in use for about seven years, has given every satisfaction, and, moreover, is calculated to effect more accurate measurement.

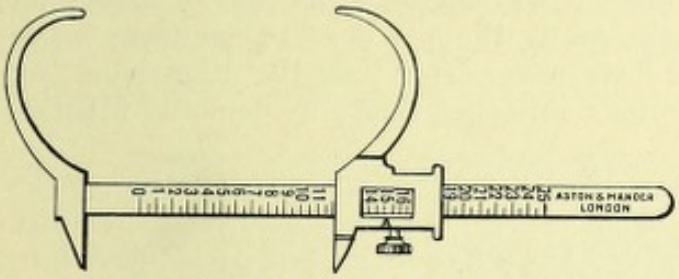


Fig. 23.—Garson's Craniometer or Callipers.

From the foregoing account of the different methods employed in different parts of the world, it will be apparent that there is not common agreement as to what constitutes the *best* system. Those who are in favour, after examination of the anthropometric and finger-print systems, of the latter, as the Indian Committee, point out the following advantages of that system over that of metric measurement—viz.

I. The apparatus required is inexpensive and easily procured, whereas that of the other is costly and liable to get out of order.

II. It is easily learned, and, therefore, it is easily taught to uneducated persons ; whereas the other needs some measure of education on the part of those taught.

III. The finger-impressions record themselves. Moreover, wrong sequence of imprinting of the fingers may be prevented by a metal guard or mitten ; whereas the other requires accurate measurement, accurate reading and recording of measurements, and is, therefore, more liable to the errors of the "personal equation," which, if once recorded, cannot be rectified.

IV. It takes little time ; whereas the other requires much time, since, to ensure accuracy, the mean of each measurement taken *three* times is held to be the actual result.

V. No record of bodily markings need be taken, hence the examinee is not required to divest himself of his clothing ; whereas in the other such is necessary, as the marks are valuble auxiliary aids to identification.

VI. No allowance for error of the operator is made or needed ; whereas in the other a margin of error must always be allowed for each of the measurements, especially where a measurement falls near the boundary limit. Duplicate or even triplicate searches are necessary, upon occasion, in both systems, but they are relatively very much more seldom called for in the Finger-Print system.

VII. The system of search is easy ; whereas in the other it must be carried out according to the somewhat complicated key of the system. Rapidity of search in either system will, obviously, depend upon the familiarity of the searcher with his system.

VIII. The system of classification being the all-important matter in both schemes, there is not much to choose between the *primary classification* of the metric system and that of the Finger-Print system, except that whereas in the former only 243 groups, in the latter 1024 groups, are formed, and in Henry's system they can be increased beyond that figure.

The value of finger-print identification has now been amply proved. In a case tried at the Guildhall in London, although the Finger-Print Office had to acknowledge that a clerical error had been made, an official stated that " out of the many thousands of recognitions made by means of finger-prints, we have never erred ; on the other hand, we have been able to correct serious mistakes made in personal identification." [1]

The system has now been adopted in the United States Army, the print of the right forefinger being taken on a card below the name of the soldier, which cards are filed.[2] It has also been introduced into the First National Bank of Cheyenne, the patrons of which are of mixed nationalities, and of whom many are unable to write their names. When a patron makes a deposit he is required to make his thumb-print on a card, below which the bank cashier writes his name, the card being retained by the bank. Cheques are drawn by such patrons by the thumb-print used as a signature.[3] It is also in operation in the Postal Savings Bank of the Philippine Islands at Manila. Stamp deposit cards have been issued, on which, opposite the place for the owner's signature and address, is a ruled-off square for the thumb-print of the depositor.[4]

Tamassia has tried to establish a system of personal identification on the variations of distribution and anastomosis of the dorsal veins of the hand, which do not agree, possibly, in any two persons in every particular. The veins are photographed, and for this purpose are rendered more prominent by keeping the hands dependent for a little time, or by tying a ligature or applying a rubber band round the wrist. Tamassia describes six types of venous distribution—viz. (1) the rude arch type, (2) the arteriform distribution, (3) the network or reticulate type, (4) the V-shaped type, (5) the double Y-Y type, and (6) the composite type, being a mixture of two or more of the previous types. The deviser of the method says that the data forming the basis of photographs are more easily noticed, are more easily photographed, and are not readily changed throughout life. While this is all true, the difficulty of utilisation of the system will be found to be encountered when accurate classification is needed.[5]

B. Identity for Civil Purposes.—This aspect of the subject of identification may be illustrated on general lines by the Tichborne

[1] *B. M. J.*, vol. ii., 1902, p. 1263.
[2] *St Louis Medical Review*, Nov. 10, 1906, p. 452.
[3] *New York Tribune*, 1908.
[4] *B. M. J.*, vol. ii., 1907, p. 1288.
[5] *Gaz. degli Osped.*, Aug. 2, 1908.

case, which occupied nearly two years in hearing. The leading features of the case were these : A man came forward making a claim to be the heir to the Tichborne estates. The real heir was supposed to have been lost at sea off the coast of South America in 1854, in the wreck of the ship *Bella*. There were certain outstanding events in the life-history of the true heir which were likely never to be forgotten by any ordinary person. The claimant, on being questioned regarding them, seemed to have no acquaintance at all, or, at most, but a very imperfect acquaintance with them. The real heir was known not only to have studied in France, but to be able to converse fluently in French ; the claimant, on the other hand, had practically no knowledge of the language. In short, it became apparent as the trial proceeded that the memory of the claimant was in just the con-

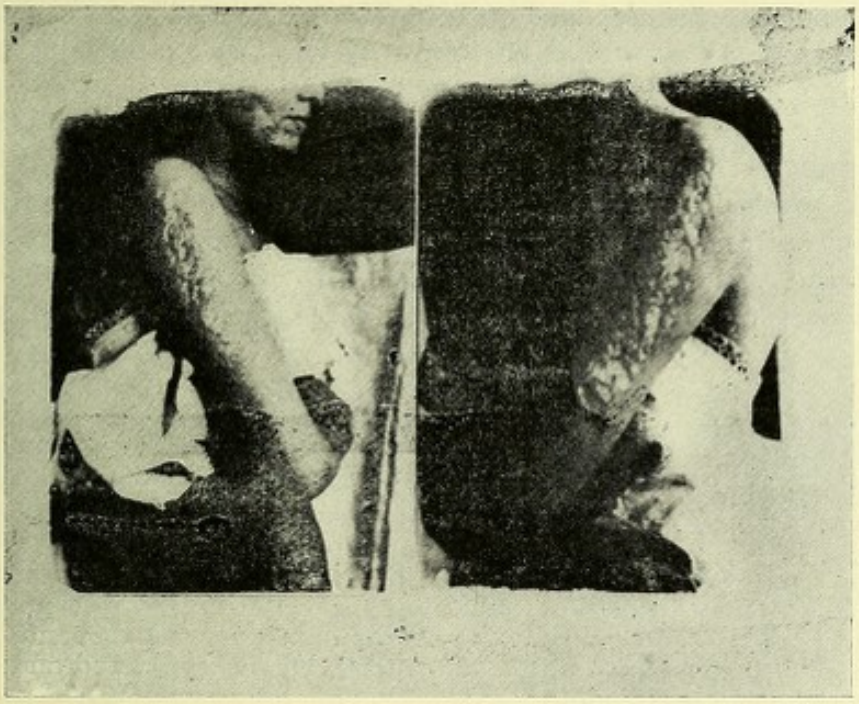


FIG. 24.—Scars of skin of outer aspects of arms caused by self-administration of hypodermic injections of Morphia.

dition of that of a person who had never experienced personally the events which formed the subjects of his examination, and that the knowledge which he did possess of them had been obtained through the agency of others, by whom, moreover, he had been but imperfectly coached. The question of personal identity, however, in its medico-legal bearings, depended in some measure upon the presence, or absence, and character of certain bodily markings, such as scars, and tattoo-marks. With reference to the former, the real heir was known to have had a scar on the left shoulder caused by an issue which had been kept open for three years ; the claimant had also a scar in this situation, but one which was evidently due, from the amount of tissue destruction, to vaccination, and not to the effects of an issue of such long standing. With respect to tattoo-marks, there were none

on the body of the claimant, and in his evidence, he swore that he had never been tattooed. It was proved, on the other hand, by old family friends of the real heir, that on the body of the real heir there were certain definite devices due to tattooing—viz. on the left forearm, a cross, a heart, and an anchor, with the initials, R. C. T.; and in addition, there was a blotch of tattooing near the wrist. On this point the Lord Chief-Justice said that it was "a piece of evidence which is of the last and most vital importance." In another case in 1834, a man supposed to be Stuart by name, was being tried in a London criminal court on the charge of being an escaped convict. His identity was duly sworn to by the prison officials as the man who had actually escaped. The real Stuart was known to have had a wen or growth on his left hand. The man in custody was not able to call witnesses to declare his true identity. A surgeon—Carfine by name—chanced to be in court, and he begged to be heard as a witness. He gave evidence that if the convict had once had a wen which had been surgically removed, that a scar would be found on the hand, and if prisoner was the man, a scar would be found on his left hand. The prisoner's hands having been examined, and no scars of any kind found, the court duly acquitted him on the ground that the prosecutor had failed to establish the identity of the prisoner with that of the convict. From the examination, too, of the mutilated remains in the Wainwright murder case, the identity of the body with that of the victim—Harriet Lane—was established by the presence of a scar on one of the lower limbs.

Case of Adolf Beck.—Probably this is one of the most remarkable cases of mistaken or mis-identification which has ever been placed on record; and it is the more remarkable in respect that the mistake in identity occurred upon two separate occasions. The facts are almost inconceivable. They are, briefly, as follows:—

In the year 1877, a man, who gave the name of John Smith, was charged at the Old Bailey, London, with having stolen from a woman certain articles of jewellery and money. There were no fewer than seventeen charges of a similar nature against him. After trial, he was convicted and sentenced to five years' penal servitude.

For after-identification purposes, his body was examined for distinctive marks, these being duly recorded. On his identification paper it was noted that (1) he was a Jew, in respect that he had been circumcised, and (2) that he had a noticeable scar on the point of his jaw on the right side.

In March 1896, similar crimes were being committed in London, the facts, circumstances, and *modus operandi* of which bore a remarkable resemblance to those for which John Smith had been convicted.

A man who gave the name of Adolf Beck, and who alleged that he was a Swede, was apprehended. He was identified as the man who had defrauded them by five women, from whom articles had been obtained on false pretences, and to whom he had given bogus cheques. He was also identified by a police official at the Police Court at the preliminary inquiry as John Smith, the man convicted in 1877. At this time it is alleged that the police authorities had in their possession the marks found on the body of Adolf Beck, because a warder in Holloway prison swore at the trial that he had made a special examination of Beck about three weeks after he was taken into custody, and that he had found a mark on the right side of the throat, which, however, he could not describe as a scar, and a mole also on the right side of the throat. Nothing, however, was said about the existence or absence of circumcision, although Beck was not a Jew, and, therefore, did not bear the marks of circumcision.

By reason of the deposition of this police official that Beck was Smith,

Beck's name in the Old Bailey Calendar appeared with a previous conviction marked against it. A handwriting expert, employed by the Treasury to examine certain written documents found in Beck's possession and to compare these with written documents given by the offender to the defrauded women, swore that he was "perfectly satisfied that they were all in the self-same handwriting," but disguised.

When Beck's counsel proceeded to cross-examine this witness as to the handwriting of certain other documents produced in the Smith trial, counsel for the Crown objected on the ground that it raised the question whether the prisoner then being tried was the person convicted in 1877 of a similar offence, and that this was a collateral issue and should not be inquired into until after the jury had returned their verdict. After argument, the judge ruled that the question whether the prisoner was or was not the man convicted in 1877 was not admissible.

Beck, in answer to the charge, pled an *alibi*. Three gentlemen of unimpeachable repute were prepared to testify that they knew that Beck was in Lima from 1875 to 1882. But the *alibi* was struck out by the judge. If this evidence had been permitted, as the issue shows, it would have proved conclusively that Adolf Beck was not John Smith, because John Smith was in prison serving his sentence on the conviction of 1877 during the years Beck was in Lima.

Beck was convicted and sentenced to seven years' penal servitude. On the breast of his convict dress he had to wear the letters and number, D.W. 523 ; D signifying "convicted in 1877," and W "convicted in 1896."

At his apprehension, while in custody, during his trial, and even after his conviction, Beck strongly declared his innocence of all the charges preferred against him. He went to prison. After he had served two years of his time in Portland, he discovered in some way that the man, John Smith, for whom he had been mistaken, was a Jew. Instantly, he sent a petition to the Home Office, craving that he should be examined by the prison surgeon. The petition was granted, and he was examined accordingly, the result being that an order was sent to the governor of the prison to remove the letter D from the legend on his coat, and a new legend was put in place of the original—viz. W. 78, the W, as before, signifying "conviction in 1896." This action on the part of the criminal authorities was a tacit admission that Beck, not being circumcised, could not be Smith, who was circumcised, and therefore could not be the man who committed the crimes in 1877. Moreover, they gave point to their admission by removing the letter D from his dress, which indicated that the accusation that Beck had been previously convicted was wrongous. Further than this, however, the authorities did nothing. Beck remained in prison. He continued, however, to send petitions to the Home Office for his liberation on the ground that having been able to prove by examination of his body that he could not possibly be John Smith, and the authorities having admitted that fact by removing the mark from his dress which signified previous conviction in 1877, he was not the person he was thought to be, and that he was innocent. These petitions were ignored. At the end of his term of sentence, shortened because of his invariable good conduct in prison, in July 1901 he was liberated from Portland on a ticket-of-leave.

As soon as he was free, Beck set about to establish his innocence and wrongous conviction. Persons of reputation had all along doubted his guilt, and they, along with him, put measures in train to re-establish his good name and character. Meanwhile he worked at his business with energy, and succeeded in recovering some of his property, for at the time of his conviction he had, as one item of property, £3000 worth of shares.

But on April 15, 1904, he was again arrested by an inspector of police on the information of a woman who charged him with the same mean, fraudulent thefts as had the women in 1896. The same mode of theft, the same false name of the offender, the same false cheques, the same line of deceit and trickery were found by the police to characterise this charge as those of 1877 and of 1896.

When at the Police Court inquiry on this second charge the Magistrate committed him for trial, Beck cried out impassionately in Court, "before God, my Maker, I am absolutely innocent of every charge brought against me. I

have not spoken to one of these women before. They were set against me by the detectives."

The woman who laid the charge against her deceiver gave a description of a man which moved this inspector of police to think of Beck. Along with the woman, the inspector went to the restaurant where Beck took his food, and after observing Beck for a couple of hours the woman identified Beck as the man who had stolen her jewellery. The inspector thereupon arrested Beck. He was identified also by a second woman, who had been defrauded both in 1877 and in 1896, but her identification was based solely on the ground that the man who defrauded her had a grey moustache, as had also Beck.

He was brought to trial, not before the judge who usually presided over the Court, because that judge was in 1896 counsel for the Crown in the prosecution of Beck, and it was, therefore, deemed inadvisable that he should try this second charge, but before Mr Justice Grantham, on June 27, 1904. Four counsel were employed by the Treasury to prosecute the charge. The evidence led against him was practically identical with that in his trial in 1896; the female witnesses told the same story, and the handwriting expert swore that the handwriting of the letters, cheques, etc., given by the man who stole from the woman, was the same as that of the prisoner, but disguised. He was again found guilty, but Mr Justice Grantham postponed sentence.

The proofs of the innocence of the accused, which had been published after his conviction in 1896, were sent to the judge by Beck's friends, to which, however, the judge made the following reply:—"I have already made special inquiries into this case, and have no doubt whatever of the correctness of the verdict, and cannot therefore direct or allow any other investigation to be made."

Before Beck was brought up for sentence, however, what seemed to be a providential intervention on his behalf occurred. A chief inspector of the Metropolitan Detective Department in the course of his duty visited one of the police stations and inquired if there were any prisoners in the cells. He was told that there was a man in custody who had just been charged with having defrauded by a trick two women of their jewellery. This inspector had been present in Court when Beck was first convicted in 1896, and Beck's second conviction was then in his mind. He went into the cell. When he looked at the prisoner, he saw at once the scar on the point of the man's jaw which had not been found on Beck, and he involuntarily exclaimed "John Smith!"

He reported his discovery at once to his chiefs. Rapid investigation was thereupon made which corroborated the importance of the discovery, and next day Beck was informed of the facts. Two days later he was set free. On 29th July he received two pardons of the King for convictions of crimes of which he was absolutely innocent.

Such wrongous convictions of an innocent man, and the grave possibilities of mis-identification, seized the public mind, and questions were asked in Parliament concerning the case, and a vote of money as *solatium* to Beck. On 9th September a Committee of Inquiry into the circumstances of the convictions was appointed by the Secretary of State for the Home Department. After hearing evidence in public, including that of Beck himself, the Committee reported on Nov. 14, 1904, "that there is no shadow of foundation for any of the charges made against Mr Beck, or any reason for supposing that he had any connection whatever with them." The Committee also expressed their opinion that "the miscarriage in this case could never have gone without remedy if the learned judge had seen fit to state a case for the consideration of the Court for Crown Cases Reserved on the point raised by Mr Gill [counsel for Beck]. We cannot doubt that if the matter could have been brought before that court, the flaw in the proceedings would have been judicially ascertained and the conviction quashed."

The bodily markings which, if they had been properly recorded and compared, would have materially served to differentiate in the identification of these two men may be briefly summarised as follows:—

John Smith	*Adolf Beck*
Had a conspicuous *wart* over one eye.	Had none.
Had a noticeable *scar* on the point of right side of jaw.	Had none.
Had been circumcised.	Had not been.
Had none.	Had a scar from slash of a sabre on left arm.

This case, perhaps more than any other, led to the passing of the Criminal Appeal Act for England.

The Edalji Case.—This case differs considerably from the Beck case. George Edalji was tried at the Staffordshire Quarter Sessions, on Oct. 20, 1903, on a charge of feloniously wounding a horse in August of that year. The trial lasted four days, he was convicted by the jury, and was sentenced to seven years' penal servitude. Edalji asserted his innocence, and after his conviction the facts of this case occupied the attention of the public, and of Parliament. In consequence, the Home Secretary appointed a Committee to consider the whole case and to report, and the report as sent to the Home Office was printed as a Parliamentary paper. The Committee reported that in their opinion "the conviction was unsatisfactory, and, after a most careful consideration of all the facts and printed evidence placed before us, we cannot agree with the verdict of the jury. . . . On the one hand we think the conviction ought not to have taken place for the reasons we have stated; that conviction, in addition to the sentence of the Court, necessarily brought upon Edalji the total ruin of his professional position and prospects [being a solicitor]; and as long as things continue as they are, he must remain under police supervision, a condition in which it would be extremely difficult, if not impossible, for him to recover anything like the position he has lost. On the other hand, being unable to disagree with what we take to be the finding of the jury, that Edalji was the writer of the letters of 1903, we cannot but see that, assuming him to be an innocent man, he has to some extent brought his troubles upon himself."

The Committee felt that the case demanded strict scrutiny, (1) because the character of the outrages which had been periodically committed upon animals had given rise to much feeling in the locality, (2) because, therefore, the police were naturally anxious to bring the offender to justice, and (3) because the police commenced and carried on their investigations, not for the purpose of finding out who was the guilty party, but for the purpose of finding evidence against Edalji, who, they were already sure, was the guilty man. Besides, the prosecution was compelled during the course of the proceedings to change the case to be presented to the jury. At first, the prosecution started with the theory that Edalji committed the outrage on the animal in question between 8 and 9.30 P.M., of Aug. 17, hours while Edalji was admittedly out-of-doors; but the case as it was ultimately left to the jury was that he might, and must, have got up between 9.30 P.M., the hour when he returned home, and before 7.45 A.M. of Aug. 18, the hour when he left his home for his office in Birmingham, and must have gone out and committed the outrage between 2 and 3 on Thursday morning, Aug. 18. There was also some discrepancy in the evidence of the police witnesses regarding hairs on a razor belonging to accused. The evidence, at the trial, consisted of (*a*) circumstantial evidence, and (*b*) certain anonymous letters said to have been written by the accused. The former amounted to this, that on the morning of the 18th, the police were shown a suit of clothes belonging to accused, the jacket and waistcoat of which were said to be damp, and the trousers to be muddy. This was important because the night in question was wet from 11.30 onwards. The muddied

trousers the police did not take away. They were also shown a pair of muddy boots, of which the police took possession of one boot at one time and of the other, later. The boots were taken to compare with certain footprints, but, says the Committee, "the comparison was of the roughest description; no proper measurements were made and preserved; no cast was taken; and no attempt was made to lift any of the footprints." The Committee thought, therefore, the value of the footprints as evidence was practically nothing. Four razors were found at the house of accused, one of which was damp as if freshly washed. The evidence of the veterinary surgeon was against the likely use of a razor as the offending weapon. On the accused's jacket, two reddish-coloured stains, about the size of a threepenny piece, were found in the centre of the right cuff, which were proved to be of mammalian blood, and on both jacket and waistcoat were found horse hairs, corresponding to the colour of the hairs of the injured animal. The Committee thought it doubtful whether the jury would have convicted upon the circumstantial evidence alone, if they had not been influenced by the case put to them regarding the anonymous or pseudonymous letters. These were spoken of at the trial as the Greatorex letters of 1903. Two questions arose out of these letters—(1) who wrote them? (2) what was their value as evidence that Edalji was guilty of the crime for which he was tried? The jury had the letters before them with others for comparison. They had the assistance of an expert witness. The Committee were of opinion that the jury must have held that accused was the writer of the letters, from which opinion, having themselves examined the letters, the Committee were not prepared to dissent. At the same time, the Committee did not think that the letters, as evidence of the commission of the crime by accused, had anything like the evidentiary weight which had been attributed to them. Moreover, the value of the letters, as proof that the accused committed the crime for which he was tried, depended upon the assumption that the crime in question was one of a series of outrages presumably committed by one and the same person. That was the original case. But a circumstance arose which compelled the prosecution to change their ground. While Edalji was in prison awaiting trial, another like outrage was committed on the night of September 21. A man admitted that he did it, although in excuse he said it was his own horse. The Committee did not attach much importance to the excuse, because, as they pertinently put it, a man who in good faith wants to kill his horse, because it is old and valueless, does not go out at night and rip up its belly. Such an occurrence compelled the prosecution to depart from the theory that all the outrages were the work of one and the same person, to the other theory that the series was the work of a gang of persons of whom the accused was one. There was no evidence put forward to support the latter view. Added to all this was the further disconcerting fact that, since Edalji's conviction, two further similar outrages had been perpetrated. It will be remembered that Sir Conan Doyle championed the innocence of the accused on the ground of his very defective vision, said to be of such a degree that accused could not have traversed the route suggested, and did what he was alleged to have done, on a dark night. On this point, the Committee called in the services of an eminent expert to examine Edalji in prison, and considered also the opinions of oculists which were laid before them, and from these they were of opinion that the alleged impossibility could not be established.

The Home Secretary, in view of the findings of the Committee, decided to advise His Majesty, as an Act of Royal clemency, to grant Mr Edalji a free pardon, but that the case was not one in which any grant of compensation could be made.

While many other remarkable illustrations might be cited, the foregoing show the bearing and value of such marks with reference to identity.

A. **Scars.**—From these considerations certain important practical questions arise—viz. Do scars ever completely disappear? The answer to this is: under certain conditions and in certain circumstances they may practically disappear, but that in average circumstances they remain visible. For example, it may be held that scars

which result from the healing of wounds in which there has been loss of substance, or from wounds which have healed by granulation, never disappear, but that scars resulting from wounds in which there has practically been no loss of substance may so disappear as to be very difficult to detect. It is sufficient to state these principles for the student to apply them in practice, without condescending upon details. Even in cases, however, in which scars disappear eventually, it must not be understood that they disappear at once; indeed, even in such category of cases, the period of duration will depend upon the original depth of the wound and the amount of tissue destruction: for in surgical wounds, however carefully apposed the edges may be, there is some loss of substance. Whether, therefore, the scars be the result of breach of continuity of the skin from violence, or from disease in which the tissues of the true skin are involved, they remain permanently. Hawthorne has recorded a most unusual case of congenital constriction of the abdomen and thigh in a girl aged ten years. The



FIG. 25.—Scars in Finger-Print. The centre figure is a Plain, and the others are Rolled, Impressions of the same Finger. The scar, which is seen to radiate upwards from the right of the "Core" of the Impression, is the result of a wound produced about forty years ago. (Author.)

paper is illustrated with two figures in which the grooved marks, especially on the abdomen and back, are well shown.[1] Can scars be removed artificially? The answer to this is: Only by the creation of a new scar. A man might attempt to conceal his identity by effacing a damning scar of a particular kind or shape by overwhelming it in one of larger size. While it is obvious that all that could be gained by such a manœuvre is change of shape, it might, at the same time, to a certain extent cause identification to become more difficult in that particular. Is it possible, from the appearance of a scar, to give an estimate as to the time of the wounding from which the scar has resulted? in other words, Can the age of a scar be approximately arrived at? This is, upon occasion, a question which is asked of the medical witness in order to connect a particular person in custody with a given act in which the perpetrator was known to have been wounded. Here, a witness must proceed with caution; and his answer must have

[1] *The Lancet*, Aug. 8, 1903.

direct relation to the circumstances of the particular case. The difficulty of giving more than an approximate answer arises from the variable periods which wounds take in healing. Therefore, speaking generally, while a scar at its first formation is of a reddish colour and the skin around it may be pigmented, it gradually becomes paler until it eventually becomes white and more glistening. The other factors attendant upon its formation are too variable to formulate any guiding principle from them, since so much depends upon the original extent of the wounding, the amount of tissue destruction, the time and manner of healing, and the health of the individual, which factors are so often, in medico-legal cases, not within the knowledge of the witness. The furthest a medical witness ought to go in appraising the age of a scar must depend entirely upon the particular case before him, and even then he ought to give a wide margin in his computation of time. From our experience we would not even generalise thus: [1] "The redness [of a scar] as a rule, lasts, two, three, or four weeks, during the period of healing; the brown discoloration, for several months, or even for a few years; the bleached appearance for the rest of life." But we agree fully with the closing sentence of this quotation: "But the duration of each stage is subject to great variation."

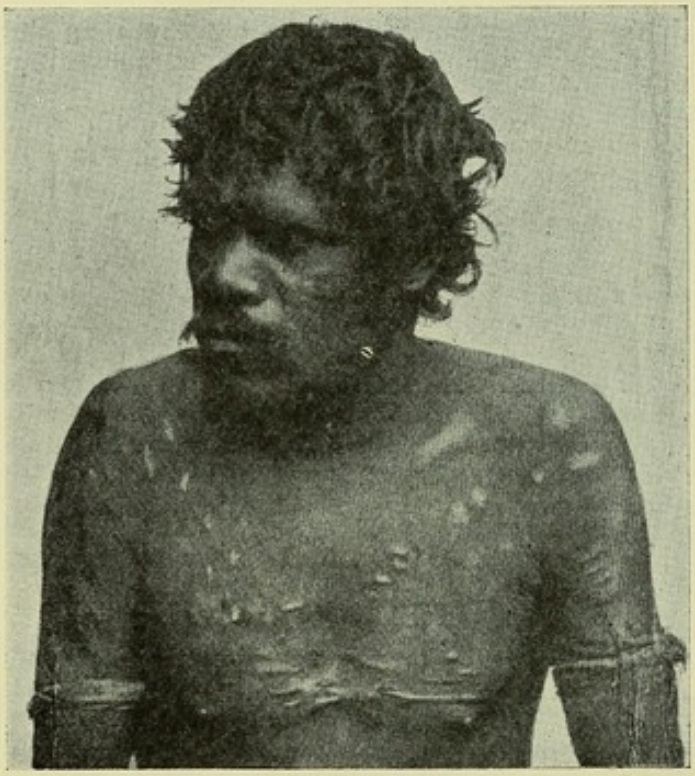


FIG. 26.—Body of Australian Aborigine, showing Raised Scars. These are produced by making the wound with a sharp flint or shell, or piece of bottle, and keeping it from healing for a considerable time with the irritant juices of plants. (*Vide* Paper by the Author on "Australian Aborigines," *Trans. Philos. Soc. of Glasg.*, vol. xvii., p. 182.)

Given a case in which it is of importance to discover a suspected scar or scars, what are the best means for their detection? By reason of the fact that cicatricial tissue contains relatively fewer (if, indeed, any) blood-vessels, per same unit of area, than normal skin of any particular portion of the body, any influence which will produce marked increase in the activity of the cutaneous circulation will form a good test. Perhaps the best way is either to apply some warmed substance to the part of the skin upon which the supposed scar is situated, or to expose that part of the nude body to the influence of heat from the fire, or to slap the skin with the flat of the hand. In reply to the further question, Do scars increase in size? it may be said, that while, generally speaking, scars produced in infancy do grow to some extent,

[1] Guy and Ferrier's "Forensic Medicine," 5th edit., p. 15.

this rule must be viewed with caution, for we believe it is not equally true of all parts of the body. It is clear, however, that scars produced during adolescence and adult life do not increase or diminish in size after the cicatricial tissue has attained its full measure of contraction after the healing process. While scar tissue is usually depressed below the normal level of the skin, it sometimes happens that it is raised above that level. This is seen in Fig. 26.

B. **Tattoo Marks.**—The practice of tattooing which still prevails to a large extent among certain classes of civilised peoples, is a reversion to the desire for personal adornment which obtains among savage peoples. The practice of tattooing and the production of scar-markings on the bodies of certain savage tribes were, however, intended to serve a distinct purpose; the former indicated the rank or other virtue of the bearer, the latter possibly also the rank, and, certainly, the tribal markings, so that by the marks (scars) on the body, the tribe to which the bearer belonged could be identified. In such cases, the scars were not depressed, or on a level with the ordinary skin, but were raised—thrown into relief.

The practice of tattooing is mainly prevalent among soldiers, sailors, and a certain class of civilians associated with both classes. We are not concerned particularly with regard to the manner in which such marks are produced; it is sufficient to say that by pricking the skin in the form of the device desired, and after the bleeding consequent thereupon has ceased, and the rubbing in of the pigment of the requisite colour or colours, the tattoo mark is produced. The extent of such marks varies among individuals; they may practically be extended over the major portion of the body, or may be confined to small areas. While the devices used are of the most varied character, from representing the full uniform of a general or an admiral, or the portrayal of a naval fight, down to the amateurish effort of a ring round the finger or a bracelet round the wrist, or to the initials of the name of the person, they most usually centre round those emblematic of love, of arms, of the sea, of war, or of religion. In many cases the presence of such markings on the body may lead to the identification of the individual not only during life but also after death. It is only necessary, in order to realise the great variety of devices, to examine a Register of Distinctive Marks of Prisoners and of Convicted Prisoners. In one such register, for example, of 297 cases recorded, 49 bore tattoo marks, and, of these 49, 17 had the initial letters of their real names. At Cheadle, near Stoke-on-Trent, a tramp was remanded on a charge of murdering a man named Bishop, a licensed victualler, at Walsall, the November previous. The tramp had entered Cheadle workhouse, and while bathing, some tattoo marks were observed on his body, which led to his arrest. In an action of nullity of marriage tried in the Divorce Court, London, in 1906, one of the witnesses identified the first husband of the respondent by certain tattoo marks on his arms. In a general way, too, from the nature of the devices, which give a starting-point, the identity may be eventually established. A soldier will naturally prefer that the devices on his body should take the form of his association with arms, and the sailor with the sea. During a long experience as

police surgeon we have seen a great variety of tattoo marks, among the more ambitious being the following :—

D. K., a sailor, had the following devices on his body. On the chest, the French arms, surmounted by a Union Jack ; on the left forearm, a negro girl, two flower-pots containing plants in blossom ; and on the right forearm, the crucifixion, and a sailor holding a Union Jack ; and in addition, the letters "D.K." The pigments used were red and blue—vermilion and Indian ink.

T. S., formerly a soldier, had on his right forearm, a palm-tree bearing fruit, with a negro climbing up the trunk, a very obvious figure of a negress, and a bracelet round the wrist ; on the left forearm, a tree with red fruit, with snakes entwined round the trunk ; an elephant ; and a bracelet round wrist. The pigments used were cochineal and Indian ink. The devices were tattooed while he was a soldier in Burmah.

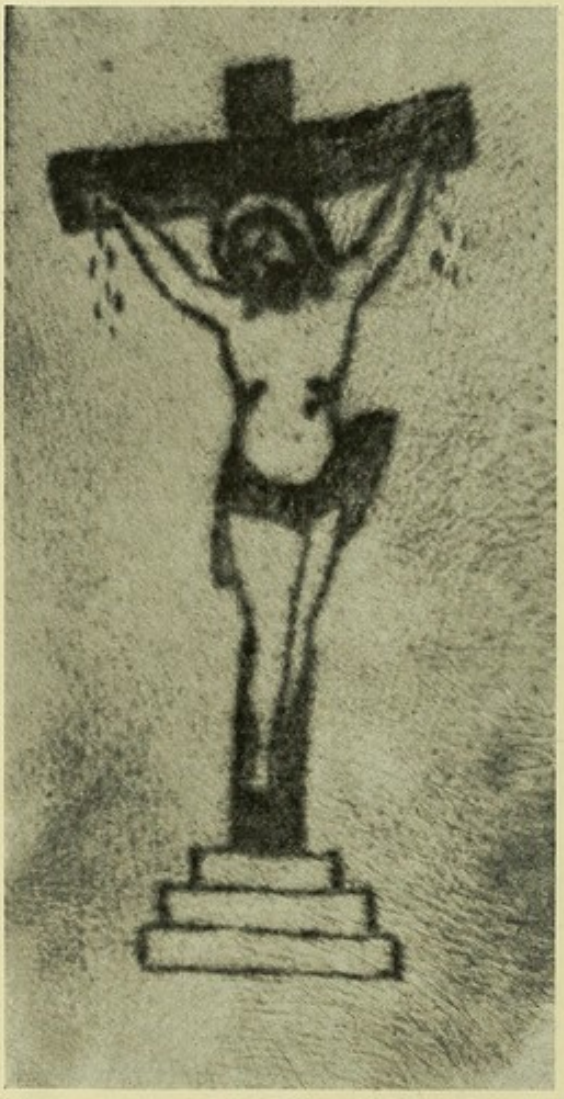


Fig. 27.—Photographic reproduction (slightly reduced in size) of Tattoo Mark, in possession of Author. The outline and shading of Cross and of the Saviour are in Indian Ink, and the drops from the Hands, and the Wound in the Side, in Cinnabar.

J. M., formerly a soldier, had on his right forearm the figure of a girl dancing, and holding a fairy rod in her right hand ; on back of the forearm, an anchor and a cross ; round wrist, an armlet ; on the left forearm, in front, a Jack-o'-tar dancing on a barrel, and holding his cap in his left hand ; on back of forearm, crossed flags, striped in colour ; round wrist, an armlet. Pigments used were cinnabar and Indian ink.

In a recent case, on the body of a woman the subject of post-mortem examination, the following devices were found—viz. 1. On right forearm—on back, busts of a sailor and a girl placed over a scroll, with the letters J. M'C. within the band of the scroll; on front, outline of a heart, with the letters R. G. enclosed. 2. On left forearm—in front, clasped hands, with the letters R. G. above, and B. S. below, and in cursive writing lower down, the name M. M'Callum ; on back, the letters M. M., and below these, an anchor, a cross, and a heart interlaced, with the letter C. below. The pigments used were red and blue.

In not a few cases, besides the initial letters of the name, further identifying particulars are tattooed. The pigments used in these devices have interest to the medical jurist solely with relation to their stability. Gunpowder, Indian ink, charcoal, common ink, Prussian blue give the black or blue colour, and vermilion and cochineal, the red. With respect to the problem of identity, the question arises,

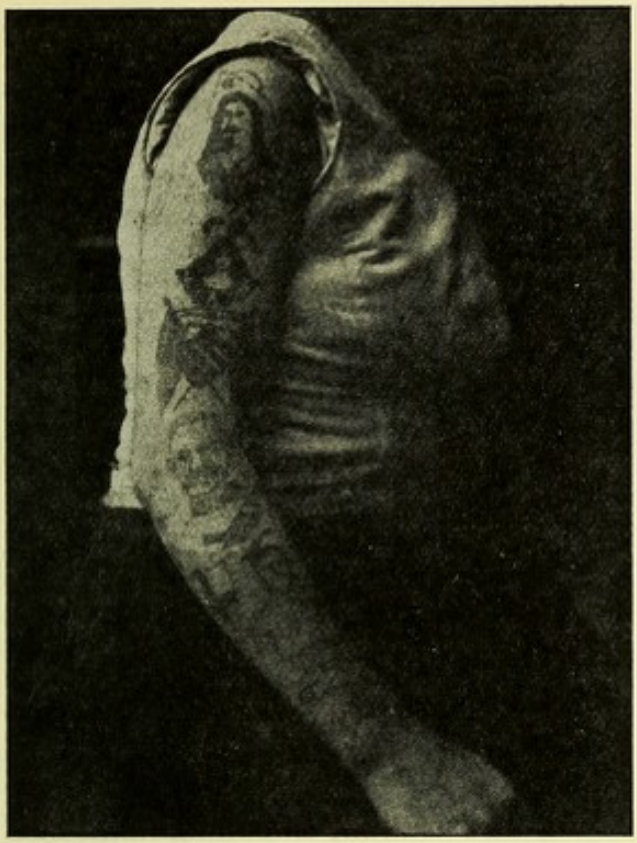


Fig. 28.—
This shows the right arm covered on its exterior aspect with a variety of devices. The left arm and front of the chest of this person were likewise similarly covered.

Various coloured pigments were employed.

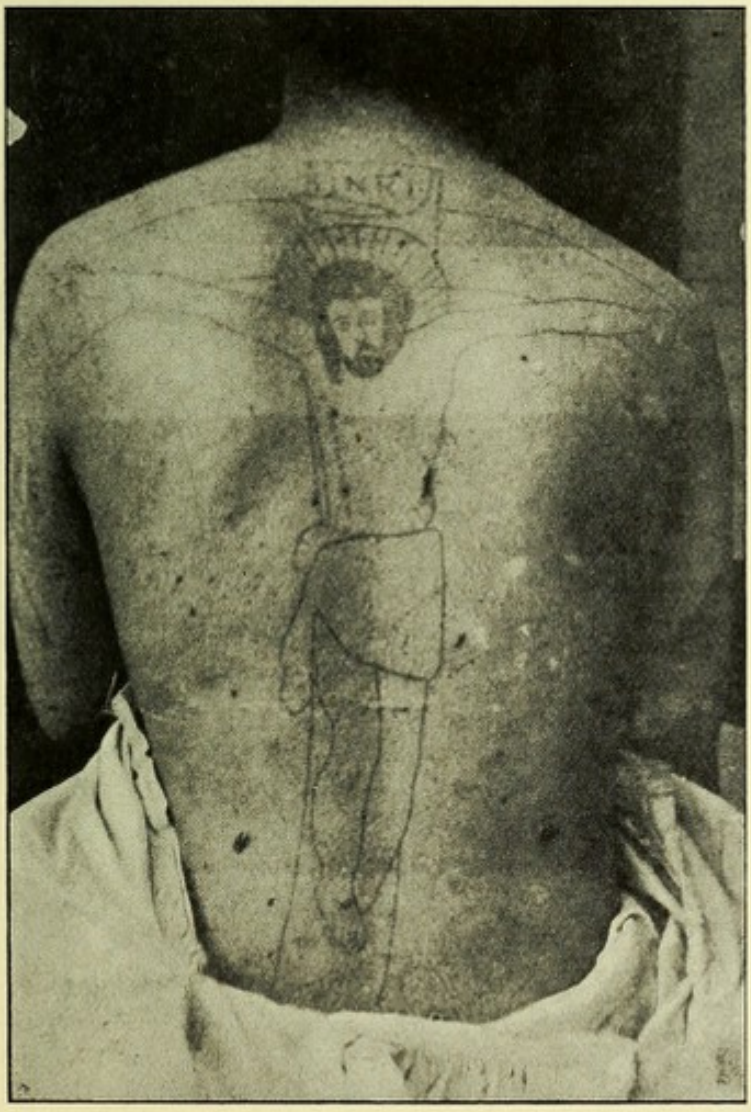


Fig. 29.—
This device covered practically the whole central part of the back.

Its drawing is crude.

May tattoo marks disappear naturally? Extended observation over a large number of cases at variably long periods after the time of their production has clearly demonstrated that such may disappear. Out of 37 cases, Casper found that *four* had completely disappeared from the skin, three had faded, and two had partially disappeared; Hutin of Paris observed out of 506 cases which came under his observation in the Hôpital des Invalides, that in 47 cases the marks had completely disappeared from the skin. Statistics need not be multiplied on this point, as it is well established. The disappearance from the skin has solely to do with the character of the pigment used, and the ratio of disappearances in any given series of cases depended upon this. The more stable the pigment, therefore — that is, the less easily absorbed—the greater the likelihood of the mark being a permanent one. Gunpowder, Indian ink, soot, charcoal, Prussian blue are the most fixed pigments; cinnabar, cochineal, ordinary ink, the least; whenever, therefore, a known tattoo mark has disappeared naturally from its original position on the skin, in all probability the colour had been originally produced by one or more of the last-named pigments. In such cases the pigments have been absorbed into the lymphatic channels, and they will be found in those lymphatic glands into which pass the lymphatic vessels from the part of skin tattooed. Marks produced by the more stable pigments are permanent for life. We have seen them fresh in colour forty and fifty years after they were made. May tattoo marks be removed by artifice? Various observers declare they may: but no one has asserted that they can be without destruction of the skin in which the pigment is located; so that a scar replaces the tattoo mark. Various methods have been devised for their removal. Skillern[1] recommends the use of glycerole of papain

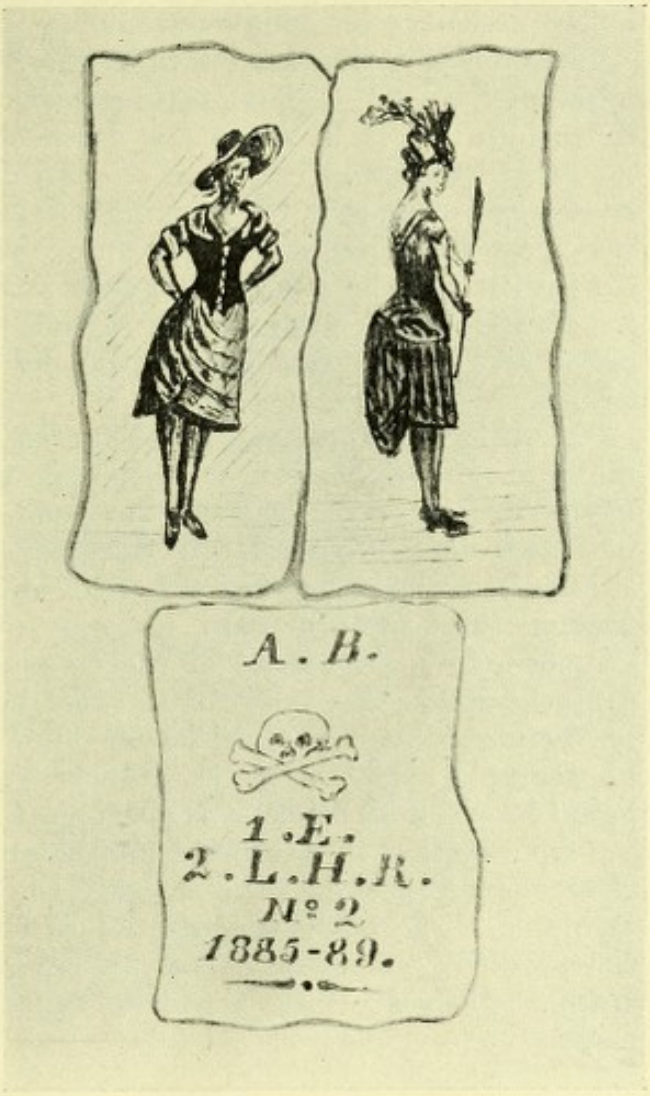


FIG. 30.—Tattoo Marks. From drawings of marks in possession of the Author, by Dr Arbuckle Brown. The lowermost device indicates clearly how Identification might be effected. The female figures were pigmented red and blue, and the inscription in blue only.

[1] *Philadelphia Medical Journal*, June 18, 1898.

as the must efficient and least painful method. The skin being first de-sensitised by chloride of ethyl spray, the marks are covered with the above substance, which is pricked into the skin as the original pigment was; then a dressing of the same material on gauze is applied to the part, and kept in position for five days. The marks at the end of that time will be disappearing. After the superficial crusts formed have separated, the procedure may be repeated, *de novo*, as many times as are necessary for complete removal.

Regarding tattoo marks, then, there are no better conclusions than those of Casper [1]—"That tattoo marks may become perfectly effaced during life; that in not a few cases they disappear so that they are no longer visible on that body when dead on which during life witnesses had often seen them, and that their existence at a former period may possibly be ascertained by an examination of the axillary glands." To this, it may be added, that such artificial methods as are necessary for their removal produce skin lesions which result in the formation of scars. (*Vide* "Les Tatouages" by Laccasagne, 1881, for further details.)

Identity by Photographs.—This, as has been noted, was an early method of identification for criminal purposes, but has been found, by itself, to be wanting. At the same time, there is a range of cases in which certain anatomical features of the face and head may be studied with advantage as an aid to identification. Photographs were used in the Tichborne case, not only of the real heir and his family, but also, for comparison, of the claimant and his family. The main differences between those of the real heir and the claimant consisted in distinguishing peculiarities of eyes, ears, nose, and mouth. In photographs which are not "touched-up," blue and grey eyes print light, brown and black eyes print dark. The only features available for examination in a hirsute person are the nose and eyes, while in clean-shaven persons, these, with the nose-furrow and mouth, are available. The angle which the eyes form with a line drawn through the middle of the forehead and nose, gives valuable evidence in a photograph. There are three prevalent types of relations, as figured below —viz.

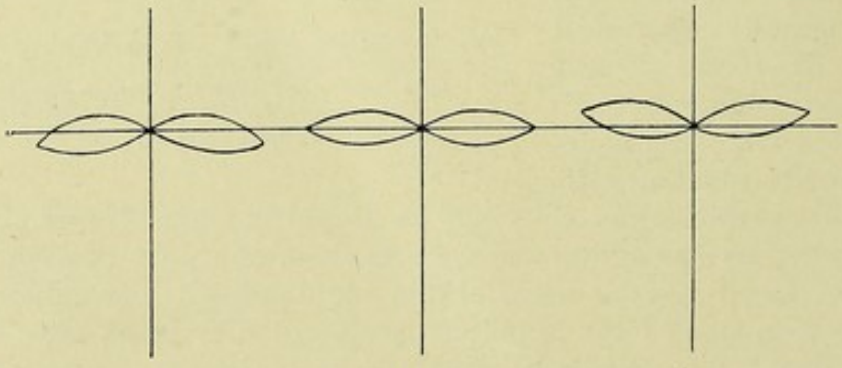


Fig. 31.

1st, where the angle is a right angle (as in fig. II.); 2nd, where it is less than a right angle (as in fig. I.); 3rd, where it is greater than a right angle (fig. III.).

[1] "Forensic Med.," Syd. Soc. Edit., vol. i., p. 109.

In the real heir (Tichborne case) the angle was greater than a right angle; in the claimant, less than a right angle. In the same way, characters of mouth and nose differ enormously in different persons. The claimant in that case had a narrow nose, set in a fat face; the real heir, a broad nose, with distended nostrils, in a thin face. The external ear is also markedly different in different persons, and is constant during life in the same person. For this reason the British Committee on Identification recommended that the ear should be part of the photograph to be put on the identification card. (Consult for further details "L'Oreille Externe," by Dr L. Frigerio. 1888. Published by Steinheil. Paris.) If photographs are produced in court to prove any point, they must be sworn to as true by the witness who produces them; and the same is true of plans, drawings, etc., in connection with criminal or civil cases. The use of water-colour sketches in criminal trials of the bodies of those done to death, has not, so far as we know, been permitted in this country. In a case, however, tried at Paris, where an unnatural father was being tried for beating and burning the body of his child until it was a mass of sores and wounds of which it died, certain water-colour sketches of the body with its wounds and injuries—painted between the time of death and thirty-six days thereafter—were shown to the jurors as evidence of the effects of the parental brutality. Counsel for the prisoner objected to their use, but after three-quarters of an hour's deliberation the court permitted their use.

Identity as affected by the use of Hair-Dyes and Cosmetics.—This question first originated in a Parisian case in 1832. A murder had been committed, and one Bênoit was suspected; he was known to have black hair. At 2 P.M. of the day of the murder, Bênoit was seen by witnesses to have black hair, but three hours later he was seen at Versailles to have fair hair. Orfila was asked the question: Was it possible for the hair to be dyed fair? His answer was in the affirmative, as Vauquelin had, fifteen years before, showed the possibility of such being done by the use of chlorine. A Parisian hairdresser, asked the same question, answered in the negative. It is a common practice to-day, mainly for purposes of rejuvenation and of fashion. The hair may be made darker in colour, or it may be changed from a dark to a lighter colour. The former is done by the agencies of dyes, which are mainly preparations of lead, silver, or bismuth, and are sold under the name of Cyprian, Ebony, Persian, and Egyptian waters. Perhaps the most common ingredient in such dyes at present is bismuth. The preparation of Naquet may be taken as a type. It is a solution of bismuth in three parts of nitric acid, to which is added a watery solution of tartaric acid, the amount of the acid being equal to one-quarter the weight of bismuth used. To this mixture more water is added to ensure complete precipitation of the bismuth. The precipitation is then filtered and washed with water until the original acidity is lost. It is then dissolved in ammonia (℥i of NH_3 to ℥i of bismuth). Then sodium hyposulphite is added to the amount of three-fourths the weight of the bismuth used, and when the salt is dissolved, the mixture is filtered, and preserved in well-stoppered bottles. It should then contain about one-twentieth of its weight of bismuth. Such a

dye produces shades of colour up to a deep chestnut. On application to the hair it loses ammonia, and deposits thereon the sulphide of bismuth. Silver preparations are applied to the hair, followed by a solution of sulphide of potassium. Indeed, in all preparations, the object is to colour the hair by a sulphide of the metal used. How to discover the presence of chemical dyes ? A portion of the hair may be cut off and steeped in dilute nitric acid; this will give a solution of the salt sufficient in quantity for qualitative examination, which can be tested in the ordinary way.

The change of colour from dark to light is effected by some agent which has a bleaching property. The change may be produced (1) by chlorinated water, (2) dilute nitric or nitro-hydrochloric acid, 1-50, or (3) by peroxide of hydrogen. Probably the last-named substance is now the most common ingredient of hair-washes intended for this purpose.

In the examination of a person who is suspected of concealing his identity in this manner, the following points will be of value :—

1. Observe whether there are parts of the hair of a different colour from the rest—due to want of uniformity of application—a very likely occurrence where the individual himself does the work ;
2. Observe whether the scalp be of its natural colour or not—since the scalp is apt to be dyed also ;
3. Note the appearance and texture of the hair itself. The hair if coloured black by dye, has lost its glossiness ; it is a dull, lustreless black. The texture is roughened, the hair feels coarser. If bleached, there is likewise loss of lustre, and the hair is brittle ;
4. Compare the hair of the head with that of other parts of the body, since the person who dyes his hair for avoidance of identity will usually confine his attention to dyeing those parts seen by the public ;
5. If in doubt, shave the hair, or cut it close, and observe, while the person is in custody, the colour of the new growth ;
6. Subject the hair to chemical analysis.

Identity from the Presence of Wounds on the Body.—On rare occasions the presence of wounds on the body may assist in associating a suspected criminal with a given crime. A few years ago, in Glasgow, a thief broke the plate-glass window of a jeweller's shop, snatched a tray of watches, and escaped. On examination of the window after the robbery, a small, almost circular, piece of skin was found adhering to the sharp edge of the fractured portion of the window. This was carefully preserved. Meanwhile the authorities looked out all the thieves whose speciality was shoplifting ; the hands of each were examined ; on the finger-tip of one of them a wound was found, not healed, of a nearly circular shape, and on the surgeon applying the piece of preserved skin it was found to fit almost exactly. Another case which fell within our own observation was as follows :—A young girl of thirteen years of age was brought to the Police Chambers by her mother, owing to the allegation of the girl that a man had criminally

assaulted her. Examination of her person proved the truth of the statement. Her genitals were bruised and swollen, the hymen ruptured, and her underclothing soaked with blood. Examination of the *locus* of the crime showed a considerable amount of blood on the flooring of the stair landing. A man, answering to the description of the girl, was apprehended, and the girl identified him as her assailant. On examination of the prisoner, with his consent, we found a recent rupture of the *frænum penis*, the inner surface of his trousers—which were of corduroy—gave evidence of blood in the seams, although they had been recently washed, and the soles and nails of his boots also gave unmistakable evidence of blood. We gave it as our opinion that the rupture was of recent origin, corresponding in point of time to that of the assault, that he had sustained the injury from forcible penetration of his organ into a cavity commensurately smaller, and that it was not likely to have been caused by intercourse with his wife. As usual, the accused strenuously denied the accusation, but at his trial before the Circuit Court he pled guilty. The above cases may be taken as exemplary of the relation of wounds leading to identity of accused or suspected persons.

Identity from Footprints.—It has been the custom in text-books on Forensic Medicine to deal with this subject at some length. We do not propose to consider the general question, as we believe this is one which may and ought to be tackled by the police authorities themselves. At the same time, the medical witness is expected to deal with the case of bloody footprints. This question arose in the famous Sandyford (Glasgow) murder case in 1862. On the flooring of the room in which the murder was believed to have been committed were certain bloody footprints, and, as at first two persons were implicated in the crime, it became of importance that the footprints should be identified. The late Sir George H. B. Macleod, Professor of Surgery in the University of Glasgow, at that time police surgeon, gave evidence on the subject at the trial. He caused the planks of the flooring on which the marks were, to be cut out *en masse*, and to be preserved. This piece was produced at the trial. There were three footprints, all of them of the left foot. The witness compared by measurement the footprints found with those of both of the persons implicated and with that of the deceased woman. The measurements did not correspond with those of the left foot either of the deceased or of one of the suspected persons, but they did correspond with those of the foot of the female prisoner, and the witness stated that, in his belief, they were footprints such as might have been made by this prisoner's left foot. In a case in the neighbourhood of Glasgow in January 1910, a thief was identified by his footprints in the snow. The nails in his boots—present and absent—conformed in every particular to the footprints in the snow, which had but recently before fallen.

Identity from Occupation Markings on the Hands.—This subject has received less attention than it ought from the medico-legal point of view. M. Maxime Vernois in a paper, "De la Main des Ouvriers et des Artisans au point de vue de l'Hygiène et de la Médecine Légale," [1] deals with some important aspects of the subject, and his paper may

[1] "Médecine Légale," 2nd series, 1862, vol. xvii., p. 180.

be perused with profit. At our suggestion Charles E. P. Cathcart, M.D., D.Sc., while a student with us, collected a large number of observations over a long period in the case of workmen treated in the Western Infirmary, Glasgow, the accuracy of which we can personally corroborate. His observations embrace the occupations of engineer, mason, hammerman, riveter, smith, joiner and carpenter, baker, weaver, coachman, tailor, violinist, miner and others.

In engineers, the most distinctive mark is (1) a callosity at the junction of thumb and forefinger of left hand, due to the friction of the chisel; in addition (2) there is a series of callosities on the projecting surfaces of the palmar aspect of the fingers and palm of right hand, due to friction of hammer-shaft. The skin of hand is also engrained with oily débris. The latter series of callosities is common, however, to all workmen who use the hammer, and they may be found on the reverse hand in the case of left-handed persons. In masons, there are (1) a series of markings as in engineers, due to friction of mallet; (2) usually, in addition, there are small callosities on the skin over the joints of right forefinger and thumb, from head of mallet; (3) there is a distinct callosity on skin over dorso-ulnar surface of first phalanx of left thumb, due to the chisel; and the hands have the feeling and appearance of dryness. In hammermen, riveters, smiths, there is a series of callosities of the right hand, as before, and also of the left. The callosities of the right hand are usually well marked on the first finger and thumb, due to the hand of the workman sliding up and down the hammer-shaft whilst at work. The skin of the hands is usually engrained with grimy dirt. In riveters and smiths especially, evidence of scorching is often found on the hands, and in smiths particularly, innumerable small cicatrices from spark-burns are often found. In joiners and carpenters (1) nearly the whole palm of the right hand, especially the back part, and base of thenar prominence, shows hardened surfaces, due to pressure of plane; while the palm of left hand may also show slight evidence of hardening; (2) callosities, due to same cause, are also formed on first and second joints of thumb, and at base of forefinger of right hand. Joiners often have the right shoulder down and the left up, due to the lopsided character of their work. In bakers, callosities are found on the second and third joints of both little fingers due to rolling out dough by hand-roller, as also a callosity on the third joint of each third finger, due to pounding rice flour. (They have, as a rule, diseased teeth, due to the lodgment of flour and want of cleanliness.) In power-loom weavers, callosities are formed on the forefinger and thumb-tips of each hand, due to the friction of the thread. Hand-loom weavers have callosities on prominent parts of "grasping" hand, due to the handle of the fly-shuttle. Coachmen show callosities between the thumb and forefinger, and between the third and fourth fingers—both of left hand—due to friction of reins. Tailors show puncture marks of needle on forefinger of left hand, and prominent position and development of "sartorius" muscle. Violinists have the tips of fingers of left hand hardened, due to pressure on strings. This is not very marked, however. Miners exhibit callosities similar to those of hammermen, due to pick-handle. Their hands and face often show small engrained blue specks due to

particles of coal-dust driven into the tissues after blasts of explosives. Dyers, photographers, and chemists have hands more or less stained with dyes or chemicals. In hat-making the hands of the workmen employed in "hat-planking" exhibit characteristic markings. Grégoirè summarises these as follows:—(*a*) general polished condition of cuticle of palmar surface of hand; (*b*) absence of hair on dorsal surface of hand; (*c*) finger-nails "ivoried" and discoloured, or loosened in terminal half or third; (*d*) terminal phalanges are short, thick, and bulbous; (*e*) callosities, "planker's segs," on thenar and hypothenar eminences. The hands of the "hat-blocker" exhibit fissures on hollow of hand, and thickening of bases of thenar and hypothenar eminences due to forcible kneading of the undyed hat "forms" which have been softened in boiling water.[1]

Identity from Handwriting.—It only happens in exceptional circumstances that a medical man may be called upon to give evidence respecting handwriting; but the question may arise (*a*) in cases where from certain paralytic or mental conditions it might be important to have an opinion whether a given person could or could not have written a document, such as a letter or a will; or (*b*) when called to identify the signature of a person to a will in which, upon emergency, a medical man had been required to write down the last will and testament of a testator. Such a duty as this a medical man should not undertake, if it be at all possible to obtain the services of a practitioner in law. However, assuming that he undertakes to do it at the urgent request of the testator and friends, the following points ought to be attended to—viz. (*a*) that the wish by the testator that the medical man undertake the duty should be expressed before witnesses who shall not be affected in any way by the provisions of the will; (*b*) that the person is in a fit state mentally to give instructions as to the disposal of his estate; (*c*) that the spoken desires of the testator be transmitted to writing in the words by which they were expressed, or as nearly as may be; (*d*) that any questions asked should only be made to make clear the terms of the will; (*e*) that after completion of the writing it should be read over clearly and deliberately to the testator, who should thereafter adhibit his signature in the presence of the witnesses, who, in turn, should sign by their full signatures, designations, and addresses, as witnesses of the testator's signature. The opinion of medical witnesses may be required in the case of disputed wills where the testamentary capacity of the testator is called in question. While the condition of the testator at the time of signature is likely to affect the writing, each case must be considered and judged upon its own merits, and no guiding principle can be laid down. In ordinary cases where identity is attempted to be established by this means, the question is usually put before experts in handwriting. It is of passing interest to note that such evidence was of considerable value in the conviction of two medical men who were charged with the heinous crime of poisoning—viz. in that of William Palmer who poisoned John Parsons Cook, and that of Thomas Neill Cream for the poisoning of more than one woman. Palmer denied that he had been with Cook the two days

[1] "La Main de L'Ouvrier Fouleur Chapelier," Annales d'Hygiène, 3, s. xxxix., pp. 133-148, 1898. Porter, *B. M. J.*, vol. i., 1902, p. 377.

before his death, but entries under these dates in his diary to the effect that he had been with Cook were produced at the trial. Moreover, in the Tichborne case, two letters by Arthur Orton, the claimant, signing himself Roger Charles Tichborne, and one by the real heir, which were shown in court, indicated clearly that the person or persons who wrote the two former, could not have written the last, and from the similarity in formation of letters of the first two, that they were in all probability written by the same person. At the same time, the revelations in the Beck case demonstrate the caution required in placing too high a value upon handwriting as a means of identification (*vide* p. 84).

Still more uncommon means of identification than those described have proved of value. In 1906 two colliers were tried at the Cumberland Assizes, Carlisle, on a charge of having broken into a store and stolen some articles of value. On examination of the premises after the deed, it was found that some person—possibly the housebreaker—had bitten a piece off the side of a cheese, and had left the marks of the teeth. Suspicion having fallen on two men, they were arrested, and one of the men permitted a cast of his mouth to be made. This was found to fit exactly the marks on the cheese. Expert evidence was given by a dentist who stated that no two sets of teeth were exactly alike. This prisoner was anxious that his mouth should be examined again to see if his teeth would fit the impression on the cheese. This was done, and it was found that since the original impression had been taken, he had knocked out a stump.[1]

[1] *B. M. J.*, vol. i., 1906, p. 343.

CHAPTER IV

IDENTITY OF THE DEAD

It will be obvious that some of the means which are open to medical jurists to establish identity in the case of living persons are equally available for the identity of the dead; as, for example, bodily markings of natural origin or of artificial production. But in the latter, the opportunity to dissect the body may materially assist in effecting identification in a way not possible in the former. The identity of the dead may require to be established under differing circumstances, as (1) in the determination of certain remains that they are those of a fœtus, and that they are of a certain age of uterine existence; (2) in establishing the identity of the sex and age, and, if possible, the cause of death of a body in which decomposition has so far advanced that identity cannot be established by ordinary visual methods; (3) in discovering the identity of certain bones which have been found, in respect to whether they belong to a human being or to one of the lower animals; (4) in identifying from certain mutilated parts of a body the sex, age, height, etc., of the person of whose body they formed a part; and (5) in other like contingencies.

In all of these conditions, however, the solution of identity resolves itself into a consideration of the following facts—viz. (*a*) with reference to *age*; (*b*) with reference to *sex*; (*c*) with reference to *stature*; and (*d*) with respect to the presence or absence of *bodily deformities or peculiarities*.

I. With Reference to Age. — The body of an unknown person being found under circumstances of suspicion, the medical jurist is expected to form some judgment with respect to its age. This, even in the case where decomposition is not advanced, is not always easy. In the case of young children, a very fair conclusion may be arrived at from the eruption of the teeth, the general development, height, and weight of the body, and the condition of ossification of the bones. But not always, from the condition of the teeth, can even an approximately accurate reply be given, for the teeth do not always appear in the order given in the books. In like manner, we may be led astray by the condition of development, and the height and weight, more especially in the case of children born and reared in cities, by reason of rickets, or syphilis, which disturbs prejudicially these factors. Advancing a little, it will be found that the difficulty does not become lessened as the scale of years is ascended. The time of onset of puberty in girls, and of virility in boys, is very variable, and although from a large mass of cases we may be able to formulate some average age at which they appear, the calculation does not apply to the individual.

It is necessary to keep in mind the possibility of precocious development. We possess the photograph of a male person, who from a budding moustache clearly visible, well-developed sexual organs and growth of supra-pubic hair, and other signs, might readily be taken for a young man of eighteen to twenty-two years, the epiphyses of whose long bones on skiagraphic examination were found, moreover, united to the shafts by osseous union, but whose age, as attested by his mother, the medical man who attended at his birth, and his certificate of birth, was only ten years and seven months. He was charged with indecent conduct to a girl at the school in which he was a pupil. Approaching middle life, the greatest difficulty is experienced, owing to the cumulative effect upon the individual of inherited conditions and of the vicissitudes of life. The worry of toil and business, the high pressure at which life is carried on in our cities, the habits of life, and the environments of existence, all produce physical effects which leave their mark upon the body, but which are difficult to appraise or predicate. Everyone is acquainted with the prematurely old man and with the comparatively active old man. Generally speaking, there is less difficulty as we approach old age, subject, however, to what has been said. The shrunken, lean person, the shrivelled, dry skin, the toothless jaws, the hollow temples and eyes, the general loss of fat from those parts which in an earlier stage of life give roundness to the form, the hard, cordy, rolling condition of the arteries, and other conditions are all indicative of the degenerative stage of life. So far, these are but general considerations which may be observed of all, and any attempt to divine the age of the person therefrom, with any claim to accuracy, will entirely depend upon the observant faculties and experience of the observer—in short, upon individual accuracy.

From this aspect, we turn to the means at our disposal in the body, anatomically, for assisting in the discovery of the age of any particular body.

In connection with charges of criminal abortion, infanticide and concealment of pregnancy, or concealment of birth, it is important for the authorities to know whether certain substances found are the product of conception, or, in the latter case, whether or not the fœtus was viable. It is requisite, therefore, that the medical witness should be able to recognise, and to fix the stage of development of, the products of conception of the first few months of pregnancy, and also the appearances of the fœtus in the later months of pregnancy.

Development of Fœtus.—I. *At end of First Month*: The entire ovum is about the size of a pigeon's egg, and measures about $\frac{3}{4}$ of an inch in diameter. The chorion is entirely covered by villi. The umbilical vesicle is fully developed. The embryo itself measures about $\frac{1}{3}$ inch in length. The caudal extremity is well marked. The eye-spots appear as dark dots, and the limbs appear as buds or dot-like processes.

II. *At end of Second Month*: Between 5th and 6th week, the embryo measures about 15 mm., or $\frac{5}{8}$ of an inch in length. The bud-like limb processes begin to show evidence of three distinct segments—the rudimentary arm, forearm, and hand—and of the lower limb, the thigh, leg and foot. By the end of the 8th week, the fœtus measures about 22 mm. in length, and the caudal extremity shows signs of disappearance. The rudimentary eyelids begin to appear, and also the concha of ears. The whole chorionic sac measures about 40 mm. in diameter.

III. *At end of Third Month*: The fœtus measures from 55-75 millimetres—2½ to 3 inches. Weight about 4 ounces. The head becomes more rounded. The development of the ribs is now seen. Sex is still indefinite. Rudimentary nails, like thin membranes, appear on fingers and toes. The placenta is formed and differentiated. The umbilical vesicle and allantois have disappeared.

IV. *At end of Fourth Month*: Length = 5 to 7½ inches; weight, from 3 to 9 ounces; skin of fœtus is rosy in colour and fairly dense; mouth is large and open. The *membrana pupillaris* (which corresponds to the *membrana nictitans* of birds) is very distinct; the nails on fingers and toes begin to appear. The genital organs are sufficiently developed to enable sex to be recognised; downy hair appears on the body and scalp; meconium may be found in very small quantities in the intestine. The umbilicus is situated nearer the pubes than the centre of the body.

Points of *ossification* may be found in *occipital, sphenoid, nasal,* and in *squamous portions of temporal* bones; also in the *ischium,* and in the *upper part of sacrum and pubes.*

V. *At end of Fifth Month*: Length = 6 to 10 inches; weight = 6 to 12 ounces; the head is disproportionately large to the size of body; the nails are now distinct; growth of hair advances; skin, as yet, does not show sebaceous secretion; the kidneys are large and lobulated, like the permanent condition of those of a sheep; germs of teeth appear in the jaw-bones.

Additional points of *ossification* are to be found in the *os calcis,* and *pubes,* in the *atlas vertebra,* and *odontoid process of axis*; there is ossification of *stapes* and the *petrous portion of temporal bones.*

VI. *At end of Sixth Month*: Length = 9 to 12½ inches; weight = about one pound; skin is now divisible into *cutis vera* and *epidermis,* and is wrinkled; eyelids still closed by *m. pupillaris*; umbilical cord is situated a little above pubes; hair of eyebrows and eyelashes begins to form; the *testes* are found lying close to the kidneys; cerebral hemispheres now cover cerebellum.

Additional points of ossification are to be found in the *four divisions of sternum,* and a *middle point,* at *lower end* of *sternum.*

VII. *At end of Seventh Month*: Length = 13 to 15 inches; weight = 3 to 4 pounds; nails do not yet reach the extremities of the fingers; *membrana pupillaris* now practically disappears, at least, it has become so thin and transparent that it is difficult to detect; *testes* are found in the act of descent towards the scrotum, in the vaginal process of peritoneum; cerebral convolutions now begin to appear.

Additional points of ossification are now found in the *first sacral vertebra.*

VIII. *At end of Eighth Month*: Length = 14 to 17 inches; weight = 4 to 5 pounds; sebaceous secretion begins to be formed on skin; the nails now practically reach the extremities of the fingers; *membrana pupillaris* has now entirely disappeared; one testis, usually the left, may be found in the scrotum, the other, the right, is well advanced in its downward descent.

Additional points of ossification are found in *second* and *last sacral vertebræ.*

IX. *At end of Ninth Month*: Length = 18 to 24 inches; weight from 6½ pounds upwards, the average weight being about 7 pounds. (Children, however, have been born weighing 12 pounds and 15 pounds.[1]) The centre of body is about three-quarters of an inch above the umbilicus; hair is found on scalp and on portions of body; sebaceous secretion is likely to be found in flexures of joints, and more or less over the whole body; both testes are in scrotum; the finger nails are fully formed and developed; the occipital bone is yet divisible into four osseous parts.

Additional point of ossification of importance is that found in the *centre of cartilage at lower extremity or epiphysis of the femur.*

What, now, are the means whereby the age of a child after birth may be ascertained? The easiest test is the eruption of the milk-teeth. On the average, the respective periods of eruption of the different teeth are fairly constant in point of time. At the same time,

[1] *B. M. J.*, vol. i., 1901, p. 16; and vol. ii., 1901 s., p. 103; vol. ii., 1899, p. 1543.

it ought to be remembered that these teeth may appear either abnormally early (indeed, some of them may, in certain rare cases, be present at birth), or their appearance may be abnormally deferred, the cause of the former usually being precocious development due to factors not yet well ascertained, but which are generally believed to be hereditary, and of the latter, hereditary disease. Precocious dentition has been frequently recorded, and probably no one has done more research in this direction than Ballantyne of Edinburgh, whose teratological researches are worthy of much praise. The teeth which usually signalise this precocious dentition are the central incisors. We have seen three such cases, in all of which the upper central incisors were congenital teeth. For a complete account of recorded cases, however, the reader is referred to a paper by Ballantyne, in which many cases are given.[1]

The following Table may be held to indicate approximately about what periods the different milk-teeth appear :—

I.	Central Incisors,	from	6th to 7th	month.
II.	Lateral do.	,,	7th to 10th	do.
III.	First Molars,	,,	12th to 15th	do.
IV.	Canines,	,,	15th to 20th	do.
V.	Second Molars,	,,	20th to 36th	do.

These temporary, or milk, teeth number twenty in all.

In addition to the evidence obtainable from this source, certain concurrent information may be obtained from examination of additional centres of ossification.

At one year : { In *lower* ends of humerus and ulna ; in *heads* of humerus and femur ; in the upper part of tibia.

About one and a half years : The anterior fontanelle is rapidly closing, except in rickety and syphilitic children.

At two years : Ossific points appear in *lower* ends of radius, tibia, and fibula.

The temporary teeth begin to be shed from the fifth to the seventh year. It ought to be noted here that in exceptionally rare cases the appearance of teeth may be delayed for a very long time. We have examined a boy of eleven years who did not then possess, and never had possessed, any teeth, and judging from the appearance of the jaws, was not likely ever to have any. A case is recorded of a man who never had any teeth till the age of 54, when the only tooth he ever had, the upper right canine, appeared, only to disappear, however, a year later.[2] It must further be remarked that the temporary teeth, or some of them, may be retained till advanced adult age ; we have seen them in a man over sixty years, in whose upper jaw especially, there was a double row of teeth. Between the ages of two and six to seven years, we must look for guidance to centres of ossification.

At two and a half years : Points of ossification (additional) in *head* of *humerus* ; in *lower ends* of *four last metacarpals* ; and in *patella*.

At three years : In the great trochanter of the femur.

At four years : In the *second and third cuneiform tarsal* bones.

At four and a half years : In the *smaller tuberosity* of *head* of *humerus*, and in *head* of *fibula*.

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[1] *Edin. Med. Jour.*, vol. xli., p. 1025.

[2] *B. M. J.*, vol. i., 1902, p. 1660.

At six years: The *descending ramus of pubes* meets the ossification of the *ascending ramus of the ischium.*

About this period the permanent teeth begin to be erupted. The following Table indicates the average ages at which the permanent teeth begin to appear in the mouth :—

I. The first Molars,	about	6th to 7th year;
II. The middle Incisors,	,,	7th to 8th year;
III. The lateral do.	,,	9th year;
IV. The first Præmolars, or Bicuspids,	,,	10th year;
V. The second Præmolars,	,,	11th year;
VI. The Canines,	,,	12th to 12½ year;
VII. The second Molars,	,,	13th to 14th year;
VIII. The third do. or Wisdom teeth,	,,	20th to 24th year.

It will thus be seen that the first molars appear about the seventh year of age, the second molars, about the fourteenth year, and the third molars, about the twenty-first year. Probably there is greater uncertainty respecting the time of eruption of the third molars than of the others; indeed, in some rare cases, they do not appear till adult age is well advanced. Of 1046 children examined by Mr Saunders,[1] 389 out of 708 of 9 years of age had the number of teeth corresponding to the above table. If we accept his principle that "where the teeth of one side are fully developed those of the other side should be reckoned," then 530 of the 708 came up to the standard. Of the remainder (1046 – 530), 516, the age could be arrived at within one year of the actual age from the appearance of the teeth alone, and that one year less than it really was. Spokes [2] states that of 638 boys between thirteen and fourteen years of age, 62 per cent. had all four second molars erupted, 4 per cent. had all absent, 5 per cent. had three absent, 7 per cent. two absent, and 7 per cent. one absent. Of 492 boys between fourteen and fifteen years, 82 per cent. had all four second molars and 92 per cent. had three erupted or visibly erupting. Since for the purposes of the Factory Acts medical inspectors must, in the absence of certificates of birth, arrive at the ages of employed children in order to conform to the age-requirements of the Acts, it is important to keep in mind the foregoing data.

In the adolescent state from fifteen years upward, an approximately accurate estimate of the age can only be given by attending to the additional centres of ossification and the progress of that ossification in the unification of bones.

At *eight years*, ossification is established in *upper end* of *radius*; at *nine years*, the *ilium*, *pubes*, and *ischial* ossific centres meet together in the cotyloid cavity —the acetabulum—to form the *os innominatum*. At *ten years*, ossification begins in the *epiphysis* of the *olecranon*; at *twelve*, the bony nucleus of the *pisiform bone* appears; at *thirteen*, the union of the three parts of the *os innominatum* is nearly complete, though they are still separable; and an ossific

[1] "The Teeth a Test of Age," 1837.
[2] *B. M. J.*, vol. ii., 1905, p. 568.

point appears in the *lesser trochanter* of the *femur*; at *fourteen*, about *twenty more ossific points* appear; in *sacrum*, in the *epiphysis* of *crest of ilium*, in *anterior inferior spinous processes*, *ischial tuberosity*, and *symphysis pubis*. At *fifteen years*, the *coracoid process* unites with the main part of the scapula, and the *two nuclei* of the *acromion process* appear; at *sixteen*, the *olecranon* process *unites* with the *rest of ulna*. Between *eighteen* and *twenty*, the *upper epiphysis* of *femur* is joined to the shaft, the *epiphysis* of the *sternal end* of *clavicle* ossifies, the *superior epiphysis* of *humerus* unites with the *shaft*, and the *inferior epiphyses* of *radius* and *ulna* with their respective *shafts*; and in like manner, the *epiphyses* and *shafts* of the *metacarpals* and of the *phalanges* unite. At *twenty*, the *upper* and *lower epiphyses of fibula*, and the *lower epiphyses* of *femur unite* with their *shafts*. *At twenty-five*, the *epiphysis* of the *sternal end of clavicle* and the *epiphysis* of *crest* of *ilium unite* with their respective bones. And from twenty to thirty years of age, ossific plates form on bodies of the vertebræ.

An individual may, therefore, be said to be of adult age when the epiphyses of all the bones are united to their shafts, and when the wisdom teeth are present.

After apparent adult age has been attained, and particularly toward later adult age, some indication of more exact age may be ascertained from the following—viz.

(1) From the angle which the neck of the femur forms with the shaft.

Before puberty the neck of that bone has an oblique direction, constituting an easy curve from the axis of the shaft; in the adult, it forms an obtuse angle; and in old age, it becomes more horizontal, the head falling below the level of the trochanter.

(2) From the dentulous or edentulous condition of the jaws. As age advances the teeth are lost either from disease in themselves, or from the gums and alveoli losing their hold of the roots. This process, however, is expedited by the facility with which artificial indentures may be supplied.

(3) From degenerative changes in certain parts of the body; (*a*) ossification or calcareous deposits in parts usually cartilaginous, such as the larynx and costal cartilages; (*b*) thinning, from absorption of the bones of the skull, scapula, etc.; (*c*) atheromatous or calcareous changes in the coats of the arteries; (*d*) the *arcus senilis*; (*e*) the altered angle of the ramus of the lower jaw.

With respect to the age of the body of which mutilated remains only are available for examination, the question of age can, usually, be answered only in a general way. The ability to answer will depend very largely upon the parts available for examination, both with respect to their amount and to their variety. In the Wainwright murder case, the age of the victim—Harriet Lane—was considered to be about 25 years, because of the presence of the wisdom teeth. In other cases, the distribution of hair upon certain parts of the body, the condition of the bones in the parts found with relation to ossification and muscular markings, and the appearance of the teeth, will assist in the determination.

II. With Reference to Sex.—Any difficulty on this question can only arise in the examination of bodies of those of doubtful sex—so-called hermaphrodites—or where decomposition is so far advanced

that the external and internal organs of generation have disappeared, either from exposure in the air or water, or after burial in the ground, or where portions only of a body are available for examination.

The general characters which differentiate the sexes may be summed up as follows :—The male is generally of larger build than the female, although the effeminate male and the masculine female must be kept in recollection ; the adult male is broader at the shoulders than at the hips, the adult female, the reverse ; muscular development is more marked in the male than the female ; hair only covers the *mons veneris* in the case of the female, but it covers the pubes and may extend upwards on the abdomen, and more or less, over the anterior surface of the chest, in the male ; while the hair of the male head according to the custom of civilised peoples is shorter than that of the female. The larynx of the male is more developed forward in the *pomum Adami* than that of the female. In the case of mutilated remains, identity is only likely to be accurate when those parts of the body bearing characteristic sexual parts are available. In this connection it is well to remember that the uterus is about the last, if not, indeed, the very last organ of the body, to resist putrefaction ; consequently when abdominal remains are available, this organ or its appendages ought to be carefully looked for. Should this organ and the appendages be absent, however, then we must fall back upon the disposition of the hair on the body, the presence or absence of the mammæ, the presence or absence of *lineæ albicantes*—as indicative, most probably, of previous pregnancy—and any external sexual remains which may be left attached to the pubes. In the Wainwright murder case, for example, the body was very roughly divided into ten parts—so roughly, indeed, that parts of the pelvis were cut with the thighs, which *a priori* indicated absence of anatomical knowledge. But the presence of the uterus, and of *lineæ albicantes* on the skin of the abdomen enabled Mr Larkin to say that the remains were those of a woman of adult age, who had borne, at least, one child.[1] Again, in the case of a London mystery which occurred in 1857, Dr Taylor was able to discover the sex to be that of a male from the appearances of the bones, and from a portion of the *corpus cavernosum penis* of one side which was left adherent to the ischium.

The following case in which we were engaged very well illustrates some of the problems which have been dealt with, and others yet to be discussed. We were asked to make an autopsy of the remains of the body of a young person which had been jammed into a Gladstone bag, the bag for some months prior to the discovery of the remains having been concealed in a trunk belonging to a young woman. The discovery was brought about by reason of the horrible stench which they occasioned while the trunk was in the house of some people with whom the young woman lodged. The circumstances of the case as they came out at the trial were these. Between five and six months before the above discovery was made, the young woman, whom we shall call X., came home to nurse her mother, who had, after the death of the young woman's father, cohabited with the brother of her deceased husband, to whom she bore children. The mother eventually died a few weeks after the young woman's arrival. About that time, one of the children of this illicit connection—step-sister to the young woman—took ill, and within a few days disappeared. To some neighbours the young woman told the story that the said child had been sent away

[1] *B. M. J.*, Dec. 11, 1875.

to some friends of her mother, to others, that she was sent away to a hospital in Glasgow to be treated. The child never returned. It was proved in evidence that this young woman continued to take the monetary parochial relief which had been given during the life of the mother for the maintenance of the mother and the children, including the one in question, up till the time of her apprehension on the charge that she had put this child to death. Post-mortem examination of the bodily remains showed that the body was in a very advanced state of decomposition, the head, trunk, and limbs being practically devoid of soft parts,—in short, the body was substantially skeletonised. By cutting open the bag, it was evident, from the attitude in which the body was found, that it had been thrust with great violence into this confined space—because the bag was comparatively small. In the bag, and covering, to some extent, the body, was a piece of woollen shawl, and, on the body itself, were the remains of an ordinary chemise. Round the neck—or the cervical vertebræ, for that was all that was left of the neck—was a piece of ordinary unbleached cotton cloth, in the form of a band. This encircled the neck twice and was tied in a double knot, but it was continued up on the face, where, in a spread-out fashion, it formed a tightly applied covering over the nostrils and mouth. The hair of the scalp, which was abundant in quantity, was of a light-brown or mouse-brown, colour, and was much matted. When the body was stretched out as straight as possible, it was found to measure between 33½ and 34 inches, but when allowance was made for the loss of the soft structures of the soles of the feet and of the scalp, the total height would, in all probability, reach about 35 inches. This height, therefore, corresponded to the average height of a child about four years of age. From the very advanced state of putrefaction of the external generative organs, the evidence of sex could only be obtained from what remained of the much-decomposed abdominal organs, which were irrecognisable as they presented themselves, being fused together into a shapeless mass. However, by careful dissection and examination, we were able to detect anatomical remains of the muscular portion of the vagina, and of the uterus ; thus showing the body to be that of a female. The other determining factors were (*a*), the height of the body, which has been already given ; (*b*), the condition of the bones ; and (*c*), the condition of the teeth. The height was about 35 inches. The long bones of the limbs were immature in structure, the epiphyses being composed partly of cartilage and partly of bone. The total number of teeth present in the mouth at the time of examination was fifteen, but five vacant places in the front of the jaws showed where teeth had been present, but had fallen out during putrefaction and by the handling of the body. The total number of teeth which had been present in the jaws was, therefore, twenty in all. All of these were fresh and good, except the back molars on each side of the lower jaw, which were carious. Keeping in mind that, in the average child, the twenty temporary teeth are usually all present from the age of two to two and a half years and that they remain until about the age of seven, when the permanent teeth begin to erupt, we were able to say from this, and from the other facts named, that the remains were those of a child about the age of four, and, judging from the appearance of the teeth themselves, that the child had no evidence of inherited disease nor was the subject of chronic ill-health. From the examination of the remains, of which the preceding is a summary, we reported to the criminal authorities the following as our opinion—viz.

(1) That the body was that of a female child of about four years of age ;
(2) That the body had been violently crammed into the Gladstone bag ;
(3) That the body had lain in the bag for a period of from four to six months ;
(4) That, by reason of the absence of the soft parts of the neck, and of the internal organs of the chest through decomposition, we were unable to state what was the cause of the child's death ;
(5) For the same reason, we were also unable to say whether the cloth which was found round the neck in the form of a band, and which had been evidently tightly applied over the mouth and nose, had been applied equally tightly round the neck, or whether the cloth had been applied during life or after death.

In a subsequent Report to the criminal authorities in reply to the question—Whether, assuming that the cloth was tied over the face during life, it was in

such a position, and of such a texture, as to cause death by suffocation, we stated it as our opinion that, on the above assumption, the application of the cloth tightly over the mouth and nostrils during life would, undoubtedly, cause death by suffocation, which would be more certain, by the cloth-band or ligature round the neck, on the same assumption.

In a more recent case, we had to examine certain human remains which had been found hidden behind the woodwork of a water-closet fitting in a tenement closet. The remains were far advanced in decomposition : the upper part of the body and the head were skeletonised, and the lower parts mummified. They were the remains of a young infant. It was impossible to form an opinion as to the sex or the cause of death. It appeared to us to have lain in the place for a period of at least nine months.

Returning, however, to the discussion of the general case of identity with reference to sex, it may be necessary for the medical jurist to pronounce an opinion as to the sex of adult skeletal remains. By consideration of the character of the long bones with reference to muscle-attachments, and especially of the shape and dimensions of the pelvis taken as a whole, such an opinion may usually be arrived at having a good claim to correctness. Generally speaking, the bones of the female skeleton are lighter, are not so large, and muscle-attachment marks not so pronounced, as in the male. Again, the angle of the neck of the femur with the shaft may be of some assistance ; in the female, it approaches more to a right angle, by reason of the greater transverse diameter of the pelvis, whereas in the male it is more of an obtuse angle. The pelvis, however, must be reckoned as the chief means of differentiating sex in a skeleton. Contrasted with the male pelvis, that of the female has the following points of difference, due entirely to the preparation for child-bearing ; the pelvis is shallower, and is of greater dimensions in its transverse, oblique, and antero-posterior diameters ; its cavity is, therefore, more capacious, the bony framework is less massive, is smoother, and what parts are angular in the male are rounded. The alæ and crests of the ossa innominata are spread farther apart ; the sacrum is wider and flatter, and, in consequence, the promontory of the sacrum is less prominent ; the thyroid foramen is smaller and of a triangular shape ; the arch of the pubes is wider and more curved.

Translated so far as may be into figures, the following Table shows the typical measurements of the diameters of the female and male pelvis respectively :—

Diameter.	Male Pelvis.	Female Pelvis.
Anterior-posterior, or Conjugate .	4 inches.	4½ inches.
Oblique	4¼ do.	5 do.
Transverse	4½ do.	5¼ do.

III. With Reference to Stature. — The calculation of stature comes to be a matter of necessity only when the examiner is called upon

to deal with a skeleton, more or less complete, or with a few bones only. Any calculation, so worked out, must depend for its correctness upon the presence, practically, of one complete half of the skeleton so far as the limbs are concerned, of the vertebral column, and of the skull; otherwise, it cannot be considered free from error to the extent, probably, of inches. The best way to determine the measurement in such a case is to place the bones in their anatomical relationship to one another, on a soft bed of potter's clay, making certain allowances for the soft parts, and then to measure. The height thus ascertained, with $1\frac{1}{2}$ inches added, will approximately equal the height of the person. We are disposed to discount very largely any conclusions from averages, because, up till now, observations have been made upon too few cases in any given series to pretend even to any average accuracy. A rough and ready method, applicable to certain parts of a skeleton, is based on the fact (which is, however, approximately correct only), that the height of a person corresponds to the measurement from the tip of the middle finger of the one outstretched arm, across the chest, to the tip of the middle finger of the other outstretched arm; applying this principle to the skeleton, it may be roughly reckoned that the sum of twice the length of the bones of the arm, twelve inches for the clavicles, and one and a half inches for the supra-sternal notch, will equal the height of the body. Such a rule, however, loses any accuracy it may possess for the average male, in the case of the female.

What is sometimes an interesting question, although it but rarely emerges into one of extreme medico-legal importance, is where a quantity of bones have been discovered in some secret place all huddled together, whether the bones are those of a human being or those of an animal; or, whether there are some of both. The case usually presents no difficulty to the individual who has the necessary knowledge of human osteology, such as the student of medicine or a medical man, especially where the bones of a more or less complete skeleton are found. The late Professor Ogston [1] adduces the following illustrative case. In a certain house in Aberdeen which had been inhabited by a woman who was executed in 1824 for the murder of her husband by "pouring oil of vitriol down his throat when drunk in bed," a quantity of mutilated and charred bones were found under the hearth-stone of one of the apartments. He was asked to examine them, and, after doing so, concluded that they were the bones of a sheep. A similar case fell within our own experience in the demolition of a house in Glasgow for railway purposes, and here, also, the bones were those of a sheep. It may be wondered why all this secrecy about the bones of a sheep; but when it is explained that proof of the stealing and killing of a sheep was followed by capital punishment, the reason for the secrecy becomes more apparent.

There are certain outstanding points, however, on this subject with which medical men ought to be acquainted.

In the skull of the lower animals the *foramen magnum* is placed farther back, and the posterior edge of it is turned more upwards, than in Man. In all

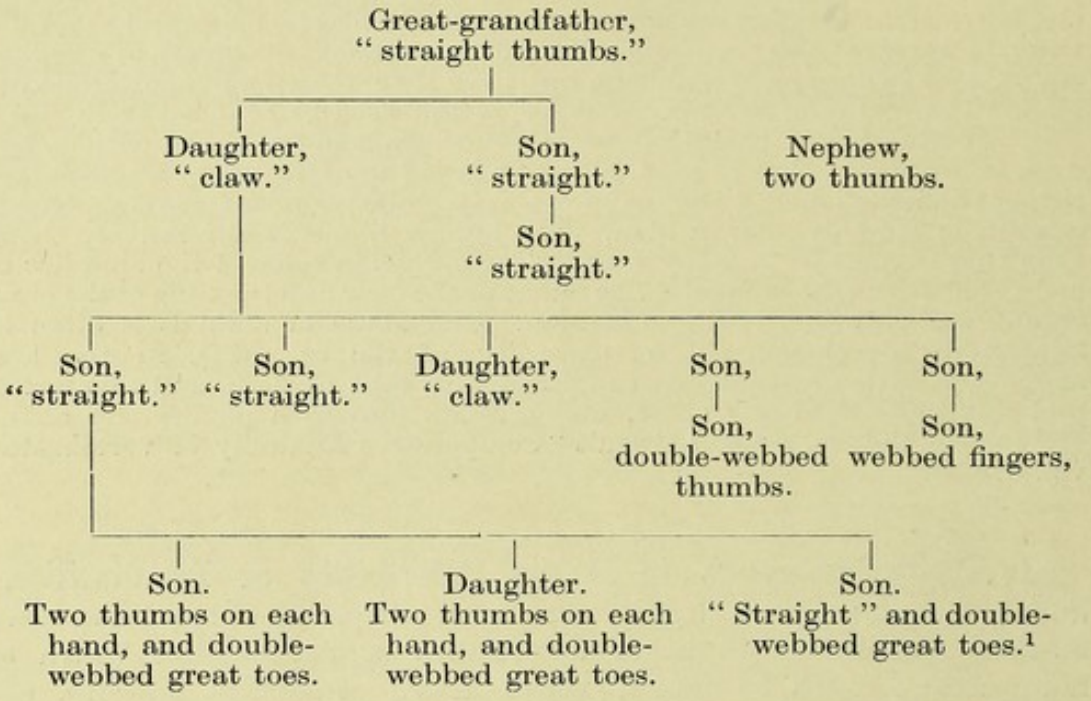
[1] "Lectures on Medical Jurisprudence," p. 73.

the lower animals, there are two more bones in the face—viz. the inter- or premaxillary bones ; and none of the lower animals possesses a protuberance at the chin. The dorsal vertebræ are, generally, more numerous in animals. The pelvis is narrower, more elongated, and its brim, more oblique. The sacrum is also narrower. Many of the lower animals do not possess clavicles : Apes have them, however, as also those animals which have prehensile hands, or fore-limbs adapted for swimming or paddling, but, even then, they are not so perfect as in Man. The sternum, in many animals, is flattened or rounded from side to side, not from before backwards as in Man. That of the orang-outang, however, is not unlike that of Man, although it is thinner, narrower, and its constituent bones are more widely separate. The infrascapular fossa is much more marked in animals than in Man. The human humerus is relatively shorter than that of animals in many cases. The carpus in some of the apes has one more bone than that of Man. The femur of the bear and the tibia of the orang-outang are very like to those of Man. The fibula of animals is often but imperfectly developed. The tuberosity of the *os calcis*, in the lower animals, is little developed as compared with that of Man, and this feature, probably more than any other, distinguishes him as a plantigrade animal. For further details, consult Owen's "Comparative Anatomy of Vertebrates," vol. ii.

IV. With Reference to Bodily Deformities or Peculiarities.—So far, these have been already considered in treating of scars and tattoo marks. But there are other deformities or peculiarities which are noteworthy; such as moles, warts, nævi, congenital hare-lip, cleft palate, congenital deformity of hands or of other parts of the body, such as defective development of the ribs; sexdigitalism; hammer-finger; brachydactylism; supplementary mammæ; artificial indentures, and tooth-stopping; effects of old disease in joints; old dislocations; fractures; occupation markings; and others which need not specially be enumerated. Most deformities or peculiarities may be considered as due to deficiency or exuberance of development. To the former, belong hare-lip, cleft palate, defective development of ribs, and defections in the anatomical perfection of the hand or foot, such as absence of fingers, or *webbed* fingers or toes. To the latter, may be relegated supplementary mammæ, and sexdigitalism or supernumerary fingers or toes, the latter of which is distinctly a hereditary phenomenon. Dr Young[1] has recorded a singularly interesting case of this, in which he was able to trace the hereditary defect through four generations, and to demonstrate that the original possessor of the deformity had transmitted it to eleven male and female descendants. We have also notes of a case in which we were able to trace it in the male line only for three generations. In Dr Young's record, the great-grandfather possessed what the family called "straight thumbs," the anatomical characteristics of which were these : the terminal joint of the thumb was ankylosed, the phalanges were broad, "as if two thumbs had been begun to be formed, producing, however, single flat phalanges with a single broad nail : the first phalanx, moreover, is longer than normal, while the terminal phalanx is short." Associated with this original deformity, in succeeding generations, was either a repetition of the original deformity, or the existence of two separate thumbs, or "claw" thumb, with webbed fingers, or toes. The following

[1] *B. M. J.*, Sept. 10, 1898, p. 715.

is a chart given by Young illustrative of the progressive family history of the deformity :—



Dr Guthrie Hunter — a former student — has sent me notes of hereditary polydactylism, traceable through six generations, the deformity consisting of six toes on each foot, but without deformity of the hands.[2]

Dr Scott has recorded a series of seven cases of hammer-finger occurring in one family, with illustrations.[3]

Mistaken Identity.—In spite, however, of the clue to identity which such deformities ought to give, it is very remarkable how mistakes do arise therefrom. The following cases are illustrative :—Dr

[1] For other references to deformities of other kinds, consult :

B. M. J., July 22, 1899, p. 253
do. May 13, 1899, p. 1150
do. July 1, 1899, p. 58
do. Dec. 3, 1898, p. 1732
} Deformities of Ribs.

Geipel (*Munch. med. Wochens.*, March 7, 1899), Congenital Absence of Shoulder and Arm Muscles.

Virden (*Pediatrics*, vol. vii. p. 351), Congenital Displacement of Scapula.

Mazzitelli (*Archiv. di. Ortoped.*, Ann. 15, f. 5, 98), Congenital Absence of both Fibulæ (120 cases).

Appert (*France Méd.*, May 26, 1899), Cardio-thoracic Malformations.

B. M. J., July 29, 1899, p. 273, Rare Abnormality of Mouth.

Cautley, *B. M. J.*, Aug. 19, 1899, p. 468, Abnormal Ossification of Parietal Bones in an Infant.

Salt, *B. M. J.*, Mar. 3, 1900, p. 509, Supernumerary Nipple.

Templeton, *B. M. J.*, May 6, 1899, p. 1089, Axillary Mamma.

[2] *Australian Medical Gaz.*, 1909.

[3] *Glas. Med. Jour.*, Nov. 1903.

Kinloch[1] narrates the facts of a case which shows how this mistake actually arose. The body of an old man, having the forefinger of the left hand and the left ear awanting, was found on the banks of the river Dee. The body was claimed by two young women as that of the body of their father, he having the like deformities, and, also, a proclivity to wander from home. They buried it as the body of their father. On returning from the funeral they had to cross a ferry. The ferryman interrogated them for whom they were in mourning, to which they replied, they had just come from burying their father. He said that surely could not be, as half-an-hour before, the old man, their father, had crossed with him in his boat. On their arrival home, they found their father awaiting them. A few years ago, the dead body of a woman was found on a public highway and was taken to Johnstone for identification. The first claimant of the body was a woman who thought the body was that of her mother who had been amissing for nine months, but she was unable to identify the clothing on the body. The second was a man from Paisley who believed the body was that of his mother, in which belief he was corroborated by his sister, who, after seeing the body, likewise declared it to be her mother's body. They made arrangements for burying the body, and had it put into a coffin.



FIG. 32.—Sexdigitalism or Supernumerary Digits.

We are indebted to Dr Edgar W. Sharp—a former student—for the use of this photograph.

The two extra digits are articulated with the distal end of the metacarpal bones of the respective thumbs. The left extra digit had three phalanges, the terminal one being rudimentary; the right had only two phalanges. Each had a distinct arterial supply, a rudimentary flexor tendon, and a finger-nail. The deformity was hereditary. The father had one extra digit arising from base of right thumb; one of his sisters—the boy's aunt—had the like deformity; but the rest of that family—nine in number—were free from it. One of the brothers of the boy's grandfather, however, had the same deformity.[2]

[1] *Edinburgh Medical Journal*, Feb. 1854.
[2] *B. M. J.*, vol. ii., 1901, p. 714.

Just as they were removing the coffin, a man arrived from Port-Glasgow who expressed a strong wish to see the body, because his mother-in-law had gone amissing. As the coffin was screwed down, he was first asked to examine the clothing, after which, he declared that the clothing was that of his relative, as he specially recognised the new shoes with which he had provided her shortly before she left his house. An altercation thereupon ensued between the claimants for possession of the body, until at last the supposed daughter declared that her mother had an ulcer on the leg, which would decide the matter. The body being then examined, and no ulcer being found, she had to forego her claim, and the man from Port-Glasgow was left in possession of it ; and he interred it as the mortal remains of his mother-in-law. A third case which occurred in Dublin in December 1897 is even more remarkable. The dead body of a woman was taken out of the canal, and was identified by a man and some neighbours as that of the man's wife : the three sons, however, declared it was not the body of their mother, because of the colour of the hair. An inquest was held, and a verdict was returned of " Found drowned." The body was interred by the family, and some insurance money was paid over by a burial society. But to the amazement of the husband and family, the wife and mother returned home after her supposed interment, hale and hearty. What doubtless helped to the mistake in identity in this case was the fact that the deceased and the person for whom she was mistaken had the like accidental marks over the eye and on the nose, and each had the same number of teeth awanting.

In a case in Glasgow in 1904, the body of a man was recovered from the Forth and Clyde Canal. Two days later it was identified by no fewer than ten persons as the body of a particular person. Those who identified included a daughter-in-law and three police officers. The death was duly registered under that name, and the remains interred. Some days later, an inspector of police who knew the supposed deceased man well, saw the man himself in the street. When the man was told of his supposed death he was both astonished and amused.

In another case in 1906, which occurred in Staffordshire, the body of a man was fished from a canal. It was identified by a daughter as that of her father. An inquest was held by the coroner, and the jury returned a verdict of suicide during temporary insanity. The body was awaiting burial by the family, who had taken possession of it, when the daughter received a letter from her father, stating that he had read about the affair in the newspapers, and " instead of having committed suicide, he was quite well, and was going to start work on Monday." Such cases might be indefinitely multiplied.

While the foregoing cases read more like fiction than fact, they are but typical of many like mistakes. Such mistakes usually arise only when the facial features are changed past recognition, most usually in the case of bodies that have lain in the water for some time ; and also, from the desire of mourning relatives to satisfy their grief by interring *a* body. On the skeleton itself there may be left such marks as may lead to identification ; for example, the body of Dr Livingstone—the celebrated missionary and African traveller—was identified on its arrival in this country by the ununited fracture of the humerus which

had resulted from the bite of a lion occasioning his remark on the incident that the lion " shook me as a terrier dog does a rat." In the same way diseases of bones, of joints, fractures of the skull from violence, or badly united fractures of long bones may leave such marks as may lead to identification when the body has been reduced to a skeleton. The only occupation-marking which leaves a permanent deformity on the skeleton is that of shoemakers from the pressure of the last—a deformity, however, which is becoming rarer from machine-making taking the place of hand-making—and which consists in a marked indentation of the sternum.

The following random cases from our notebook indicate how identity may be established in cases of drowning where decomposition has far advanced :—

1. J. M.—by a black band worn on left wrist ;
2. J. P.—by the right hand being awanting from a former accident ;
3. H. W.—by the left leg measurements being less than those of right, owing to the use of a crutch for some years in childhood when suffering from disease of left ankle. The calf of left leg measured 1½ inches less in girth than the right ;
4. A. W.—by congenital hare-lip, which had been operated upon when an infant ;
5. J. H.—a tailor, by a bunch of black thread found on neck of coat, pins in lapel of coat, and tailor's thimble on finger ;
6. G. W.—by the left leg being bandaged from ankle to knee.

As instancing how identity may be established from a variety of sources, the classical case of the murder of Dr George Parkman by his fellow-professor, John W. Webster, in Boston, U.S., may be cited. The latter had borrowed money of the former, who was last seen entering the laboratory of Webster for the avowed purpose of getting repayment. When his absence from his usual haunts became noticed, the friends of Dr Parkman put the matter into the hands of the criminal authorities. The laboratory of Webster was searched, and in it were found the haunch bones, a thigh, and a leg, all of an adult, and, in addition, in the refuse of the laboratory furnace, fragments of skull bones and artificial indentures were found ; and in a tea chest in Webster's possession, the trunk of a human body, and a thigh which corresponded to the one already found. The parts being anatomically pieced together, it was concluded that they were those of a man measuring about 5 ft. 11 in. ; from the condition of the bones found, that they were parts of the body of an elderly man ; and from an examination of the artificial plates of teeth by the dentist of the deceased, who was able from a peculiarity in them to fit a marked irregularity in the left side of Dr Parkman's jaw, that the body was that of the missing man.

The following were the measurements of the human remains found in Webster's laboratory, as set down in the joint report of Drs Winslow Lewis, jr., George H. Gay, and James W. Stone :—

Measurements	*Inches*	*Inches*
Thoracic portion, length, ...	—	$17\frac{1}{4}$
,, ,, below axilla, circumference, . .	30	—
Pelvis ,, length, ...	—	$9\frac{3}{4}$
,, ,, circumference below crest of ileum,	$30\frac{1}{2}$	—
Thighs, both, of the same length, ...	—	18
,, circumference of largest part of each, . .	$18\frac{1}{4}$	—
Left leg, length to outer malleolus, ...	—	16
,, circumference of largest part, . . .	$12\frac{3}{4}$	—
Total length, .	—	61
Deduct distance from bottom of pelvis to top of acetabulum,		$3\frac{3}{4}$
		$57\frac{1}{4}$
All the parts being placed in opposition, the distance from the top of seventh cervical vertebra to outer malleolus, .		$57\frac{1}{2}$
Difference, .		$\frac{1}{4}$
Total length of parts discovered, ...		$57\frac{1}{2}$
Distance from sole of foot to outer malleolus on another body,		3
Distance from top of head to base of sixth cervical vertebra,		10
Total height = 5 ft. $10\frac{1}{2}$ inches, or		$70\frac{1}{2}$

Another feature of historical interest in the trial of Webster in March 1850, was that Dr Oliver Wendell Holmes was one of the expert witnesses for the prosecution, he being at that time Lecturer on Anatomy in the Medical School at Boston. The identity thus established was substantiated later by the confession of the accused, who suffered for his crime the extreme penalty of the law.[1]

In 1909, there were transmitted to us for examination and report the contents of three bottles and of a small cardboard box. The contents of the former proved on examination to consist mainly of the ashes from a fire-grate, but intermingled with the ashes were seventy-one pieces of bone of varying shapes and sizes, but all relatively small, which proved to be the osseous remains of a young infant whose body had been burnt. The contents of the box proved to consist of six small pieces of cartilage with portions of adherent muscle (*vide post*).

[1] Report of Trial of Prof. John W. Webster, etc., by Dr Jas. W. Stone, 1850.

CHAPTER V

DEATH: IN ITS MEDICO-LEGAL RELATIONS

It is difficult to define death otherwise than the cessation of life. Death of the individual is termed *somatic* death, and death of the tissues, *molecular* death. But these do not happen consentaneously: molecular life remains for a variable period after the occurrence of somatic death. In considering many phenomena in connection with violent, or what may be termed, medico-legal, forms of death, it is of the utmost importance that this fact should be continually kept in recollection. Moreover, it throws light upon the phenomena of death itself. It is sometimes alleged that so uncertain are the earlier signs of death that not infrequently, in the opinions of those who make this assertion, persons are interred alive. Such persons urge, therefore, that no body ought to be interred until putrefaction has definitely declared itself, and that, until this is shown, bodies ought to be retained in mortuaries. From a careful study of the facts put forward, we believe that the allegation is practically baseless, and, in any case, that it has been founded upon very insufficient and inadequate data.[1] In temperate climates, and, more certainly, in rigorous winter climates, bodies are usually kept for such a sufficient period after death is reckoned to have happened, that the fear of live interment may be lightly brushed aside. In Canadian towns and cities in winter, for example, where the ground is so frost-bound that inhumation is impossible, and where, in consequence, bodies have to be stored in suitable places until interment becomes possible, the non-occurrence of live interment is placed beyond doubt. Even in hot climates where early interment is the rule because of the rapid onset of putrefaction, there is little chance, where the body is kept a reasonable time compatible with safety to the living, for live interment to occur. We do not assert that live interment is absolutely impossible, but we do state that its occurrence can be extremely rare, and, further, that indubitable evidence of the fact has been but rarely recorded. "The Premature Burial" of Edgar Allan Poe blends fact and fiction so ingeniously that the casual reader may be left with the impression that the occurrence is comparatively common. That there have been odd occasions of live interment in states of suspended animation there is reason to believe, but, on the other hand, many of the facts recorded of other cases as evidence of live burial, are quite explicable by post-mortem phenomena. A class of persons exists, however, in whose minds the morbid dread of being buried alive is a source of much anxiety, and such are within

[1] *Med. Times and Hospital Gazette*, Mar. 17, 1900. *B. M. J.*, Jan. 16, 1897, p. 159. "Premature Burial: Fact or Fiction," Walsh, 1898. *Medico-Legal Journal of New York*, June, 1898. "Premature Burial," 2nd edition, Hadwen, 1905.

their right in exacting that such precautions should be taken as to prevent its occurrence. We go further, and say that in the case of every supposed death, satisfactory proof of its occurrence ought to be given, in a way to be afterwards discussed. But little sympathy can be extended to the hysterical efforts which have been made from time to time to excite the public mind in this direction. The precautions which have been suggested ought to be taken have met with little sympathy in this country, but in America they have borne fruit.

A Bill to Prevent Premature Burial was introduced into the Legislature of the State of New York on March 4, 1898, in which it was proposed (1), to make it compulsory that in all cemeteries, crematories, or other places for the final disposal of the dead other than by embalming, in places of 10,000 inhabitants or upwards, or wherein the number of bodies to be disposed of should amount annually to one hundred or more, mortuaries should be erected in which the bodies to be finally disposed of should be placed, which should be kept at a temperature of between 60° and 70° F., and in constant attendance upon which there should be a physician and other persons ; (2), that no body should be finally disposed of before the lapse of 72 hours after the time of death as certified by a duly qualified physician or coroner ; (3), that the certificate of the said physician or coroner should bear that he had made the following tests on the body to determine the existence or non-existence of death—viz.

1. That he had made two or more incisions in one or more of the arteries of the deceased and that no blood flowed therefrom ;
2. That he had applied a test to the web of the fingers to discover the absence of translucency (test given in detail in the Bill) ;
3. That he had proved the absence of respiration by a mirror held before the lips and nostrils ;
4. That he had applied to the skin of the deceased in two places a piece of red-hot iron or steel for at least ten seconds, and that no blister had formed ; and
5. That he had examined the body of deceased and had found mucus covering the eyes thereof.

After the receipt of such a certificate and the expiry of the 72 hours, and only then, the body may be finally disposed of.

We are inclined to apply to the above Bill a term which is not unknown in American politics—viz. freak legislation—and this for a variety of reasons, the chief of them being that in France and Germany where such mortuaries and other arrangements exist—called in the latter country, the Leichenschauer system—not a single case has been recorded in which a body deposited therein as dead has returned to life.

The thesis of those writers who declare that under ordinary circumstances premature interment is by no means impossible, is that no one individual sign of death is absolutely certain except that of visible putrefaction, and they argue, therefore, that no body should be buried until decomposition has appeared in it. While, from the point of view of the value of individual signs, their contention is in the main true, it is not true to say that no combination of signs, short of decomposition, cannot indicate the actual occurrence of death. It appears to us that the following combination, when found, will without doubt point to death having taken place—viz. (1) the loss of animal heat to a point below that compatible with life ; (2) the absence of response to stimuli of the muscles and (3) the onset of *rigor mortis*. Moreover, these signs would distinguish between any state of suspended animation and real death.

For the purpose of preventing even the possibility of live inter-

ment, these writers advocate the establishment of waiting mortuaries wherein all bodies believed to be dead should be placed, until signs of decomposition appear. Such mortuaries have existed in Munich since 1869. There, the bodies of all persons who die within the city are removed to the mortuaries within twelve hours in ordinary cases, and within six hours in infective cases, after death is supposed to have taken place, and elaborate precautions are taken by electrical bell arrangements from the hands of the bodies in the coffins to a central office, where night and day an attendant is stationed, to signalise any return of animation. We are not in possession of any statistics from these mortuaries to enable us to say what proportion of supposed deaths, if any, is mistaken suspended animation, but we may be quite sure that if the figures had been favourable to the contention of these authors they would have been quoted.

We are not aware, indeed, of a single authenticated case of premature burial having been recorded in this country. [1]

But the case of the woman at Hapton, near Accrington, in January 1905, whose body was laid out for dead, but who was discovered by the undertaker to be in a state of suspended animation, points strongly to the greatest need on the part of medical practitioners of care being exercised in verifying the fact that death has actually occurred before they give a death certificate.

The point at which prevention would be most easily and efficiently accomplished is in proper verification of the death in every case, which fact ought to be certified in every certificate of death.

SUSPENDED ANIMATION

Suspended animation, which might by imperfect observation be mistaken for death, may take one of three forms, or, in other words, it may proceed from one of three causes—viz. (1) *Syncope*; (2) *Asphyxia*; (3) *Trance*. Probably the first and last named are the commonest. John Howard, the prison philanthropist, speaks of the resuscitating effect of cold air on a person who was being carried out for burial. The causes for such conditions will be better understood if the sanitary condition of the rooms of the sick in those days are inquired into; ventilation was then unknown in the sick chamber. In Asphyxia, at a certain stage of the process from whatever cause arising, suspended animation supervenes, due to the surcharging of the blood with CO_2 gas. It is one of the perils of the fœtus during child-birth. The following is a very instructive case of that kind. Dr Taylor of Leith [2] gives an account of the delivery of a child, breech presenting, in which difficulty arose during the birth. On examination of the cardiac region of the inanimate child after delivery no sound could be heard, or pulsation felt. Concluding, therefore, that the child was dead, the body was wrapped in a sheet and placed beneath the bed, while he continued his attention to the mother, whose condition remained critical. Dr Taylor waited at the bedside of the mother till 1 P.M.—the child having been born

[1] *The Lancet*, vol ii., 1890, p. 406.
[2] *Glas. Med. Journal*, vol. xiv., p. 280.

at 11 A.M.—and was about to leave the bedside, the woman being now out of danger, when he fancied he heard a rustling noise beneath the bed, which at first he thought was due to mice; on the sound being renewed, he brought out the body of the child and looked at it, and was about to replace it, when he observed "a quivering of the muscles." Believing the child to be still alive, he began artificial respiration and other resuscitating measures, and at 2.30 P.M., was able to hand over to the nurse a living child.

The condition of Trance, is said, by most writers, to be associated with hysteria, and is, therefore, more commonly met with in females. The name covers a variety of conditions, the essential basis of which, however, is low vital action. The body of the victim of it becomes motionless, there is complete insensibility, and although respiration and circulation seem suspended, careful search for the evidence thereof will reveal their presence, though in a very feeble form. It is, therefore, a state which might easily be mistaken by a lay person for death; but the maintenance of the animal heat (although subnormal temperature is the rule), the response of muscular irritability to stimuli, and the absence of the onset of *rigor mortis*, ought to satisfy a medical man that death has not occurred. The most notable case of this kind was that of Colonel Townshend.[1] This gentleman had the power of voluntarily suspending the action of the heart. He submitted himself to this experiment while observed by Drs Cheyne and Baynard and Mr Skrine. While in this state these observers could find no evidence of breathing,—a bright mirror was unsullied when applied to the mouth,—nor any pulsation at wrist or heart. After the person had been in this state for about half-an-hour, the observers were on the point of leaving—thinking him dead—when they observed a slight motion of his body; and then on examining the pulse, they found that the heart had resumed its function, and, shortly after, the Colonel began to breathe gently and to speak. He died, however, that same evening. Necropsy of his body revealed nothing abnormal, except disease of the kidney. In this connection, too, are the feats of Indian Fakirs in suspending animation. The student who is interested in this subject ought to consult an article entitled, "A Study in Apparent Death,"[2] wherein are recorded many interesting facts on the subject apparently beyond the reach of trickery.[3]

PROXIMATE CAUSES OF DEATH

All deaths, by whatever name we designate them in our nosology, or from whatever disease or violent cause arising, may be resolved into one of three proximate causes or sources—viz.

I. Death beginning at the Brain, called *Coma*.
II. ,, ,, ,, Heart, called *Syncope*.
III. ,, ,, ,, Lungs, called *Apnœa*, or *Asphyxia*.

[1] Cheyne's "English Malady: Or a Treatise on Nervous Diseases," 5th edit., 1735, p. 307.
[2] *Scribner's American Monthly Magazine*, Dec. 1880.
[3] Case of Irving Bishop. *The Lancet*, vol. i., 1889, pp. 1001, 1216.

Life being maintained by the interdependent action of these three organs which were termed by Bichât the tripod of life, the arrest of the function of one of them is quickly succeeded by the arrest of the function of the others, and life ceases. The proximate causes of death may, therefore, be denominated (1) Coma; (2) Syncope; and (3) Apnœa or Asphyxia. There are, however, good reasons for saying, from clinical observation and post-mortem appearances alike, that there ought to be added a mixed form due to the combined effects of the first and last named—viz. *Comato-Asphyxia*.

I. Coma, or Death beginning at the Brain.—The arrest of the functions of the brain may be due to a variety of causes. Of these the following are the chief:—

1. Compression of the brain: from
   - (*a*) Depressed fractures of vault of skull;
   - (*b*) Hæmorrhagic or serous effusions, as in Apoplexy, Hydrocephalus, or Hæmorrhage in Fracture of Base of Skull;
   - (*c*) Tumours.
2. The Effects of Narcotic and other Poisons.

These poisons may be subdivided into two classes—viz.

A. Those which are introduced into the body from *without*:
   - (1) Vegetable poisons, as opium and its preparations; many vegetable alkaloids: some ptomaines.
   - (2) Mineral Poisons, as Arsenic, Barium, Oxalic Acid (in certain doses), and Carbolic Acid.

B. Those produced *within* the body during the currency of certain diseases of liver and kidneys—Autogenetic poisons—as in
   - (*a*) Uræmia, in Bright's disease;
   - (*b*) Cholæmia, in Jaundice;
   - (*c*) Acetonæmia, in Diabetes Mellitus.

C. Mixed Causes, which begin in the brain, but which chiefly affect the action of the heart or lungs, or both, as in Concussion, so-called—but in which cases there is likely to be injury to brain substance.

The condition of Coma may exist for some time before death ensues. The characteristic symptoms are as follows:—

(1) More or less profound stupor;
(2) Absence, or imperfect perception, of sensory impressions;
(3) Suspended, or imperfect, operation of intellect;
(4) Imperfect action of reflexes, shown by accumulation of mucus in air-passages, and relaxation of sphincters.

By reason of the interference with the respiratory function, the post-mortem signs resolve themselves into a combination of both proximate forms of death,—Coma and Asphyxia—hence the name Comato-Asphyxia.

Post-Mortem Appearances are:—

1. Hyperæmic condition of Brain and Spinal Cord, and their membranes.
2. Signs of Asphyxia.
3. Brain Lesions.

II. Syncope, or Death beginning at the Heart.

Causes.—1. Sudden cessation of the action of Heart, due to—

(*a*) Shock; (*b*) Emotion; (*c*) Blows on head or epigastrium; (*d*) Drinking large draughts of Cold Water when overheated; (*e*) Sudden evacuation of fluids, natural or pathological, from the body, as in emptying an over-distended bladder, or tapping a large hydrocele, an ascites, or pleural effusion.

2. Deficiency of Blood due to Exhausting Hæmorrhages.
   (*a*) Uterine hæmorrhages;
   (*b*) Bursting of varicose veins during sleep;
   (*c*) ,, ,, aneurysms;
   (*d*) Wounds of Heart or large blood-vessels.

If an animal be bled to death and the heart be examined immediately thereafter, it will be found contracted, as the organ goes on contracting until sufficient stimulus—the blood passing through it gradually lessening in amount—is lost to cause it longer to contract. The deaths of Lord Frederick Cavendish and Mr Burke in the Phœnix Park murders, 1882, were due to syncope, caused, in the former, by severance of the right axillary blood-vessels, and, in the latter, by a penetrating wound of the right ventricle of the heart.

3. Result of Exhaustive Diseases;—in which may be included all chronic diseases; infective diseases, etc.
4. Extensive Injuries to Body from Mechanical Causes, such as Accidents on Railways and by Machinery,—the "neuro-paralytic" death of the German school.
5. Heart Diseases—of the degenerative type.

Symptoms.—These may be observed during temporary syncope, as in (*a*) fainting, or (*b*) the currency of a fatal hæmorrhage. In (*a*), the sufferer usually falls motionless; the face is pale; pulsation disappears from wrist; respiration ceases. In a few seconds, however, symptoms of return of consciousness assert themselves. In (*b*), there are cold sweats; the vision becomes dim; the pulse becomes quick, weak, fluttering; there may be vomiting; jactitation of limbs; passing delirium; irregular sighing respiration; convulsions may appear; death succeeds.

Post-Mortem Appearances.—In sudden cessation of the heart's action, the heart conditions, with respect to contained blood, will vary with the cause of the cessation of function. If it be due to exhaustive hæmorrhage, the respective cavities of that organ will contain comparatively little blood, and there will be a relatively bloodless condition of the organs of the body, and of the skin. If due to disease of the heart itself—degenerative changes in the heart muscle—the cavities respectively are likely to contain normal quantities of blood. The brain and lungs are not engorged with blood. It is stated by some observers[1] that in death from shock "the heart is quite empty, and the blood accumulates in the abdominal veins." Our observations from post-mortem examinations compel us to say that it would be more correct if the condition of the heart were described as "comparatively empty." The post-mortem appearances found after penetrating wounds of the heart will be discussed under the head of Wounds (*vide postea*).

[1] Guy and Ferrier's "Forensic Medicine," 5th edition, p. 265.

III. Apnœa or Asphyxia, or Death beginning at the Lungs.—Almost every writer who would be a reformer in medical nomenclature has raised valid objections to the term asphyxia to denote interference with respiration.[1] Literally, the word means—*pulselessness*, or *want of pulse*. They would prefer the word Apnœa, which means want of breathing. In this, we agree; but, unfortunately, the term apnœa has been utilised by physiologists to signify cessation of respiration in an animal while the blood is kept oxygenated by artificial respiration. The term asphyxia is consecrated by long use to signify interference with respiration, and it would only introduce confusion were the former term to be substituted for the latter at this time of day.

Causes.—These may be divided into 1. External; 2. Internal.

1. External; in the sense of operating on the air-passages externally.

A. Natural or from Disease.—(1) Anything that causes occlusion of the air-passages by mechanical action. Internally: Foreign bodies; membranous exudations; tumours, abscesses, fluids, normal and abnormal, etc.

B. Accidental.—Anything which causes mechanical impediment to respiratory function by exercising pressure on chest walls; as pressure in panic-stricken crowds, falls of débris in such occupations as that of quarryman, miner, collier, navvy, gravedigger, sand-pit labourer, builder; and in hoist and pit-cage accidents in which persons are pinned down.

C. Violent Causes: as Strangulation, Suffocation, Hanging, Throttling, Drowning, Penetrating Wounds of Thorax, Inhalation of irritant gases, or CO_2, CO, or coal gas.

D. Rarefaction of atmosphere, as in ballooning.

2. Internal; in the sense of operating on the pulmonary function physiologically or pathologically.

A. From causes operating upon the nervous system:—

(*a*) Paralysis of respiratory nerves, or of respiratory centre from injury or disease; or from the action of such poisons as woorara and conia.

(*b*) Fixation of respiratory muscles from over-stimulation of spinal cord, as in strychnia and nux vomica poisoning.

(*c*) Causes operating from the lungs or pulmonary circulatory system: (1) Lung diseases generally; (2) Pleurisy with Effusion; (3) Empyema; (4) Pneumothorax and Hydro-pneumothorax; (5) Pulmonary apoplexy; (6) Embolism or Thrombosis of Pulmonary vessels.

Symptoms.—If the respiration be suddenly cut off, external movements cease within three to five minutes, but the heart continues to beat for some minutes thereafter. Depending upon this fact is the chance of resuscitation of those who though asphyxiated are not yet lifeless. The phenomena of asphyxia, which are divisible into two stages, are essentially those of carbonic acid poisoning—viz. (*a*) stage of irritation, restlessness, increased respiratory action which gradually becomes more violent, and lividity of lips being the main symptoms. Unconsciousness supervenes—(*b*) stage of paralysis—when CO_2 gas

[1] Watson's "Principles and Practice of Physic," vol. i., pp. 59-75.

begins to accumulate in the blood-vessels and re-aeration of the blood in the lungs is prevented.

Post-Mortem Appearances.—

External.—1. Livid markings on skin; 2. Marked condition of post-mortem lividity which is of a dark colour; 3. Lividity of lips, varying in colour from pale-blue to almost black; 4. Normal, or semi-protruded state of tongue; 5. Face generally may be either calm and placid in expression, and normal as to colour (usually seen after death), or it may be distorted, much congested, and livid, with frothy muco-sanguinolent fluid coming from mouth and nostrils, with also congested conjunctivæ; 6. Lividity of finger and toe nails, usually well marked in infants and young children.

Internal.—*Chest*: 1. The lungs are engorged with blood dark in colour, and on section, they give a plentiful, dark-coloured, frothy, bloody exudation; and in infants, from overlaying, some of the air-vesicles on the marginal surfaces of the lung may be found ruptured; 2. Punctiform ecchymoses may be seen on costal or pulmonary or pericardial pleura; 3. In the windpipe a cinnabar-red coloration of the mucous membrane will be seen, which may vary in extent from branch-like patches to uniform coloration of the whole mucous surface.[1] Microscopically, the lung tissue shows very marked dilatation of capillaries and veins, and engorgement of blood-vessels in interlobar spaces. In asphyxia in infants, interlobar emphysema may be found in patches, or more or less generally, in the lungs.

Heart.—1. The cavities of the right side are engorged with dark-coloured, imperfectly clotted blood; 2. the venæ cavæ are likewise engorged; 3. the cavities of the left side are empty, as is also the arterial system. MacWilliam affirms that the blood-distribution seen in the heart after death is a post-mortem development, due to *rigor mortis* in the heart muscle; that the left ventricle on the onset of *rigor mortis* expels its contained blood—which he alleges is present originally in amount equal to that of the right ventricle—with a marked and measureable degree of pressure; and that the right ventricle contents remain because the muscle composing its walls dies slowly and gradually, and does not, therefore, exercise this expulsive pressure.[2]

Other Bodily Organs.—1. Abdominal viscera show venous congestion; 2. the brain is very often congested, although not so markedly as in death from coma; bloody points, however, may be seen on section of brain substance, and there may be serous effusion into the ventricles.

Blood.—The blood, generally, is dark in colour, and is mostly fluid in the large veins; clots may be met with in the heart, but they are not firm in consistence.

From the foregoing signs, therefore, it will be apparent that death by asphyxia resolves itself into death from excess of CO_2 in the blood. Interference with the due aeration of that fluid prevents its oxygenation, hence CO_2 accumulates in it. This increasing, the CO_2 in the arterioles causes contraction of these vessels thereby throwing increased action upon the heart, and, by reflex action, causing increased action of the respiratory muscles through the respiratory centre in the

[1] Pulmonary Changes in Asphyxia, Ivy M'Kenzie, *Jour. of Anatomy and Physiology*, vol. xi., pp. 120-132.

[2] *B. M. J.*, vol. ii., 1901, p. 1078; *ibid.* vol. i., 1902, p. 832.

brain. But the CO_2 still accumulating, the respiratory centre is deadened, respiratory action becomes more weakened and fitful, and ultimately ceases after gradually increasing intervals between the respirations—the heart, however, continuing to beat for some minutes after respiratory movement has finally ceased.

SUDDEN DEATHS

Death may supervene very rapidly and unexpectedly. It would appear as if the suddenness of death is more frequent now than formerly; but whether this is due merely to the more common recording of the facts, it is difficult to say, because owing to the registration of the causes of such deaths under distinct diseases, it is impossible to differentiate between those which occur suddenly and those which take place after longer or shorter periods of illness. It will probably be not far from the mark to say that at least one per cent. of all deaths may be ascribed to sudden causes. Popularly, it is supposed that all deaths of this kind are due to cardiac disease, but this is not scientifically correct.

Sudden deaths arise from a variety of natural causes, of which, probably, cardiac disease is one of the chief. The different causes may be grouped under the following heads—viz.

I. Diseases of the heart, including angina pectoris, valvular diseases with imperfect compensation, degenerative changes of the fatty and brown types in the heart-muscle, and the conditions which may arise therefrom, as rupture of muscular tissue or of valves. Spontaneous rupture, however, does rarely occur, except in the later decades of life, usually at or over the age of seventy, and then most commonly the site of rupture is the left ventricle.[1]

In such cases, excitement, excessive emotion, and blows of a trifling character delivered under exciting circumstances may produce sudden death. We have made examinations of bodies of three persons in whom death occurred during a scuffle or after a blow had been struck. In two of the cases, valvular disease sufficient to account for the death was found, but in the third—that of a young man who had never been robust—no cardiac lesion was discoverable. There can be little doubt that syncope alone may account for death in certain cases; due, in some way, to interference with cardiac innervation.

II. Diseases of the main blood-vessels such as aneurysms and thrombosis. Rupture of aortic or abdominal aneurysms causes almost instant death, while rupture of intra-pericardial, intra-cranial, and other aneurysms of small vessels are also likely to cause death, but probably not so rapidly as the former. Sudden deaths from thrombosis of large vessels during the puerperal condition are by no means uncommon after delivery. Idiopathic hæmorrhages within the cranium may be distinguished from those produced by violence by the situation of the effused blood relatively to the meninges of the brain; in the former they are usually within the membranes or in the brain substance, whereas in the latter, they are commonly found between the membranes and the bone. It must not, however, be forgotten

[1] *The Lancet*, vol. i., 1889, p. 75; *B. M. J.*, vol. i., 1902, p. 453.

that hæmorrhage which is due to violence may be found on the surface of the brain, but in such cases, some measure of bruising or laceration of brain tissue will usually be found. In all cases where there is any doubt, the parts must be carefully dissected to discover the presence or absence of a ruptured artery ;

III. Brain hæmorrhages, as in apoplexy. Death may occur rapidly in cases where the hæmorrhage is extensive or is situated in the Pons Varolii, or in the cerebellar region : death may happen suddenly, also, from hæmorrhage consequent upon rupture of varicose veins during sleep (*vide post*) ;

IV. Certain lesions of Lungs, as pulmonary apoplexy, hæmorrhage from ruptured vessels in phthisical cavities, and in hæmatothorax, or even in pneumothorax following chronic lung diseases ;

V. Perforating ulcers of stomach, or of other part of the alimentary tract. Death occasionally follows the drinking of large draughts of cold fluids when persons are overheated :

VI. Certain conditions associated with pregnancy, as rupture of the sac of an extra-uterine pregnancy, rupture of the uterus itself during labour, and uterine hæmatoceles ;

VII. Rupture of internal organs from degrees of violence, as of a hyper-distended bladder, of gall-bladder, of intestines, or of any solid viscus. Such ruptures occur, very frequently, without any external marks of injury on abdominal wall being discoverable ;

VIII. Foreign bodies in the pharynx or air-passages. We have examined several bodies in which liquid, solid, or pultaceous substances have been found in the air-passages and which have, probably, regurgitated into these channels during the act of vomiting, or have become impacted in swallowing, while the persons were intoxicated. In one case, in which the assailant was charged with culpable homicide, a vinous liquid—probably beer—was found in the trachea and air-passages of the victim.

IX. Nervous seizures. While it is not usual for death to follow epileptiform seizures, it has to be borne in mind that fatal results do occasionally happen, particularly when the cause is uræmia. In infants and young children fatal issues sometimes quickly ensue from *laryngismus stridulus*. This must be kept in mind during inquiry into cases of suspected overlaying.

In all cases of sudden death, while it is the duty in Scotland of the Procurator-fiscal, and of the Coroner in England, to determine how far inquiry into the causes of deaths should go, medical practitioners should hesitate, unless upon the strongest evidence, to certify as to any particular cause without a post-mortem examination of the body.

THE SIGNS OF DEATH

The question of Death is of importance from different medico-legal points of view. It arises in answer to the queries, Is the person really dead, or only apparently dead ? and, again, If dead, how long time has elapsed since the occurrence ? Usually, in addition to these, is a third query—viz. What was the cause of the death ? But the discussion of this last query will be deferred until later.

Has Death taken place, and if so, How Long Before?

In cases in which the last sentence of the law has been carried out, it is part of the duty of the surgeon of the prison in which the execution has been performed to certify that the person is dead, in terms of the sentence that "he be hanged by the neck till he be dead." And in the cases of those who labour under the fear of premature interment and who have given special instructions in their wills for certain tests to be used before the body is committed to the grave, the duty of certifying that death has actually taken place will fall upon the physician. There are other circumstances, moreover, in which, soon after apparently sudden demise, the duty of saying whether or not death has occurred will be demanded of a physician. This question, obviously, is attended with some difficulty only in such cases as the last named; for where some time has elapsed, a lay person may be equally competent to pronounce an opinion. Every sign of death, therefore, is of importance when considered relatively to the supposed time of its occurrence. It will be well, therefore, to consider these signs in their chronological order.

The first in point of time are :—

I. Cessation of Respiration and Circulation.—The former may be tested by—

(*a*) Auscultation,
(*b*) Placing a hand-mirror before the mouth or nostrils; or a light downy feather; noting bedewing or movement;
(*c*) Placing a saucer full of water on the chest or abdomen, and observing presence or absence of rippling of water therein (Winslow's test);

The latter, by—

(*a*) Auscultation;
(*b*) Manual exploration of principal arteries, as carotids, for pulsation, or thrill:
(*c*) Applying a ligature tightly round a finger, and observing whether or not a bloodless zone forms at the seat of the ligature and a zone of livid redness on its distal side (Magnus' test);
(*d*) Applying pressure to the finger-nail and observing whether or not at the moment of application of pressure the nail becomes white, and on relaxation of the pressure, again becomes pinkish-coloured;
(*e*) Dropping a spot of melted sealing-wax on the forearm, and observing whether or not redness or vesication ensues;
(*f*) Holding the web of the fingers against a strong light, natural or artificial, and observing whether the web is translucent or not;
(*g*) Inserting a bright needle deeply into a fleshy part of the body and observing whether it is tarnished or not on withdrawal after it has been allowed to remain *in situ* for about ten seconds;
(*h*) Injecting hypodermically a solution of Fluorescin (resorcinphthalein and sodium bicarbonate—a gramme of each

dissolved in 8 c.c. of water) (Icard's test).[1] Where cessation of circulation has occurred, no local discoloration of tissue results; but if circulation still continues, a yellowish-green coloration of the skin will take place round the injected part, and the substance may be detected in the blood at some distance from the part injected by pricking the skin. By immersing some white silk threads in the blood and afterwards boiling the threads with water in a test-tube, a greenish-coloured solution will result which will dye the threads.

The same observer has suggested as an easily applied test of death what he calls the "réaction sulfhydrique," which, he says, is due to the action of the anœrobic organisms which do not begin to attack the body until life is extinct. By acting upon the bronchial mucous membrane they cause H_2S to be generated, which may be detected by placing a piece of paper moistened with neutral acetate of lead over the nostrils of the body.[2]

The absence of reaction to these tests, or to some of them, five minutes after death is supposed to have taken place, will betoken the occurrence of death. In cases of suspected suspended animation, these tests will detect also whether the circulation still continues or not. It is of the utmost importance that the examiner should differentiate between *systemic* or *somatic* and *molecular* death, for although the former has occurred, there may be certain response to some of the above tests by reason of the continued existence of the latter.

II. Loss of Lustre of the Eye.—This usually takes the character of a glazed appearance. Later, the eye-ball becomes covered more or less with mucus. According to Guy and Ferrier,[3] in deaths from Apoplexy, Carbonic Acid, and Prussic Acid, "the eyes may continue brilliant and prominent for a long time," and, according to Nysten,[4] the same result is produced from distension of the body with gas. From the examination of a large number of bodies, however, especially where death was due to the first two causes named, we have not been able to corroborate this conclusion, nor have we seen the result spoken of by the last observer.

So long as molecular life remains in the tissues of the eye, atropine will dilate, and physostigmine contract, the pupils.

III. Effect of Stimuli on the Body.—After death, mechanical stimuli produce no result whether molecular life be present in the tissues or not: on the other hand, for a variable time after systemic death, and while molecular life remains, electrical stimuli cause some measure of response.

This phenomenon of the persistence of molecular life may be studied to some extent in a limb newly amputated. If the exposed muscle be pricked or irritated, contraction of the muscular fibres may be seen, and this will persist for a variable period after the removal of the limb from

[1] *La Mort réelle et la Mort apparante*, 1897.
[2] *Le signe de la mort réelle en l'absence du médecin.* Paris, 1907.
[3] *Op. cit.* p. 246.
[4] *Archives Génerale de Médecine*, June 1862.

the body, the length of the period depending upon the proximity to the normal bodily temperature at which the limb is kept.

IV. The Skin of the Body becomes White or Greyish-White.—The reason for this is the cessation of circulation. To this rule, however, there are parts of the body which are exceptions, in odd cases; for example, in persons of florid complexion the colour is apt to remain even for a day or two over the malar prominences, due to the fact that in that situation the capillary vessels of the skin are unusually dilated. The livid or brownish colour of old ulcers, too, is retained, as is also the yellow or other colour of Jaundice. Tattoo marks also remain, as do also the colours of ecchymoses. In deaths from inhalation of CO gas, the rosy colour of the skin of face, of shoulders, of upper chest, and of inside of thighs is retained; as are also the red splashes on the surface of the body in deaths from cold and exposure. In certain cases of death by drowning, too, a rosy colour of lips and of malar prominences may also be observed (*vide post*).

V. The Temperature of Body falls.—The loss of heat and the rapidity of the loss depend upon certain circumstances. It is due to the cessation of circulation and the consequent loss of oxidation of the tissues. Generally speaking, the rate of loss may be estimated at about one degree an hour on the average of time taken by the body to fall to the temperature of the surrounding medium; but relatively, the temperature falls most rapidly immediately after death, and more slowly the nearer it approaches the temperature of the medium. Usually speaking, the time which the process takes may be reckoned as between 8 and 12 hours. The important point to observe, however, is that the cooling of the body is progressively downwards.

The rate of cooling of the body is modified by the following circumstances:—

(*a*) *Condition of the body*: Fat bodies retain heat longer than thin ones; the bodies of strong persons longer than those of weak; and clothed bodies longer than naked.

(*b*) *Medium in which body is placed*: In ordinary water bodies cool more rapidly than in air; in putrescent fluids they retain heat longer than in ordinary water: the colder the medium, of course, the more rapid the cooling.

(*c*) *Kind of Death*: In deaths by lightning, and by suffocation, bodies retain heat for a longer time. According to Nysten, in the latter form of death a body may take three days to cool down. In diseases, microbic in character—as in cholera, yellow fever, small-pox, and others—the temperature of the body may even rise after death, due to the multiplication of these organisms in the still living fluids and tissues of the body; and the same fact has been observed in death from acute rheumatism, injuries to the nervous system, and abdominal diseases.[1]

VI. General Muscular Relaxation of the Body ensues.—This condition has been termed Primary Flaccidity to distinguish it from the condition of flaccidity which occurs after the departure of *rigor mortis*. During this condition, spasmodic muscular states ordinarily relax and

[1] *Lancet*, vol. i., 1889, p. 1173.

disappear; but to this there is the important exception that weapons or other articles clutched in the hand at the moment of death may be retained firmly even through this condition of general flaccidity.

According to Casper,—and his conclusions accord with our own observations,—a body which presents the foregoing phenomena may be reckoned as having been dead for about ten to twelve hours at most.

VII. Loss of Elasticity of Eye-Ball: or Flaccidity of Iris.—This is due to the loss of tension which the fluids of the eye-ball undergo after death, and is characterised by the change of shape which the ball assumes on synchronous pressure from two sides opposite to each other. Formerly, more importance than ought to have been was attached to this as indicative of the time of death. Observations have shown that it may be produced even before death.[1] The test seems to have originated with Ripault.

VIII. Contact Flattening of the Muscles.—The muscular system of that part of the surface of the body which is in contact with the medium on which it lies or has been placed after death, becomes flattened from pressure of the superincumbent weight.

IX. Hypostasis, or Post-Mortem Staining, or Cadaveric Lividity.—This phenomenon may be observed upon all bodies, no matter what may be the cause of death, even in deaths from hæmorrhage. The extent, colour, and incidence of the phenomenon varies in different cases. It is found upon that part of the body which is the most dependent with relation to the position of the body, and with relation to the different parts of the body; thus, in a body placed on its back after death, the lividity will be found on the dorsal aspect of the trunk, the posterior aspect of head and neck, the extensor surfaces of the upper limbs, and the flexor surfaces of the lower limbs. In bodies placed in positions other than this, the incidence of the lividity will be found accordingly: and so, from its distribution, it is possible to affirm as to the position in which a given body has lain after death. In medico-legal work, especially in cases where there are marks of violence on the body, the incidence of lividity ought to be carefully noted. While it is true, generally, to say that this coloration is to be found on the most dependent parts, it is to be noted that it does not appear upon those parts of the body which are in actual contact with the surface upon which the body is lying, even though these are dependent parts; nor does it appear in parts constricted, or under pressure, as, for example, under the site of the collar, or at the pressure marking of a waistband. The coloration may be said to be present on a body in the average case from 8 to 14 hours after death; we have seen it, however, as early as 5 hours, but this is exceptional. The phenomenon is due to the fact that the blood, like any other fluid when unacted upon by any counteracting force, obeys the law of gravity; hence the blood gravitates into those capillary vessels which are the most dependent in the body in the position in which it lies. And what is true of the external manifestations of hypostasis is equally true of the internal. In a body which has been lying on its back during the occurrence of its onset, the bases and back parts of the lungs, the

[1] *Vide Brit. Med. Journal*, Sept. 25, 1880; vol. ii., 1880, p. 580.

posterior wall of the stomach and the lowermost parts of the intestines, along with the kidneys, will be found similarly affected; and it is of great importance that the mere appearances of hypostasis in these organs should not be mistaken for phenomena of a different kind due to very different causes, such as lung disease, or poisoning.

Hypostasis, in respect that it is manifested by a discoloration, is liable to be, and has been, mistaken for subcutaneous extravasation of blood or ecchymosis, and hence a significance has, by mistake, been attached to it that may wrongously affect an accused person, in respect that the result of a natural phenomenon has been interpreted as the effects of violence. By what means, therefore, may hypostasis be differentiated from ecchymosis? The best test which can be employed, and indeed the only one upon which absolute reliance can be placed, is by making an incision into the tissues through the centre of the discoloured mark. If the discoloration be due to post-mortem lividity, only a few bleeding points from cut capillaries will be observable; but, if it be due to ecchymosis, blood—coagulated or fluid—will be found extravasated into the cutaneous and subcutaneous tissues. *In every case where an examiner is founding evidence of violence to a body on such discoloured marks, such an incision should be made.* It may be said that such is not necessary since the difference may be established by the respective colours. This is not possible in many instances, and therefore, it ought to be a routine practice before an allegation of violence is based upon such marks, that each place should be duly incised. The colour varies from a pale blue, through distinct blue, to a reddish-blue colour; indeed, in some cases, it may even be of a blackish colour; hence colour alone is no guide. It has been given, as another difference between these, that a bruise is raised above the level of the skin and a hypostasis never; that is true of one stage in the history of a bruise, but only of the early stage; and it must be recollected that it is the colour, after all, which attracts attention, and not the swelling, which may have, indeed very probably has, disappeared. This hypostasis must not be confounded with the rosy colour imparted to the skin in Carbon Monoxide poisoning, which is additional to the other colour-markings on the body, although it imparts a hue to the usual lividity above described.

X. Cadaveric Rigidity or Rigor Mortis.—This phenomenon, which is also known by the name of Death-stiffening, occurs after death more or less in *all* bodies in which the tissues have reached some measure of maturity; it is doubtful if it occurs in the immature fœtus. It may, however, be seen in the mature fœtus which has died during the process of delivery[1]; and right through all ages up to old age; but with a variability of time of onset and of duration, due to a variety of factors.

Rigor mortis is essentially due to intimate changes in the muscular system; it has no marked relation to the nervous system. If the nerve-supply to a given series of muscles be cut soon after death, the onset of *rigor mortis* in these muscles is not interfered with, except that the time of onset is somewhat retarded as compared with that of any other series of muscles the nerve-supply of which has been untouched. According

[1] Parkinson, *B. M. J.*, vol. i., 1908, p. 304.

to Bierfreund,[1] section of the ischiatic nerve of one side causes delay for some time in the appearance of *rigor mortis* in the muscles supplied thereby. The intimate change which occurs in the muscle to produce the stiffening is coagulation of the myosin within the sheath of each muscular fibre. When a living muscle is at rest, it gives a faintly alkaline reaction, but after contraction, the reaction becomes distinctly acid. During the state of *rigor mortis* the reaction is markedly acid, due to the presence of sarco-lactic acid, and, possibly, of other acids. Moreover, during this state, the sarcous elements become quite opaque, as seen on microscopic section. After *rigor mortis* passes off, the reaction of the muscles becomes alkaline. During the perfection of the *rigor mortis*, experiments have shown that a *limited contraction* of the muscle takes place; in other words, a muscle shortens in its length sufficient to lift a light weight; and there would appear to be a stage in the development of the phenomenon—for it must be borne in mind that this change is indicative of molecular life in the muscle—when, according to Brown-Séquard, the injection of defibrinated or arterial blood into a body will restore contractile power, under a stimulus, to the muscles. It is of much interest to inquire whether or not the intimate changes which occur in nerve fibres in their passage from molecular life to molecular death, coupled with the changes which occur in the same transition state in muscle, are not jointly involved in the complete development of the process. There is one thing quite clear, it appears to us, that any contractility which occurs in a muscle is not of the nature of physiological contractility, and, also, that deprivation of a muscle of its nerve-supply does not prevent the eventual onset of the stiffening, although it may retard it.

If an attempt be made to lift the lower limb of a body in which *rigor mortis* is fully present, from the table upon which it lies, the general effect will be to lift the whole body as if it were simply a unified mass, and if the stiffened elbow of such a body be forcibly flexed, the flaccidity, or mobility which results permanently remains.

There are, however, circumstances in which this rigidity does not ensue after death. In muscles which have been badly lacerated, for example, it does not supervene; and it is possibly for this reason that it has been affirmed generally of deaths by lightning, that *rigor mortis* does not occur. This is not in accordance with observation, however, as will be shown in discussing death from that cause.

Mode and Incidence of Invasion.—*Rigor mortis* appears *first* in the involuntary muscular fibre, and that occasionally gives rise to the view that there is hypertrophy of the heart, when it is only rigidity or contraction of its walls produced from this cause. Whether to this cause solely may be attributed post-mortem delivery—from contraction of the uterine muscular fibre—is yet an open question: we are of opinion, however, that it is an important factor. It next appears in the voluntary muscles, and usually, in the following order—viz. the muscles of back of neck and face; muscles of thorax, back and front, front of neck, and of upper extremities; muscles of trunk of body; and last of all, the muscles of the lower extremities. Larcher [2]

[1] *Archiv. für. dis. ges. Physiologie*, 1888.
[2] *Archives de Médicine*, 1862.

from the examination of this phenomenon in 600 bodies, came to the conclusion that the order was as follows:—(1) muscles of lower jaw; (2) of lower limbs; (3) of neck; (4) of upper limbs. He further states that joints of lower jaw and knee stiffen more thoroughly, but more slowly, than the shoulder-joints; and that the muscles which stiffen first are the longest to remain in that condition. From observations made in the mortuary of the Glasgow Royal Infirmary many years ago, we cannot sustain the findings of this writer; our observations lead us to the order first described, and to distinctly affirm that the muscles in which *rigor mortis* first appears are those in which it first disappears.

Period of Invasion.—This can only be stated in a very general way, since so many factors determine the result. On the average, however, stiffening will likely have begun in the neck and jaw and face about 5 to 6 hours after death, will be definitely present in the upper part of the body in 10 hours, and will be present over all the body between 12 to 18 hours; and it will, in all likelihood, have passed off in the bulk of cases by the end of 36 hours. Under certain circumstances, however, it may appear unusually early, or its appearance may be retarded unusually long. Brown-Séquard states, for example, that in a death after an exhausting attack of enteric fever, it was present 3½ minutes after death, disappeared in about 15 minutes, and that putrefaction had begun within 1 hour, after death. Another case is recorded by Finlayson, in which *rigor mortis* was generally present in the body 15 minutes after death.[1] On the other hand, in certain cases, it has not appeared until the lapse of 16 hours after death, and has been present as long as 21 days thereafter.

Modifying Factors of Onset and Duration.—There are four principal factors which determine the time of onset and its duration—viz. (1) Age; (2) Muscular State of the Body; (3) Temperature of Environment; (4) Mode of Death.

(1) *Age.*—It has been asserted that *rigor mortis* does not appear in the immature fœtus. We have, however, without doubt observed it in the fœtus of seven months, although it was but transitory. The term "maturity" applied to the fœtus is, after all, but a relative term, and every fœtus of seven months is not in the same condition with respect to the state of development of its muscles; therefore, it would be better, in applying the above rule, to speak of the immature muscular development of the fœtus, since, in our opinion, the rule would then hold good. It appears definitely in the mature fœtus,[2] in the newly-born child, in young infants, and in every age-period up to old age. It is usually well marked in adolescents, in adults of young and of middle age, but is less well marked in elderly persons. These conditions are to be accounted for, especially, by the second factor—viz.

(2) *Muscular State of the Body.*—Other things being equal, the stronger muscularly the person is at the time of death, the slower is

[1] *B. M. J.*, vol. ii., September 6, 1884.

[2] *Vide* Tableton, *B. M. J.*, vol. i., 1908, p. 1424; Murphy, *ibid.*, p. 1045, Whitfield, *ibid.*, vol. ii., 1907, p. 1581; Ulrich, Zentralb. f. Gynäk, 33, 1907, p. 1007.

the time of onset and the longer the duration. The converse is equally true: the more feeble or exhausted the muscular condition, the more rapid the time of onset and the shorter the duration. This general rule may be laid down—viz. *That whatever exhausts the muscular irritability before death causes the early appearance and the more rapid disappearance of rigor mortis.*

(3) *Temperature of Environment.*—In colder and more temperate climates the time of onset conforms to the above rule. If a body, already the subject of newly established rigidity, be exposed to a temperature of 75° C., the rigidity becomes more pronounced, since other albuminates in the muscles, in addition to myosin, become coagulated. This phenomenon has sometimes been called Heat Stiffening. If, on the other hand, a body be exposed immediately after death by violence or otherwise, to a temperature at or below freezing point, the onset of the stiffening is retarded so long as this temperature continues: but when the temperature is gradually elevated to 10° C., or 50° F.,—in short, when it is thawed—rigor comes on rapidly, but disappears more quickly than it would have done had the body not been subjected to the process. This happens, for example, in the frozen carcases of animals transported in this condition from abroad.

(4) *Mode of Death.*—This as a modifying factor when reduced to its elementary conditions, is but another way of speaking of the exhaustion of muscular irritability. Whatever exhausts the muscular irritability hastens the onset and shortens the duration of the stiffening; hence, in all exhausting diseases, of long or short duration, *rigor mortis* appears early and passes off quickly: this would include, therefore, all long-continued, febrile, and chronic diseases, in addition to continuous convulsive disorders, however produced, and, by extension of the principle, to overdriven animals or overworked persons. Chronic alcoholism favours the long duration of the stiffening and retards the onset of putrefaction, doubtless by inhibiting the combustion of the tissues during life.

Table showing Conditions which affect Rigor Mortis

I.	Where Muscular Irritability is reduced .	(1) Body weak and emaciated; (*a*) from want; (*b*) from disease; (2) Feeble muscular development; (3) Exhaustion of muscular irritability; (*a*) from violent exertion prior to death; (*b*) from convulsions; (*c*) tetanus, or strychnia poisoning; (*d*) violent muscular contortions from lightning-stroke; (4) From protracted or febrile diseases; (5) Where temperature of environment is high.
	Where *Rigor Mortis* Appears and Disappears Early . .	
	Where Putrefaction Commences Early .	
II.	Conditions opposite to above . . .	Conditions converse of above.

The three conditions which stimulate *Rigor Mortis* are:

A. The stiffening of Catalepsy.

B. Freezing of the body, from exposure in winter or artificial freezing.

C. Heat stiffening.

The first having, however, been eliminated in the examination of the body for real or apparent death, by the maintenance of a bodily temperature compatible with life over a period incompatible with the existence of actual death, we need describe it no further, except to say that if a limb extended and rigid from this cause be flexed, it will return to its former state. With respect to freezing of body, it may be distinguished by the fact that flexion of the joints is always accompanied by crackling sounds due to the fracture of the frozen fluids of joint and surrounding tissues. The condition of heat stiffening may be seen in bodies of persons who have precipitated themselves, or who have fallen, into vats of boiling fluids. It may also be observed, but usually in a more limited way, in persons who have been burnt to death in paraffin lamp accidents, in which roasting and charring of parts of the body have occurred.

There is another condition which is of considerable medico-legal importance, and which is known by the names of *Cadaveric spasm*, or *Instantaneous Rigor*. It may be found, for example, in the hand of the suicide which grasps a weapon which he has used against himself. We have seen it several times in cases of cut-throat, and, then, the weapon was so firmly clutched that it required considerable force to disengage it. This condition is, without question, due initially to a voluntary vital act; and it would appear as if the last voluntary act of life were continued right into the period of general *rigor mortis*. It does not appear that an adequate explanation of the phenomenon has yet been made. That it is not simply an unusually early local onset of ordinary cadaveric rigidity seems quite clear, because the local muscles do not share in the general primary flaccidity of the muscular system, else the weapon would fall out of the hand, or the postural attitude of the body would be lost. Whether the nervous system plays an important part in it,—and that is likely,—and if so, to what extent, are questions which future experiment and research have yet to reveal. One instance of it which has become historical occurred in the famous charge of Balaclava during the Crimean War. Captain Nolan, while riding in front of his cavalry, was wounded by a Russian shell, which tore open his chest-wall. "The arm which he was waving in the air at the moment remained high uplifted, and he retained his seat on his horse, which wheeled round and returned; the rider gave a death-shriek, and passed through the ranks in the same position and attitude before dropping from the saddle."[1] Several like instances have also been observed in other campaigns. During the siege of Ladysmith in the South African War, while some of the defenders were engaged in a game of cricket, a shell from the Boer lines killed Captain Vallentine Todd while in the act of bowling, but the ball remained clutched in his hand. The body of a woman was recovered from Campbeltown harbour in 1907, and in her right hand were found a few coppers firmly clutched. In a Fatal Accidents Inquiry held at Clackmannan in May 1907, regard-

[1] Ogston, *op. cit.* p. 375.

ing the death of an engineman at a colliery, at which we gave evidence, the following instance of instantaneous rigor was noted in connection with the deceased. The man at the time he died was standing in front of his boiler when a sludge-plate was blown out by the steam pressure, thereby permitting the steam to escape with great force from the boiler. Deceased had a long iron instrument, called a "claut," in his hand, and by means of this tried to readjust the sludge-plate in position. The force of the steam, acting through the plate and the instrument in his hand, knocked him over among the engine coals which were lying immediately behind him. During this time he was being assisted by another workman. When his companion went to his assistance, he found him to be dead, but his hands were still firmly grasping the handle of the "claut." Witnesses stated that it required some force to disengage the grasp of deceased from the handle. When a weapon, or other article, is found firmly clutched in a dead hand, it is a positive proof that it was in the hand of the person during life, and that the grasp was about the last, if not the very last, voluntary act of his life; further, it is almost conclusive proof of suicide, for nothing can simulate it, and it cannot be produced in any way after death, as we have tried several times experimentally without success. Indeed, instantaneous rigor is to be found only in cases in which, before death, there has been high mental tension and nerve excitation.

If the phenomena of death, already described, be found on a dead body, it may fairly accurately be affirmed that death had occurred from two to three days before, at the outside limit.

The different muscular states which a body undergoes between the period of somatic and molecular death may be summed up as follows:—

I. The condition of Primary Flaccidity; condition of relaxed muscles—responsive to electrical stimuli;

II. The condition of Cadaveric Rigidity, or *Rigor Mortis*—condition of muscular stiffening of body;

III. The condition of Secondary Flaccidity,—irresponsive to any kind of stimulus,—which is synchronous with the onset of Putrefaction.

During the first, and so long as some measure of molecular life in the tissues remains, electrical stimuli will produce response in muscular contractility; and the chemical reaction of the muscles will either be neutral, or faintly alkaline. During the second, molecular death takes place; therefore, no stimulus will provoke response; reaction is then markedly acid. During the third, disintegration of muscular elements takes place; reaction becomes again alkaline.

The last stage in the resolution of the body from the organic to the inorganic state is that commonly called Putrefaction.

The agencies by which the body is reduced to the latter state are animalculæ and micro-organisms of a great variety of kinds, aided by the action of warmth and the presence of moisture. There is a fauna and flora of decomposition[1] which forms an interesting subject of study, but which cannot be discussed in detail now.

[1] *Vide* a paper by Hough on "The Fauna of Dead Bodies," *B. M. J.*, vol. ii., 1897, p. 1853.

The various steps of the process of colliquative putrefaction need not be particularly described, but its outstanding features cannot be omitted. Within 36 to 48 hours after death, in usual circumstances, the superficial veins of the body begin to assume a brownish colour, and thus give the body a marbled appearance; the dependent parts being all the time of a more or less livid colour. In about 3 to 5 days, a greenish or bluish coloration of the skin which then appears, or has a short time before appeared, on the body—in the abdomen (right iliac region) of bodies exposed in the air, or over the sternum in those exposed in water—begins to spread slowly over the body. Thereafter, it depends upon meteorological conditions how rapidly the putrefactive process is hastened. By the evolution of gases of putrefaction in the various cavities of the body,—H_2S, CH_4, NH_3, CO, PH_3, N—and through the liquefaction of the tissues produced by the same micro-organisms, the cavities eventually burst open from the tension of the gases, and the stage of colliquative putrefaction is reached. So far, this description applies generally to the process as it occurs in the air, or in the earth. But in a body which has lain in the water, the process is somewhat different. In this case, the first appearance is bleaching of the palmar and plantar skin surfaces; next, there is a bloated and swollen state of the tissues of face and body, accompanied or followed by a greenish discoloration of the anterior aspect of thorax; this, in turn, is succeeded by an extension of these conditions and a distended state of the abdomen due to putrefactive gases, although the colour of the skin of abdomen remains free from the greenish colour for a long time thereafter. Different views are entertained as to the nature of the bluish or greenish colour produced on chest or abdomen. The initiating cause is, without question, microbic; but whether the colour is a pigment the result of chromogenetic organisms, or is due to the formation of a compound of Iron, Potash, and Cyanogen, is not definitely determined. Probably it is due to both. The putrefactive process, thereafter, depends upon (*a*), conditions of weather, and (*b*), the character of the column of water in which the body is immersed with respect to purity or impurity; decomposition being retarded by low temperatures, and pure fresh water, or sea water, and hastened by high temperatures, and water of stagnant pools and cesspools, liquid sewage, or columns of water polluted by sewage.

The following Table shows in summarised form the approximate times within which certain changes of the appearances of the body take place, but they must be considered as only approximately correct, and the consideration of the length of time which has elapsed since death, must have strict reference to the conditions of each separate case.

Table to illustrate Progress of Colliquative Putrefaction

One to Three Days . .	Greenish coloration of right iliac region of abdomen: Softening of the Eye-ball.
Three to Five Days . .	Brownish coloration of surface veins of body. Extension of greenish coloration over abdomen, and over other parts of body; swelling of external genitals, and development of brownish or greenish coloration of scrotum, or vulva.

Eight to Ten Days . .	Distension of abdomen with gases, such as H_2S, PH_3(?), and Carbon gases ;
	Liquefaction of eye-ball.
Fourteen to Twenty-four Days .	Formation of bullæ, of varying large size, on skin.
	Increased distension of abdomen.
	Bloated condition of whole skin of body.
	Increase of discoloration over body.
	Maggots appear in orbits, on scrotum, or upon other parts of body.
	Nails are loose, and are falling off.
	Swollen, bloated condition of face, rendering recognition impossible.

After this it is impossible to time-table the progress of decomposition. The preliminary to disarticulation of the body is the onset of the colliquative stage, which occurs at too variable a period to be named, but in which the cavities of the body, and the joints, are burst open, and the internal organs rapidly undergo dissolution, at a rate depending upon the state of organisation.

Such is the average development of putrefaction in a body in air. In water, it would appear as if the putrefactive changes proceeded more rapidly in the chest ; with but this exception, the former description may, generally, be held as equally applicable to the latter.

Putrefaction, however, may be modified in its progress, and in the character of the products formed.

The two principal modifications are :

A. Saponification.

B. Mummification, or Desiccation.

A. Saponification.—A body upon which moisture has been constantly acting—whether it be immersed in water or in damp soil—may undergo this change. It may, indeed, happen in a limited way in a body shut up in a bag or trunk, from the amount of fluid naturally present in the body. In the body previously described (p. 107), certain parts were distinctly adipocerous, particularly over the buttocks and thighs.

Saponification consists in the metamorphosis of the nitrogenous and fatty constituents of the body into new chemical compounds which are more or less stable in composition. Collectively, these compounds are known as adipocere (*adeps* = lard, and *cera* = wax), from the unctuous, yellowish-white, waxy appearance which the substance shows on section. Adipocere is a fatty-looking substance which may vary in colour from a white to a yellowish-white tint, imparts an unctuous feeling to the fingers, melts at a flame, and burns with a feebly luminant flame, and has a faint mouldy, cheesy odour. On its external surface it may be reddish-brown from coloration due to rust from the coffin-nails. (Fig. 33.)

Chemical Composition.—Adipocere, which was first described by Sir Thomas Browne, is essentially a compound hard soap, the alkali of which may be Ammonia, Soda, Potash, or Calcium—usually a combination of these—in differing proportions. The Ammonia is obtained from the decomposition of the nitrogenous compounds of the body by microbic action, from the union of the liberated nitrogen and hydrogen, which

unites with the fatty acids of the fatty structures of the body—oleic, palmitic, stearic, butyric, and others—to form a substance which is composed of the oleate, palmitate, and stearate of these alkalies, the whole being united together by the fibrous tissues of the part involved, as these are not affected by the process, and being coloured, as described, on the surface by oxide of iron. In addition, there is an odorous, volatile substance which is difficult to name, but which, in our opinion, is composed of volatile fatty acids. Such is a description of specimens in our possession. Adipocere has a melting-point of 126·5° F., and it is more or less soluble in hot alcohol.

It is not usual for the whole body, in any given case, to be converted into adipocere, but Dr Guy [1] has seen whole bodies transformed completely among the bodies disinterred while laying the foundations of King's College Hospital. In connection with like operations at

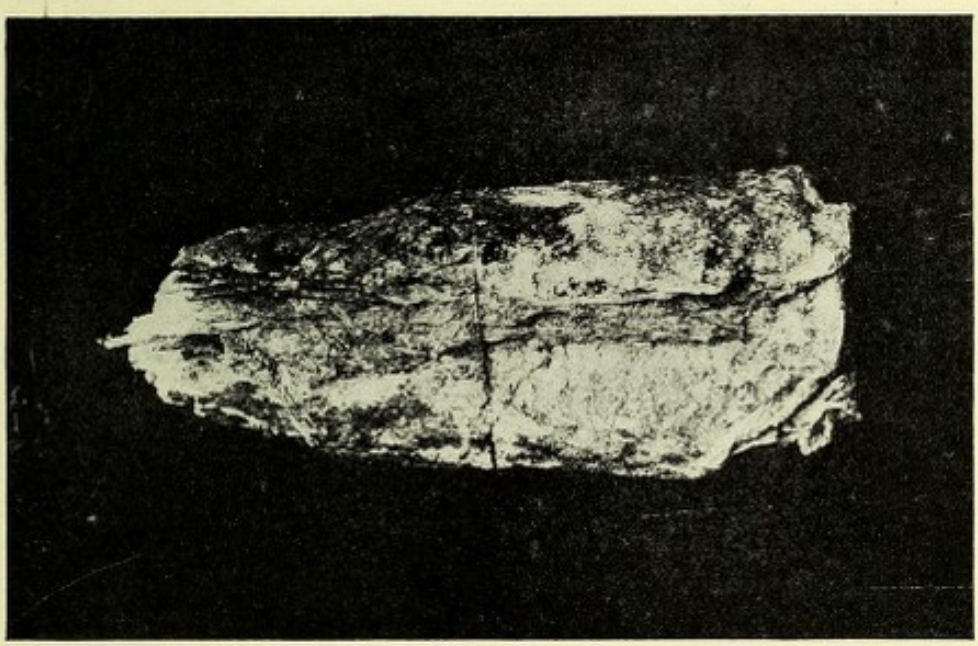


FIG. 33.—Photograph of a piece of Adipocere in possession of the Author. It represents the outer fleshy part of the upper thigh. It is coloured by rust on its exterior, and the planes of fibrous tissue are still plainly observed in the adipocerous mass.

the Royal Infirmary, Glasgow, in 1879-1880, and again in the winter of 1903, and spring of 1904, we examined some of the pits which were then laid bare, into which were put the bodies of some of those who had died in the typhus and cholera epidemics of 1848-1849, and we observed whole limbs, chiefly the lower, the chest and shoulders, and, in several cases, the buttocks, so changed, and in more than one case the whole body. In one of these cases, the facial features of the deceased were so little changed that he was recognised by one who knew him while living. This change into saponification takes a considerable time to produce. Even in limited areas of the body it will take some months; usually, however, it takes years—probably not less than ten. In the Clones tragedy (Ulster Winter Assizes, 1904) the body of the victim, which had been buried in a dung-heap, was found to be largely adipocerous, although the period of concealment was only about six months. It

[1] *Op. cit.* p. 257.

appears more quickly in the bodies of infants and young children than in those of adults. Casper [1] narrates an instance in which the body of a newly-born child buried in damp soil, was found converted into adipocere, to the extent of one-third, by the end of thirteen months. It is very difficult, indeed, to lay down any rule regarding the time in which in any given case it may be produced, owing to the variable factors of moisture and air.

B. Mummification.—The derivation of the word descriptive of this change points to its characters—viz. that of desiccation. It is a common result after a complete process of embalming, but it happens naturally only in few circumstances. According to Damaria, it is a common occurrence in bodies inhumed in certain parts of Piedmont, and it is found, not infrequently, in bodies buried in shallow graves

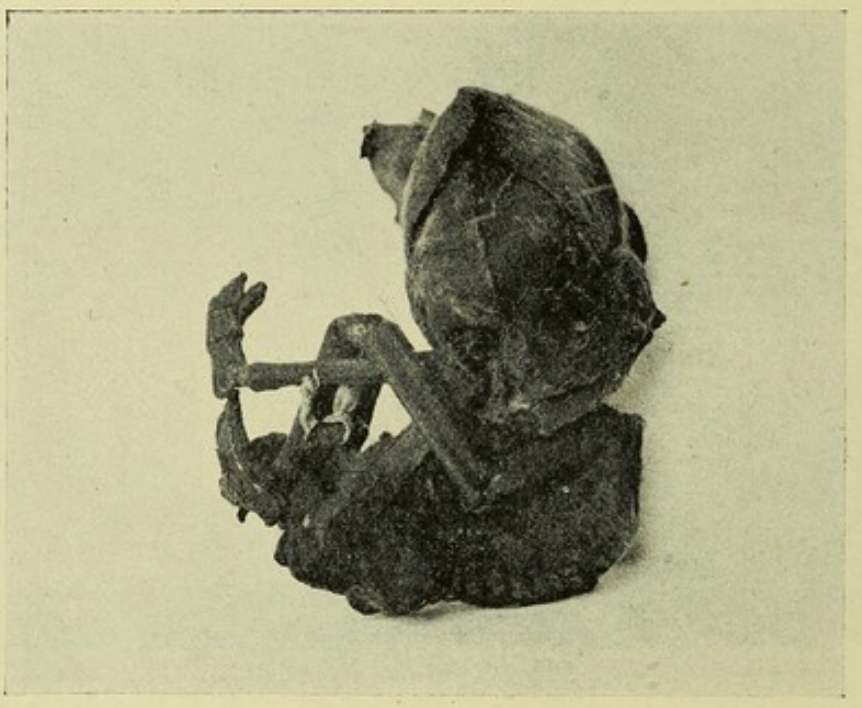


Fig. 34.—Mummified Fœtus found behind a kitchen grate. Between the lower limbs may be seen the ligature—a piece of white tape—by which the umbilical cord had been tied. It does not appear to have been of viable age. (Author.)

of sandy soil in hot climates, or in warm dry vaults as at Malta and elsewhere. It has occasionally been noted in the bodies of infants which have been secreted behind kitchen-grates, or in dry-stone walls, or in trunks kept in a warm atmosphere. The late Professor Ogston [2] mentions two cases illustrative of the last, and we have seen one instance of the first. The factors necessary for its production are: (1) the absence of dampness, and (2) the continuous action of a current of dry, or warmed, air. The appearance of a mummified body is remarkable in this, that while the whole structure is desiccated, black, and shrivelled, the anatomical features, even to minutiæ, are preserved. The skin, which clings closely to the shrunken framework of the body, and the hair on the scalp, are preserved intact; and even

[1] *Op. cit.* vol. i., p. 41. [2] *Op. cit.* p. 69.

the skeletonised features of the face are also preserved. In a fœtus in our possession, found behind a kitchen grate, not only is the stump of the umbilical cord still present, but also the ligature with which it was tied; and the individual bones of the carpus and metacarpus may even be counted. (Fig. 34.) This specimen has remained unaltered, under a glass case, for at least twelve years. The body in this condition is practically odourless, and any faint odour perceptible is only that of fustiness.

The following cases which have come under our observation are of interest.

1. The body of a newly-born female child was found in the ventilating aperture in the wall of an unused larder in the basement flat of an occupied house in the West End of Glasgow, on June 20, 1902. The following were the appearances of the body found by us at post-mortem examination—viz.

(*a*) *External.*—Body was covered by a whitish fungoid growth more or less generally distributed over surface of body, excepting the left side of head, neck, and upper part of trunk. The rest of the body was dried and mummified, the skin being dry and leathery, and dark-brown in colour. There was an irregularly-shaped wound or gash on right side of neck, commencing under lower jaw on neck below level of right ear and extending to middle line of neck. It measured 4 inches long, and had passed into the deep tissues of neck and throat. It was so decomposed, however, that it was impossible to say whether it had been produced during life or after death. The remains of the umbilical cord were found attached to the mummified wall of the abdomen, and were dried and shrivelled. It was difficult to say whether it had been torn or cut. The femoral epiphysis had an osseous nucleus.

(*b*) *Internal.*—A fracture was found in the left parietal bone above and behind the left ear.

The lungs were in a remarkably fresh condition, due, most likely, to the external mummification of chest wall. They showed distinct mottling in colour, and after full testing, floated perfectly in water.

The mother, a domestic servant in the house during the previous winter, was apprehended, was tried before a sheriff and jury on a charge of concealment of pregnancy, was convicted, and was sentenced to a term of imprisonment. The history of the case as revealed at the trial was briefly as follows:—On January 30 previous the mistress found the girl to be ill, and sent for a medical practitioner, who from the girl's condition advised that she should be sent to the Maternity Hospital. It was suspected that she was about to be delivered of a child. She was sent to Hospital, and it was reported to her mistress that the girl had been delivered of a child, but that no child had been seen. Some months later, a bad smell began to pervade the basement flat of the house in question, but for some time the cause could not be traced. On June 18, the mistress went into the unused larder, observed the wall-ventilating opening, and saw a red streak passing down the wall from the opening. The police came and found the body. The body had thus been exposed to a current of air for a period of about four and a half months.

Complete Mummification of Body of Newly-Born Child

In May 1908, the body of a newly-born child was found in a cellar in a self-contained house in a town near Glasgow. We were asked to examine it along with the late Dr Graham of Paisley. The entire body was in a mummified condition, the external tissues being brownish in colour and leathery in consistence. Allowances being made for shrinkage of tissue and for straightening of lower limbs, its entire length was estimated to measure approximately 19 inches. The remains weighed 2 lbs. 2½ oz. Attached to the umbilicus was a flattened, dried portion of umbilical cord two inches in length. This was removed to be softened. After being softened, the free end showed that it had

been severed by a sharp instrument, and from a definite, well-marked, circular indentation about half-an-inch from the free end, we were of opinion that it had once been tied with some form of ligature, which, however, had disappeared. There was an osseous nucleus in the lower femoral epiphysis of the size of a small spilt-pea. Portions of tissue of left cheek were amissing, and from indications around the margin of the missing portion we were of opinion that it had been eaten by rodents, probably rats. There were certain fragments of clothing found on the body. Most were composed of cotton, but there were also portions of linen bearing embroidery. The tissues over the surface of the occipital bone contained what looked like dried, extravasated blood. This was particularly apparent on the bone itself, close to the lambdoidal suture. The brain was represented by a dried, dark-coloured, contracted mass. There was no fracture of skull bones. The contents of the thorax were indistinguishable as organs. In the lower part of the abdominal cavity was some tissue which occupied the position of and which seemed to be the remains of an infantile uterus, thus confirming the external indications that the infant was a female. From the foregoing examination, we reported (1) that the body was that of female child of mature uterine age at birth; (2) that the umbilical cord had been cut and, probably, ligatured; (3) that we were unable to say whether or not the child had respired or whether the evidence of violence found on the head had or had not anything to do with its death; (4) that the fact that the body had been clothed indicated that the child had been cared for after birth, and (5) that the body had probably lain where it was found for many years. Inquiries by the police of the occupant of the house, which had been shortly before the time of discovery vacated by him, resulted in a statement that the wine-cellar in which the body was found had not been used by him for over 30 years, but that access to the cellar might have been had from outside the house.

A most interesting paper on Egyptian embalming, and particularly on the unwrapping of the mummy of Meneptah, the Pharaoh of the Exodus, by Elliot Smith, may be consulted with profit.[1]

The preservative action of Antimony on the bodily organs has been well shown by the late Sir Thomas Stevenson in his account of the exhumations of two of the victims of Chapman, or Klosowski (London, 1903). Of the condition of the body of Bessie Taylor he said that the body generally was in a remarkably good state of preservation after being in the grave for 21 months; and of the body of Isabella Spinks he remarked: "On opening the sound dry elm coffin a female body was disclosed of an almost lifelike aspect, except for the pallor of the countenance, which was covered with a fine mealy deposit of earthy phosphates, giving the appearance of the face having been dusted with face-powder. Such deposits are not uncommonly met in exhumed bodies. There was no putrefactive odour. The shroud was perfect. There were no larvæ in or around the body. The short dark hair of the head was clean and unchanged. The fingers and hands were of a pink colour, with a few vesicles on them. No fungi were visible on the surface of the body. The right eye was shrunken, the left vesiculated but unruptured. I have never before made an exhumation so long—five years—after burial, or met with so well-preserved an exhumed body."

The foregoing appearances are all the more remarkable when it is realised that the coffin in which the woman Spinks was buried was at the bottom of a public grave 18 ft. deep, that seven other coffins had been deposited in the same grave on top of it, and that the stench from the other coffins was terrible, but that from Spinks' coffin was much less.[2]

Mummification is said to come on more readily in cases of poisoning by Arsenic and other poisons owing to the preservative action of these substances, but of this we have had no experience.

[1] *Annales du Service des Antiquités de l'Egypt*, 1907. *B. M. J.*, vol. i., 1908, p. 342.

[2] *B. M. J.*, vol. i., 1903, p. 873; Waldo. *B. M. J.*, vol. ii., 1904, p. 752.

Putrefaction of Internal Organs.—While a body is undergoing putrefaction, the internal organs do not disappear synchronously, as might be expected from the different organised conditions in which these exist. Obviously, the more highly organised the structure of the organ, the more resistant is it to the putrefactive process; and the converse is true.

The following tabulated statement of the order of putrefaction of these organs must, therefore, be interpreted in that view.

The organs may be divided into two classes—viz.

1. Those which putrefy early.
2. Those which putrefy late.

Of the former class are the following :—

1. Trachea.
2. Brain (of young).
3. Stomach and Intestines.
4. Spleen.
5. Liver.
6. Adult Brain.

Of the latter :—

1. The Heart.
2. Lungs.
3. Kidneys.
4. Urinary Bladder.
5. Gullet.
6. Diaphragm.
7. Aorta.
8. Uterus.

It will be seen from the foregoing that the organs which are composed of muscular layers resist putrefaction longer than the parenchymatous organs, with the exception of the stomach and intestines, which, by reason of their putrefactive contents at the time of death, decompose quickly. Again, it may be said that the rapidity of the process depends, in some measure, upon the amount of fibrous tissue which an organ contains, as in the lungs. Further, the internal organs of the young putrefy more rapidly than those of the middle-aged or the elderly.

Factors which modify Rate of Putrefaction.—These may be divided into—

I. Internal Factors.
II. External Factors.

I. Internal, or Subjective. — The following are the chief:—(1) Age; (2) Sex; (3) Condition of Body at Death; (4) Kind of Death.

1. *Age.*—Bodies of newly-born children, and of the young generally, putrefy more rapidly than those of later life. Very old bodies do not putrefy rapidly because already they are partly shrivelled.

2. *Sex.*—This has but little influence, except in the case of the bodies of women dying after child-birth, more especially when death has been caused by septicæmia.

3. *Condition of the Body.*—The physical state of a corpse influences the rapidity of putrefaction to some extent. Fat, flabby, lymphatic

corpses putrefy more quickly than lean, shrivelled bodies, doubtless due to the larger amount of fluid in the tissues of the former.

4. *Kind of Death.*—The bodies of persons dying suddenly in robust health decompose less quickly than those of persons dying of acute or chronic diseases, especially of the infective diseases. Much mutilation of tissue, too, favours decomposition from the larger area exposed to the action of animalculæ, as also suffocation by smoke, H_2S, etc.; while the bodies of chronic alcoholics, and those who die by poisoning from Carbolic Acid, Arsenic, Antimony, and Chloride of Zinc, etc., resist putrefaction longer, owing to the preservative action of these substances on the tissues, or to their destructive or inhibitive action on the ordinary fauna which induce decomposition.

II. External, or Objective.—Of the external factors, the following are the chief :—

1. The Presence or Absence of Air ;
2. The Temperature of the Medium ;
3. The Presence or Absence of Moisture ;
4. The Kind of Medium in which the body lies.

1. *The Presence or Absence of Air.*—The presence of air promotes, its absence retards, decomposition. So, likewise, any factors which contribute to the free play, or the opposite, of the atmosphere, will accelerate or retard. Things being equal, a nude body will decompose more rapidly than one ordinarily clothed. Porous sandy soils, for the same reason, accelerate decomposition, while clayey, dense, or water-logged soils will retard it; hence the advisability of forming places of interment in open, sandy, or gravelly, soils. Likewise the kind of coffin used for encasing the body helps or hinders; a wicker-work coffin, or one composed of roughly adjusted deal planks will help, while hardwood, zinc, or lead "shells" prevent or retard. In the interment of bodies, since rapid dissolution of the body is aimed at, only the former conditions should be adopted: too strong words cannot be used in condemnation of the practice of interring bodies in air-tight coffins.

2. *The Temperature of the Environment or Medium.*—Putrefaction begins at about 50° F., is most favoured by temperatures from 70° to 100° F., and is retarded between 100° and 212° F., because the fluids are dried up. Moreover, microbic action is hindered at too high and too low temperatures, while at low temperatures, the fauna of decomposition are paralysed in action. It is for these reasons that in Arctic climates, such as Northern Siberia, huge carcases of animals now extinct have been discovered intact, even with the hair *in situ*, just as if they had been buried some days before, and the bodies of men, in crevasses, after Alpine accidents, have been found fresh long after the occurrence of their death. Upon the action of cold, too, is based the importation of fresh meat and fruits from foreign countries.

3. *The Presence or Absence of Moisture.*—Moisture is absolutely needful for ordinary decomposition of an animal substance, and usually the body contains sufficient for the process. Any additional moisture, however, aids in the rapidity of the action : hence the reason, or one of them, why bodies decompose more quickly in water than in

the earth. And if warmth be added, the rate of decomposition is much hastened.

4. *The Kind of Medium in which the Body lies.*—These media are three in number—viz. Air, Earth, and Water. We may take the dictum of Casper[1] on this point as being approximately correct. "At a tolerably similar average temperature, the degree of putrefaction present in a body after lying in the open air for a week or a month corresponds to that found in a body after lying in the water for two weeks or months, or after lying in the earth in the usual manner for eight weeks or months"; in other words, a body, *cæteris paribus*, decomposes in the air twice as quickly in the same time as in water, and eight times as rapidly as in the earth.

Putrefaction rapidly develops in bodies which are exposed in water largely charged with sewage, and especially so, if in summer. After the deplorable accident at the launching of the steamer *Daphne* in the Clyde in July 1883, in which many workmen working on board at the time of the launch were drowned, we had an opportunity of examining the bodies of the victims as they were recovered. Several of the bodies floated within eight days so decomposed that identification was not possible except by their attire. The whole body was uniformly bloated and of a reddish-livid colour, the natural cavities were abnormally inflated with putrefactive gases, especially the abdomen, and for the latter reason, many of the bodies came to the surface floating buttocks upwards.

Exhumations.—It is sometimes necessary for the purposes of the criminal law, in cases of civil actions or of life insurance where the cause of death is disputed, in charges of desecration of graveyards, and in other contingencies, to disinter bodies for examination: in the two first-named cases, to determine the actual cause of death, and in the last, as to disturbance of graves. Or exhumation may be called for where relatives desire a body to be disinterred from a grave in one place and interred in a grave in another. In any case, it is a very disgusting operation, and one which is not unattended by danger. The order of procedure is this: the Crown Authorities, that is, the Sheriff in Scotland, after petition in which are set forth the reasons for the exhumation, or the Home Secretary in England, grants a warrant to the medical inspectors to disinter, and in needful cases, to dissect the body. The necessary preparations having been made with the authorities of the graveyard, the body is disinterred, and the examination of the body made. The body should be identified by the relatives, when possible; failing such, the undertaker and gravedigger should, at least, identify the coffin and the grave. It will be well to take the following precautions—viz.

1. Let the exhumation be conducted in the coolest and lightest time of the day;
2. Let the dissection be performed, when possible, in the open air, and in a place temporarily screened off from public gaze; or if under cover, in as airy a place as possible;
3. Provide plenty of disinfectants,—Chloride of Lime preferably, water, sponges, and cloths;

[1] *Op. cit.* vol. i., p. 37.

4. After the body has been exhumed and liberated from the coffin, expose it to the air to permit the concentrated foul gases to be dissipated ; thereafter, souse the body with a strong solution of Chloride of Lime in water ;
5. During the examination, keep as much as possible to the windward side of the body, and use plentifully disinfectants for the hands during the inspection.

The examination should be conducted in like manner to that of a comparatively fresh body, both as to method and completeness, and the report written in detail as in an ordinary case ; and the same precautions should be taken where poisoning has been suspected, in securing, when possible, the stomach and its contents and the other internal organs, and in establishing identity of the specimens in their passage from hand to hand for chemical analysis. In such cases, too, it is important to preserve a portion of the earth surrounding the coffin and portions of the coffin itself, lest it might be set up as a defence, in the event of a poison such as arsenic, for example, being found, that what was found in the body was imparted to it by the soil.

The law in some countries imposes limits as to the time within which an exhumation may be permitted. In Scotland, the limit is twenty years, but in England, there is no limit of time. In France, the period is ten years, and in Germany, it varies with the enormity of the crime committed—viz. for offences punishable by death, 30 years, for offences, punishable by imprisonment for ten years or more, 20 years ; the period becoming shorter, *pari passu*, with the crime.

CHAPTER VI

LAW AS TO DEATH CERTIFICATION

THE general discussion of the subject of Death would be incomplete without some reference to the legal duties and relationship of the practitioner to the State with regard to the certification of deaths, since his duty does not cease in a case at the termination of life.

Certification of death is one of those duties which the Legislature has imposed upon the medical profession and which must be performed without fee or reward. Failure to testify is followed by a penalty. It is necessary, therefore, that practitioners should know their duty to themselves, to the State, and to the dead, in its civil and criminal relationships.

The young practitioner will find it profitable to study the printed matter which is found with each book of blank forms of certificates issued by the local registrars.

Law on the Subject.

I. In England. The Acts of Parliament in which the law is written are the Registration Act, 1836 (6 & 7 Will. IV. cap. 86), and the amending Act, the Births and Deaths Registration Act, 1874 (37 & 38 Vict. cap. 88). Under section 20, sub-section 2, of the latter Act, where a person has been attended during his last illness by a registered medical practitioner, such practitioner is bound to give a certificate, in which he states to the best of his knowledge and belief the cause of death, and said certificate the practitioner is to give to the person required under the Registration Act—the "qualified informant"—to convey it to the registrar of the district. The following are the exact words of the foregoing 20th section of the statute:—"In the case of the death of any person attended during his last illness by a registered medical practitioner, that practitioner shall sign and give to some person required by the Act to give information concerning the death a certificate, stating, to the best of his knowledge and belief, the cause of death." On the question being raised by a medical practitioner as to whether he or any other practitioner could refuse to give a certificate, it was submitted to the Registrar-General for his views on the subject, to which he replied as follows:—"The duty of the medical practitioner is very clearly explained by the 20th section of the Act, which admits of no other interpretation. . . . The medical practitioner under the circumstances described in the Act has no option in the matter; he cannot withhold the certificate. He can, of course, if he sees fit, himself communicate with the coroner or police with regard to any suspicious circumstances which may have come under his notice when in attendance during the last illness of the deceased; but he may safely leave this duty to the registrar, who in his 'Regulations' is directed to report to the coroner [on a form provided from this office] all deaths

caused directly or indirectly by violence, or which have been attended by suspicious circumstances, as well as sudden deaths, and every death the cause of which is stated to be unknown." [1] Such an interpretation of the statute makes it compulsory, therefore, for a medical man to report upon the cause of death, no matter now disagreeable may be the immediate or remote consequences of this statutory duty to the friends or relatives of the deceased, whenever the cause is known and whatever the cause may be; but there are, at the same time, cases in which by reason of suspicious circumstances, the practitioner may not be able to decide between the symptoms of natural disease and poisoning. While he has no desire, through a mistake, to give unnecessary publicity to the case, which, after all, if he were proved wrong, would reflect harmfully upon himself, he may be equally actuated by the desire to prevent a miscarriage of justice. In such circumstances, it would be most advisable before granting the certificate to have a personal interview with the coroner, with whom the best course to be followed under the circumstances may be arranged. Failure to certify makes the practitioner liable to a penalty of 40s., and the giving of a false certificate makes him liable, on summary conviction, to a fine of £10, or on indictment, to seven years' imprisonment. A medical man, however, in the above circumstances may refuse on reasonable grounds to grant a certificate.

In cases of death which have been the subject of inquest by the Coroner on information given by a medical man or by others, it becomes the duty of that official by the Act (50 & 51 Vict. c. 71, secs. 18 (3), 4 (4), and 16) to send to the Registrar a certificate of the finding of the jury as to the cause of death within the time required by the Registration Acts. It is important, also, to consider what is the time which is applicable to the " qualified informant " in the ordinary case. Sections 10 and 11 of the Births and Deaths Registration Act, 1874, enact that personal information of a death must be given to the registrar by the informant, with penalty of 40s. in case of failure, within *five* days of its occurrence, or, where a written notice of the death with an accompanying medical certificate of the cause of death is sent, within *fourteen* days.

II. In Ireland. The law is included in the following Acts—viz. the Registration of Births and Deaths (Ireland) Act, 1863 (26 Vict. c. 11) and the amending Act, the Births and Deaths Registration Act (Ireland), 1880 (43 & 44 Vict. c. 13). As in England, the practitioner in attendance during the last illness of a deceased person is bound to give to the informant of the death a certificate, in which the cause and other particulars are duly stated, which certificate must be delivered by the informant to the registrar within five days after the death. The same penalties apply as in England in cases of failure to certify and of false certification; and like provisions control the action of the Coroner by virtue of 43 & 44 Vict. c. 13, sections 17 and 20.

III. In Scotland. The Registration Acts (which must be read together) at present in operation are: (1) The original Registration Act of 1854 (17 & 18 Vict. c. 80); (2) the first amending Act, 1855 (18 Vict. c. 29); and (3) the second amending Act of 1860 (23 & 24 Vict.

[1] *The Lancet*, vol. i., 1887, p. 1144.

c. 85). Section 41 of the original Act and section 14 of the second amending Act both deal with the relation of the medical practitioner to the registrar with respect to the certification of deaths, and are to the effect that the practitioner who attended during the last illness of a deceased person is bound to transmit to the registrar, within *seven* days after the death, a certificate of the cause of death ; failing to do so, the registrar must then forward to him a certificate-form duly filled in, and by a printed or written requisition, shall require him to return the said form duly completed within *three* days after receipt thereof, under a penalty not exceeding forty shillings in case of failure. In cases which have been inquired into by the Procurator-fiscal, this official, by section 40 of the original Registration Act, is bound to inform the registrar of the result of said inquiry, but no time is defined in the Act within which said information must be returned to the registrar (*vide* p. 11). Contrasted with England and Ireland, the relation of the practitioner to the duty of certification of deaths is legally different. In the former, he is bound to deliver the death certificate to the legal or qualified informant who is bound, under a penalty, to convey it to the registrar ; in *Scotland on the other hand, the practitioner is himself bound to send to the registrar such certificate within seven days after death, or within three days thereafter after notice by the registrar, where he has failed to do so.* Such then is his legal duty. In practice, however, it commonly happens that the informant obtains the necessary certificate from the practitioner soon after the decease, and himself conveys it to the registrar.

CREMATION

The Cremation Act, 1902 (2 Edw. VII. ch. 8), laid down the law respecting the manner of disposal of dead bodies. In view of the fact that fire is likely to destroy all evidence of foul play, even by poisoning, the certification of death required before a body can be cremated is of a much more searching character than that required for ordinary burial, the object being to obtain the fullest information and to prevent the fraudulent concealment of facts. Therefore the Act requires that two certificates of death must be provided, one, the statutory medical certificate, by the medical attendant of the deceased, and a second, called the confirmatory medical certificate, which can only be given by a registered medical practitioner of not less than five years' standing. Besides, every cremation authority must appoint a medical referee and a deputy, approved by the Home Secretary, to whom the certificates are submitted, and when these are deemed satisfactory the cremation is allowed to take place. Should he deem the certificates unsatisfactory, the referee may refer them back to the grantors for further information or to be filled in proper form. In cases where the cause of death has not been definitely ascertained by the certifying doctors, the referee may require that a post-mortem dissection of the body should be made by a medical expert in pathology. Since the Home Office regulations came into operation on May 1, 1903, up till December 31, 1907, 1739 cases were submitted to the medical referee. In 31 cases the certificates

See Case of Price B.M.J. vol i, 1884 p. 1009

were sent back to the grantors for emendation or for fuller information, in 20 cases a post-mortem examination was ordered, and in 4 cases the referee refused to permit cremation.

Prosecutions for contravention of the provisions of the Act have occasionally been recorded. At the Edgeware Petty Sessions, May 6, 1908, an undertaker was prosecuted on two summonses charging him with (1) unlawfully and knowingly procuring the burning of the body of a still-born child, and (2) contravening the regulations made by the Secretary of State by causing and procuring the cremation of the body of a still-born child otherwise than on the written authority of the medical referee acting on behalf of the London Cremation Company Ltd. Of the two bodies one was that of the wife of a medical man, the other that of the still-born child at whose birth the mother died. The husband desired that the bodies of his wife and child should be placed in one coffin. Due legal arrangements were made for the cremation of the remains of the wife, but none for the infant, the undertaker being of the belief that the child being a still-born child, and being enclosed in the same coffin as that of the mother, there was no need. When the coffin was being consumed, it burst open and disclosed the two bodies. The matter was reported by the officials of the Company to the authorities. The Court held the undertaker guilty of contravention of the Act and he was fined.[1]

While the foregoing, therefore, is an exposition of the law relating to the duty of the medical profession in the certification of deaths in the different parts of the kingdom, there are certain points which, by being attended to on the part of the practitioner, will contribute to his safety against fraudulent practices. While he is bound to state on the death-certificate (in its unaltered form) the date upon which he last saw the person alive of whose death he now certifies, it may happen that that date is not very proximate to the date of death; again, he may be asked to certify the death of a person whom he has but once seen; in both of those circumstances, it is best for the practitioner himself to verify the fact of the occurrence of death before he grants certificate, else he may find that he has certified the death of one who is yet alive. A few years ago, an old and respected practitioner of Glasgow was tried before the Justiciary Court on the charge of false certification, the facts being that he had granted a certificate of death of a man, whom he had seen but once, on a representation by friends that death had occurred, but which was untrue, as the person was then alive. He was acquitted of the charge of wilful false certification. In the evidence given before the Select Committee of the House of Commons on Death Certification, Dr Grimshaw, Registrar-General for Ireland, told the Committee the following facts:—Dr Lyons—who was at one time a member of Parliament—when in practice in Dublin, was attending a man who was very ill from paroxysmal asthma, complicating bronchitis. He saw the man one day in a very bad attack. Next morning, friends of the patient called at the house of Dr Lyons, stated that the patient was dead, and asked that a certificate of the cause of death be sent to them. It happened, however, that Dr Lyons had gone out on his round of visits, and calling upon this patient

[1] *B. M. J.*, vol. i., 1908, p. 1263.

early because of his serious condition, found the man not only alive, but sitting up in bed. It was clear that the informants wanted the certificate from Dr Lyons so that they could register the death and obtain the insurance money. It is very important, too, that a practitioner should not grant a certificate of death of a person whom he has not seen for a length of time, even although the person is known to him as suffering from a disease which might easily and suddenly prove fatal, such as, for example, heart disease. A coroner stated before the above Committee that, on one occasion, he had to make inquiry concerning the cause of death of a man. A medical man was prepared to certify that he died from heart disease, he having seen the person and having diagnosed that disease six months before, although he had not seen him in the interval. The coroner, however, because of the extreme desire of a brother of the deceased that an inquest should not be held, thought the circumstances suspicious, and, on holding an inquest, it was proved that the deceased died from a suicidally-inflicted pistol-shot through the heart. Although the law, as yet, makes no recompense to the practitioner for the certificate which he is bound to give, and will make none for the trouble he may take in personally verifying the fact of death in any case, it exacts of him at the same time the exercise of reasonable care in the performance of such a duty, and, therefore, for his own comfort, he will do well under such circumstances as the above to personally view the body before granting a certificate, or to decline entirely to grant a certificate.

But there is another aspect of the question which it is important every practitioner should know, and that is with relation to the number of certificates of death he is legally entitled to give of any individual death. Although there is no statutory enactment which expressly forbids a medical practitioner to give a number of certificates, there are statutory provisions which will disannul the value of, if not entirely disallow, all certificates more than one. Such legal provisions arose out of an attempt to prevent the over-insurance of children—a practice which was attended with a fearful sacrifice of young life in some of the chief cities of this country, and with wholesale murder in Liverpool and elsewhere by poisoning.

Medical Certificates of Death as affected by the Friendly Societies Act, 1875 (38 & 39 Vict. c. 60).—In Section xxviii. of this Act, it is enacted :—

1. That no society shall insure or pay on the death of a child under five years of age any sum of money which, added to any amount payable on the death of such child by any other society, exceeds six pounds, or on the death of a child under ten years of age any sum of money which, added to any amount payable on the death of such child by any other society, exceeds ten pounds.
2. No society shall pay any sum on the death of a child under ten years except to the parent or personal representative of said parent and upon production by said parent or representative *of a certificate of death issued by the registrar of deaths.*
3. No registrar of deaths shall give any one or more certificates

of death for the payment in the whole of any sum of money exceeding six pounds on the death of a child under five years, or exceeding ten pounds on the death of a child under ten; *and no such certificate shall be granted unless the cause of death has been previously entered in the register of deaths on the certificate of a coroner or of a registered medical practitioner who attended such deceased child during its last illness, or except upon the production of a certificate of the probable cause of death under the hand of a registered medical practitioner, or of other satisfactory evidence of the same.*

4. That it shall be an offence against this Act if any society pays money on the death of a child otherwise than is provided for in the Act, if any parent or his representative claims money on such a death by any certificate of death other than is provided for in the Act, or by false or fraudulent certificate, or in any way attempts to defeat the provisions of this Act.

From the foregoing, therefore, it is perfectly clear that the intention of the Legislature regarding the insurance of the lives of children at least, is that the medical practitioner shall only provide one certificate of the death to the qualified informant, who, in conveying said certificate to the registrar and on statement of the fact that the deceased was insured, should be entitled to the provisions of the Act in respect of the sums to be paid for the ages definitely stated: and further, that the duty of giving the number of extract certificates of death to cover the sum to which the informant is entitled shall be imposed solely on the registrar. It is, therefore, better for the practitioner to satisfy the requirements of the Registration Acts, and to leave the relatives and registrar to settle the rest.

Again, under no circumstances should a medical man be tempted to sign blank certificates, or to sign the certificate of death of a person while such person is still alive. This may not only bring upon him a charge of false certification,[1] but his action may be deemed "infamous conduct in a professional respect" by the General Medical Council, and may effect the removal of his name from the Medical Register.

By resolution of date Nov. 24, 1897, the General Medical Council gave notice "that any Registered Medical Practitioner, who by his presence, countenance, advice, assistance, or co-operation, knowingly enables an unqualified or unregistered person (whether described as an assistant or otherwise) to attend or treat any patient, to procure or issue any medical certificate or certificate of death, or otherwise to engage in medical practice as if the said person were duly qualified and registered, is liable to be judged as guilty of 'infamous conduct in a professional respect,' and to have his name erased from the *Medical Register*, under the said enactment."

Under what circumstances may a Medical Practitioner decline to grant a Certificate of Death?

It is to be noted that it is expected that a medical man who has attended during a fatal illness will be able to state the cause of death, and that, in certain circumstances even without such attendance, he

[1] *B. M. J.*, vol. i., 1900, p. 1365.

may equally be able to certify the probable cause of others. For the purposes of the State, certification of death by the medical profession is intended to effect two objects—viz. first, to designate the cause of death for statistical purposes, and, second, to prevent criminal practices. While the law desires that the cause of death should be accurately certified so far as that is possible, it certainly expects that the practitioner shall be able to say whether it was due to natural or to unnatural causes. If he be satisfied that it is due to the former class, the knowledge of this fact would entitle him, nay compel him, to certify, and the statement of the fact ends the matter. On the other hand, if he has grave suspicion, and more so, if he sees actual proof, that the death is due to an unnatural cause, then his clear duty, in the former case, is to decline to grant a certificate, and, in the latter, to state the facts, leaving it to the legal authorities to deal with the questions of cause and culpability. In the Maybrick case, for example, because of no certificate being granted, an inquest had to be held. Therefore reasonable suspicion of foul play would be a justifiable cause for withholding a certificate. In the same category may be reckoned lapse of time between the dates of the death and his last visit to the deceased. A medical practitioner is not warranted in withholding a certificate of death by reason of his fees for the attendance not having been paid. In 1898, a medical practitioner was tried on the charge of failing, without reasonable excuse, to sign and give a certificate of death of a person upon whom he had been in attendance up till the time of death. He urged the above as a reasonable excuse, but the magistrate fined him in 40s., and costs.[1]

We are of opinion that if members of the medical profession would decline to grant certificates of death except after personal verification of the fact, and then in strict accordance with the facts, and, further, would decline to do so except in cases in which they had been in attendance, the reforms so much needed in Death Certification would be more rapidly accomplished.

For further information, the reader may consult the Evidence given before, and the Reports of, the Select Committee on Death Certification, of 1893, which was appointed "to inquire into the sufficiency of the existing Law as to the Disposal of the Dead, for securing an accurate Record of the Causes of Deaths in all cases, and especially for detecting them where Death may have been due to Poison, Violence, or Criminal Neglect"; "Death Certification and Registration in Scotland," by the Author, *Glas. Med. Jour.*, Oct. 1893; *B. M. J.*, vol. ii., 1900, p. 1509; *ibid.* p. 1579; *ibid.* p. 1647.

[1] *B. M. J.*, vol. i., 1898, p. 862.

CHAPTER VII

MEDICO-LEGAL FORMS OF DEATH

HAVING discussed the subject of Death in its general medico-legal aspects, it is now necessary to consider those special kinds of death from causes which usually form the subject of criminal investigation. Among these are included the following—viz.

I. By Drowning.
II. By Suffocation.
III. By Hanging, Strangulation, and Throttling.
IV. By Lightning and Electricity.
V. By Burning and Scalding.
VI. By Criminal Neglect and Starvation.
VII. By Cold and Exposure.
VIII. By Heat Apoplexy.
IX. By Mortal Wounds.

I. DEATH BY DROWNING

This is a comparatively common form of death. During each year many cases of death are registered from this cause in England and Wales, and Scotland. Of the total number of suicides by different kinds of violent deaths in England and Wales in 1865–94, 21 per cent. and in Scotland in 1877–94, 28 per cent. was from this cause.

It is important that it should be clearly defined what is meant by death by Drowning. *A person may be said to have died from drowning into whose air-passages and lungs air has been prevented from entering by any watery, viscid, or pultaceous fluid into which his head has fallen and remained.*

It is not necessary for the fulfilment of the act of drowning that the whole body be submerged, nor, indeed, even the whole head; it is enough that the mouth and nostrils be submerged, and that a person so situated is not able to withdraw himself. Intoxicated persons, epileptics, and others, have been known to be drowned in very small pools or shallow puddles of water. We have seen one such death in an intoxicated person who on a December night fell face downwards in a shallow puddle of water about one and a half feet in diameter, and about three inches deep. In a case occurring in a lunatic asylum in the neighbourhood of Glasgow, a male inmate committed suicide by submerging his head in a sink filled with water (*vide post*). In the bulk of cases, however, the whole body is submerged. Death by drowning is, therefore, due to asphyxia. Circumstances, such as unconsciousness on the part of the individual from any cause, may modify the appearances found on the body. It has been stated by various

writers that in drowning asphyxia is not always the proximate cause of death, and that instead of the signs of asphyxia being found on all bodies taken from the water there may be evidence of death from syncope or coma. It is difficult to conceive, if we start from the proposition that death by drowning consists essentially in deprivation of air from the lungs by a watery medium, how the signs of asphyxia can ever be absent; since any person who dies in the water, in whom the respiratory function is in operation in any degree, must die from such deprivation of air by the water, and, hence, he must die from drowning, and the post-mortem signs of asphyxia will be revealed on examination. In the entire absence of these signs we are of opinion that it may safely be affirmed that the person did not die from drowning. This does not, of course, exclude the possibility of other signs contributory to death being found; but in every case of death in the water the proximate cause must be asphyxia, since the interference of the water is the cause of impediment and ultimate arrest of respiration. We can conceive but one contingency in which signs of asphyxia will not be found, and that is where the respiratory action has ceased at or before the moment of submergence. A person walking along the bank of a river, or canal, may be seized with a fatal attack of syncope, and his body may fall into the water: but in such a case, respiration being arrested permanently, there will be no water inspired, and, consequently, the signs of asphyxia will be absent. But in cases where persons fall into the water during an ordinary faint, or as the effect of an apoplectic or epileptic seizure, or from serious injuries to the head by falling from a height into the water, the respiratory function will at once be interfered with, and the person will die asphyxiated. In the post-mortem appearances of such cases, difference in degree in the signs of asphyxia will, doubtless, be found, due to the amount of struggle for breath prior to death; and, in addition, there will be other lesions found in the body—hæmorrhage into the brain in apoplexy, and injuries to head, or body, or both, in cases of accident; but in all of them, the signs of asphyxia will be apparent. These views are based upon the examination of the bodies of over 100 cases of drowning ranging from young children up to persons advanced in life. We believe, therefore, that the following may be taken as a safe rule:—*That if a person falls alive into the water—the process of respiration being in operation or resumed in the water—and if he die therein, the proximate cause of death will be asphyxia, of which the signs will be apparent on examination of the body; but the measure of their intensity will be determined by the struggle for breath, and the time occupied in dying.*

Period of Death.—This may be any time between one minute and twenty minutes, since persons are said to have been resuscitated after having been in the water for the latter period. The specific gravity of the human body being slightly less than that of ordinary water when the lungs are ordinarily full of air and when the whole body is submerged, little deprivation of air or raising a part of the body out of the water is all that is needed to cause it to sink. This is usually brought about in the case of those who are not able to swim, or have not the presence of mind to float, by aimless struggling to save themselves. It is only of passing interest to note that such bodies of water, as the Dead Sea,

will easily sustain the human body, by reason of their high specific gravity.

The first medico-legal question which arises in the examination of a body which has been taken out of the water, is—

Was Death due to Drowning?—A presumption—apart from evidence—may be determined in certain cases by the fact that a very large number of deaths is caused by accident during occupation, or while bathing or boating, or of set purpose, as in suicide. On the other hand, it must not be forgotten that bodies are sometimes thrown into the water to cloak the commission of crime in another form. Presumption, therefore, is of no value whatever when dissection of the body will indicate proof. The question, therefore, resolves itself into another—viz. *Was the person dead or alive before the body was submerged in the water?*

External Appearances.—There are certain external appearances found on a body, which, to a limited extent, help in the solution of this question. These may be summarised as follows :—

1. Coldness of the Body.
2. Pallor of Body Surface.
3. Facial Appearance and Expression.
4. Appearance and Situation of Tongue.
5. Presence or Absence of *Cutis Anserina.*
6. Condition and Appearance of Hands and Feet.
7. Retraction of Penis and Scrotum.

The first two signs are of no absolute value, and may, therefore, be summarily dismissed.

Regarding the Facial Appearance and Expression, our experience is that, in most cases, there is nothing to point to the cause of death. The face of the drowned is usually pale, bears a calm, placid expression, the eyes being either shut or partially open—up till the time when putrefactive swelling takes place. The foregoing will usually be descriptive of the face within 36 to 48 hours after submersion; but after the same period in summer and 8 to 10 days in winter, the face besides being bloated and swollen assumes a reddish or livid tint. The only phenomenon, seen occasionally on the face of the drowned, and which may be taken in the main as characteristic of drowning, is the *presence of a fine foam or froth at the mouth, or nostrils, or both.* Various causes, however, may prevent this being present at the first time of inspection, such as cleansing of the face, or the froth having been washed away by the water on the body being taken out of the water of submersion. It reappears, however, most usually some time after the body has been allowed to lie undisturbed; then, it wells out of both mouth and nostrils, forced out by putrefactive gases, or by the onset of *rigor mortis.* In cases of coal-gas and carbon dioxide poisoning, froth may likewise appear at mouth and nostrils, but it is composed of much larger bubbles than is that of drowning, which is a fine-bubbled froth. The difference is more appreciable when both have been seen and compared. The foam, in drowning, is due to churning together of air, mucus, and water.

There is another appearance of the face which, although but comparatively rarely seen, must be carefully noted. We have seen it in,

at least, four cases. This is a remarkably rosy hue of the lips and of the skin over the malar bones, more commonly, however, on the lips than on the cheeks. In every case in which we have seen it the submersion has taken place in winter and during intensely cold, frosty weather. It appears to us to be due to oxygenation of the blood in the mucous membrane of the lips and in the capillaries over the malar bones. In these cases, too, the body either floated within a few hours after submersion, or the act of drowning took place by submersion of the face only in a shallow pool of water.

Appearance and Situation of the Tongue.—It may be said that in the bulk of cases, beyond a slight duskiness of the organ, no unusual colour is present; exceptionally, however, it is darker, and is then accompanied by more marked facial signs of asphyxia. The organ is not infrequently protruded beyond the line of the teeth, but we have never seen it beyond the lips. In most cases, probably, it lies in its normal position in the mouth.

With respect to the Presence or Absence of *Cutis Anserina* and Retraction of the Penis, which, by some, are considered to be evidence of an act occurring during life, nothing more, in our opinion, can be proved by their presence than that molecular death of the tissues had not taken place at the time of submersion. These signs, moreover, are not peculiar to deaths by drowning, having been seen in deaths from other causes. Both are due to the contraction of involuntary muscular fibre; in the former, to contraction of the muscular bundles in the skin known by the name of *arrectores pili*, and in the latter, to the longitudinal fibres in the cutaneous cellular tissues of the organ. In the skin it shows itself by a puckered appearance, imparts to the sensitive hand a roughened sensation, and the papillæ of the skin can be seen by the naked eye to be elevated above the normal level of the skin. Casper says of the retraction of the penis that he has almost never failed to find it in the bodies of those recently drowned, and has not observed "anything similar so constantly after any other kind of death."

The condition and appearance of the Hands and Feet of a body taken from the water should always be noted. There are certain appearances found on these parts of every body which has lain in water, whether death has been caused by submersion or not—due to purely physical causes apart from the existence of life—viz. a bleached or sodden condition of the palms and palmar aspects of the fingers and of the soles and plantar aspects of the toes. This is caused by the action of the water on the thickened epidermis of these parts. From its puckered, bleached appearance on the hands it has been called "washerwoman's hand," which it closely resembles; and from its greyish-blue colour and wrinkled character, "cholera hand," from its likeness to the condition of the hand of one dying from that disease. By itself, therefore, the bleached condition above referred to can only form evidence of the body having lain in water for some time. There is one appearance in the hands, however, which, when seen, is of the greatest importance, and that is, the *presence of objects in the firmly clenched hand*—as weeds, grass, sticks, or other objects—which may be found floating in, at the bottom or on the banks of, the column of

water from which the body has been taken. On this fact is based the proverbial saying,—"a drowning man catches at a straw." This almost conclusively indicates death by submersion, as it constitutes a conscious vital act on the part of the person while in the water. The presence of sand, mud, or fine gravel under the finger-nails, to which some attach importance, seems to us, except in very special circumstances, of but slight significance, unless by some special characteristic the identity of the substance with that of the bed or banks of the column of water can be established.

Of the external phenomena, therefore, which may be found on a body taken from water, these only are of substantial importance —viz.

1. The presence of a fine foam or froth at the mouth, or nostrils, or both; and
2. The presence in the firmly clenched hand of the person of objects which are to be found in or beside the column of water from which the body has been taken.

After all, however, in order to answer the question with which we started, we must rely upon the internal appearances whereby to return a definite reply.

The prime cause of death being asphyxia, the principal evidence is likely to be found in the lungs and respiratory channels.

Internal Appearances.—Of the appearances of the lungs and air-passages, the following are characteristic of death by drowning:—

1. The increased volume of the lungs. This is at once apparent when the thoracic cavity is laid open, by the lungs bulging out into the freed space, just as if they had formerly been kept down under some degree of tension—for they are distended. This phenomenon is called "ballooning."
2. The appearance of the lung structure on section. The cut surfaces show a copious, watery, bloody, frothy exudation of a dark colour. The exudation is usually markedly copious, indicative of the presence of water.
3. The presence of a fine, clear, or, occasionally, blood-tinged foam or froth in the larynx, trachea, and larger bronchial tubes. When this is present, it unmistakably points to death by drowning, and it is accounted for in this way: during the violent efforts at respiration water enters the air-passages, along with a certain proportion of air, and the water, air, and viscid mucus become churned together to form this froth, which is composed of fine air-bubbles. This is essentially a vital act, and the froth when present is proof positive of interference with the function of respiration by a liquid during life.
4. The presence of water in the stomach.

There is usually a certain amount of water swallowed during the act of drowning when the person is in possession of his senses; but it may not be present when the person is unconscious, even although respiration is going on.

It will entirely depend upon the condition of that organ

prior to and during submersion, whether the watery contents can be identified with that of the drowning medium, for water may have been swallowed copiously immediately prior to submersion. But where fluids, or semi-fluid substances, of a disagreeable or disgusting character are found in the stomach—liquids which a person would not willingly swallow in any ordinary circumstances—they indicate submersion as the cause of death, where such constitute the drowning medium. For example, where liquid manure, or muddy water, or water containing fine shells, or like substances, is found, valuable aid is afforded to the diagnosis of drowning, where other evidences may be doubtful. Experiments by Riedel and Kanzler on animals show that fluid cannot enter the stomach after death, until putrefaction has advanced considerably. The gullet may, therefore, be looked upon as a canal *in posse* rather than *in esse*, until that time. For this reason, therefore, the presence of water in the stomach becomes of some importance.

The following signs, in a tabulated form, found on a body taken from water, would indubitably indicate death by drowning :—

1. The presence of material clutched firmly in the hand or hands which could only be obtained in the water, at its bottom, or on its banks ;
2. The presence in the air-passages of a clear, or blood-tinged, foam or froth, composed of fine air-bubbles ;
3. The increased volume, and œdematous and engorged condition, of the lungs ;
4. The presence in the stomach of water, or other composite liquid, corresponding to that of the drowning medium, or of substances which float or are suspended in the drowning medium, such as weeds or fine shells.

It is very usual in this connection to say something relative to the treatment of those in whom animation is suspended from drowning.

The line of treatment may be summarised under the following heads—viz.

1. Free the body of its clothing, and the mouth and air-passages of water : wrap the body in blankets.
2. Restore the animal heat of the body by warm applications, frictions, etc.
3. Stimulate the action of the heart and the respiratory nerve-centre.
4. Institute artificial respiration, either by Sylvester's, Hall's, Howard's, or Schäfer's method.

The details can be filled in as circumstances suggest.

The next important question upon which the medical examiner may be expected to be able to throw some light is, *Whether was the act of drowning accidental, suicidal, or homicidal ?* In very many cases, possibly the large majority, the examination of the body will not help in its solution ; indeed, the question only emerges when marks of violence are found upon the body ; therefore, the problem must be solved by the criminal authorities. There are, however, certain general indications, attention to which may assist as a guide to the answer apart from the evidence of eye-witnesses : for example, in

suicides where there has been a declared intention to commit *felo de se*, or where writings to that effect are found in a pocket of the drowned person.

The question of Accident usually bulks more largely in cases falling under the following classes—viz.

1. Among persons whose normal occupation is on or near rivers, canals, reservoirs of various kinds, or who, generally, have to do with harbours, or are engaged in boat-traffic, or in the launching of ships.
2. Among bathers, usually in summer.
3. Among intoxicated persons mistaking their way in the dark, or among others, in a fog, and thereby falling into a river, a harbour, or a canal; or falling face downwards into a shallow pool of water, either from the effects of alcohol, of epilepsy, or other such cause; or young children falling into vessels of water, such as wash-tubs, etc.

Among the causes of accidental drowning in the cases we have seen may be enumerated the following:—

(*a*) Children falling into wash-tubs.
(*b*) Adults drowned while pleasure-boating, by upsetting of boat.
(*c*) Intoxicated persons wandering into a canal.
(*d*) Persons wandering in a fog into a river, or canal.
(*e*) Boys drowned while bathing.

One unusual case deserves mention. Several men, some of them more or less intoxicated, were lounging away their time during a strike on the banks of the canal near Glasgow. One of them, an expert diver and swimmer, for a small bet volunteered to dive to the bottom of the canal from the ledge of a bridge near by. Having taken off his clothes he sprang into the water, but he did not speedily return to the surface. On the alarm being given two of his companions dived in after him, and found his body nearly perpendicular to the bed of the canal, his head sticking firmly in the mud at its bottom. When his body was brought out, he was found to be dead. There was a bruise on his forehead, due to his head having come in contact with a stone in the bed of the canal.

But accidental drowning may be accompanied by culpability, as the following case shows. A woman was tried in Glasgow in May 1901, on the charge that while in a state of intoxication she was unable to exercise reasonable care of her infant daughter of nine months, who, in consequence, fell out of bed into a pail of water standing beside the bed, wherein she was drowned. The jury, however, found the accused not guilty.

But charges of homicidal drowning in the case of children are not unknown. At the Glasgow Circuit Court, February 1906, a young married woman was charged with having assaulted her male child, aged seven months, and did beat him, and place him in a basin of water and suffocated and drowned him, and did thus murder him. In our post-mortem examination of the child's body, we observed that a bloody watery fluid escaped from the mouth and nostrils as the body was being undressed. There were several bruises on the left side of head and abrasions of the face. These when dissected revealed extravasated blood in the underlying tissues. Within the skull, there were four small areas of superficial hæmorrhage on the surface of the right hemisphere of the brain, but there was no fracture of the skull. In the lungs, frothy fluid was found in the bronchial tubes, the lungs themselves were engorged with

blood, and their bases were sodden. We reported that death was due to drowning and that the injuries found on the head were due to forcible contact with a blunt instrument. The evidence at the trial showed that the accused was, at the time when the child died, in a state of intoxication, that the child was found lying on a table in the kitchen of the house in its nightdress, with its head in a basin of water, that there was bruising on the left eye, swelling of the upper lip, and bruising of the left side of the head, while blood was oozing from the nose. Accused stated to the women whom she called into her house at the time, that the child had had a fit, that she had put it into the water because of the fit, and that she had not let the infant fall. The husband stated that his wife was fond of her child, and he could not believe that she injured it, and if she did so, she must have been out of her senses. The jury returned a verdict of " not proven."

The question of Suicide emerges under the following circumstances :—

1. Where stones, dumb-bells or other weighty bodies are found in the pockets, or attached to the person, and in the absence of any other cause of death.
2. Where the feet, or the hands, or both, are found ligatured together.
3. In cases of persons of known depressed mental condition from any cause, such as grief, or social or commercial disaster, or disappointment, or in cases of persons of known unsound mind. Suspicion is strengthened if a razor, for example, be found in the pocket, especially in the case of women. At Grangemouth, an elderly man tried to commit suicide by cutting his throat with a razor. From the back room in the house where the razor had been used, blood-stains were tracked to a swing-bridge over a stream, a distance of about 200 yards, and in a shallow part of the water the body was found.
4. Where the bodies are found in columns of water of sufficient depth to enable the act of drowning to be easily and efficiently performed. This established fact must, however, be borne in mind that eccentric suicides do drown themselves in very unusual places, such as shallow ponds, a water-bath, or other equally unlikely place, as a water-butt.

An interesting example of this may now be narrated. In May 1906 a male inmate of a lunatic asylum in the West of Scotland committed suicide by drowning himself in a sink in the following circumstances :—This man had gone to the lavatory during a quiet time of the day when the majority of the patients were out exercising or walking. He had filled the sink with water and, standing beside it, had deliberately placed his head under the water, until loss of consciousness supervened. The sink had evidently been filled full of water, as the clothing on front of his chest was soaked. After he became unconscious, his head remained under water. He was first observed in this position by a fellow-patient, who drew the plug, letting off the water in the sink, and then informed the attendant-in-charge of the occurrence. The medical superintendent, who was in his office at the moment, on being informed, proceeded hurriedly to the lavatory, and quickly removed the suicide from the sink to the floor, and with the aid of the attendant began artificial respiration and kept it up for over an hour, but without avail. The medical superintendent, who kindly supplied the foregoing details, further wrote : " The position in which I found the body was this—the upper part of the chest was resting against the front of the sink, the head was sunk just under the level of the brim of the sink, the legs were bent under the body, but the knees did not rest on the floor." This man was not considered to be suicidal in tendency, but was stated to be homicidal.

The question of Homicide is at once raised under such conditions as the following :—

1. In cases where, upon the banks of the column of water in which the body has been found, there are evidences of a struggle, and especially

when articles belonging to other than the deceased person are found on the banks associated with those known to have belonged to the deceased; or where, grasped in the hand of the drowned person, there are fragments of clothing or hair, not corresponding to those of his own person.

2. In cases where, on post-mortem examination, the usual internal signs of death by drowning are absent, and where, on the other hand, lesions due to violence are found on the body. It is necessary, however, to bear in mind that suicides who have determined to end their lives may have attempted first of all to cut their throats, or to suspend themselves, but having failed to achieve their purpose, have completed the act of self-destruction by drowning themselves.

It ought to be further observed that while homicidal drowning may be comparatively easy in the case of children or other helpless persons, it cannot be so easily attempted or effected in adults who are in possession of their senses, from the likelihood, or from the fear, of detection. Where such is tried the assailants are usually more than one in number.

In June 1907, we examined in the position in which it was found in the house, the body of a well-built, well-nourished woman of middle life. The house was in charge of police. The body was lying on the floor of the bathroom. The clothing from trunk of body had been removed partly by cutting and otherwise, and had been again loosely replaced over the body. It was soaking wet. Her left shoe was found lying in the water in the bath. A little pool of water had formed on the floor near the mouth of the body. On certain parts of the brasswork of the bath-taps were reddish stains, like points of interjection, which looked like blood-stains. In one of the bedrooms, occupied by one of the persons who had been taken into custody, was found a man's linen collar marked with several recent stains of blood, and certain articles of male underclothing which were quite wet. In another bedroom, occupied by the second person in custody, was found a man's nightshirt, which bore stains of blood on its upper left breast, left side of collar, on both sleeves, and wrist-bands. After removal to the mortuary, the body was further examined. The face was congested in appearance, and post-mortem lividity was of a deep purplish-blue colour. There were a lacerated wound on right temple, half-an-inch long, surrounded by an area of swelling, bruises on left arm, forearm, and hand, on right arm, forearm, and hand, and on both legs. In the deep tissues of the scalp, underlying the lacerated wound, was an area of extravasated blood measuring 2 in. × 1½ in., and over the ear, a second area of 3¼ in. × 2½ in. The air-passages contained some clear watery fluid. Both lungs were engorged with blood. On section of each, fine frothy mucus, clear in character, could be freely expressed from smaller bronchial tubes. The right heart contained much dark blood. The contents of stomach had a definite alcoholic odour. We reported that the cause of death was asphyxia, produced by the presence of fluid in the air-passages, that the injuries did not directly contribute to the death, but that the injury to the right temple may have stunned her. From want of evidence, no charge was ultimately preferred against the men in custody, and they were liberated. It was shown, however, that the woman's body was taken out of the bath and laid on the bathroom floor before our examination.

In those cases in which marks of violence are found upon a body taken from water, it behoves the medical examiner to devote much careful attention to the facts, for it is likely to be asked of him, whether or not the lesions found were produced during life, and, if produced during life, would they alone account for the death. From experience we believe that there are no questions more difficult to answer than these, under the circumstances given. In wounds found on a body which has lain in the air, certain conditions of the wounds themselves and of the surroundings of the body are likely to offer means for an answer. For example, there will be the evidence of hæmorrhage by clotted blood in the wounds themselves, by the blood-stained condition of the tissues exposed in the wounds, by the blood on the clothing, or in the immediate vicinity of the body; moreover, in incised wounds, there is the evidence of eversion of the edges. But in a body which had been lying in the water, all such evidence as the presence of hæmorrhage above indicated will be entirely awanting, because it has been dissolved and washed away in the watery medium. Should, however, there be bruises on the body, or bruising in connection with the wounds, the

fact that the body has lain in water will not affect their integrity; hence, we have to fall back upon the everted condition of the edges and the ecchymoses whereby to form an opinion respecting the ante-mortem causation of the lesions. Even these do not warrant us in saying more than that these may either have been produced during life, or just immediately at or after death while molecular life of the tissues existed. But in this connection, the question as to whether wounds upon such a body are of suicidal, accidental, or homicidal origin may be determined by certain local circumstances referable to the water itself. In navigable rivers or canals, bodies when they float—and even in canals especially, before they float, and by reason of the comparatively shallow depths of such water-ways—may sustain injuries not only extensive in character but peculiar in kind, from the revolving screws of passing boats. It was part of our duty for many years to examine the bodies of persons found in a canal subject to much traffic by screw-steamers, and thus we are able to indicate the character and extent of lesions on bodies referable to this cause.

The following case taken by random from our case-book will illustrate this point:—

CASE 39. Severe and extensive injuries found on body as follows:—evisceration of chest organs; punctured wound on right chest; fracture of left thigh; lacerated wound of temple.

CASE 43. Scalp severely torn; fractures of spine, right arm, and forearm.

CASE 64. Compound fracture of left leg; simple fracture of left arm.

But in contrast to such cases there are those in which one can only come to the conclusion that death was due to violence by assault and drowning.

CASE 12. This body had been in the water for more than six days. The following marks of violence were found:—three incised wounds on the right side of nose, one deep, the other two superficial; six incised wounds on left brow, left temple, eyebrow, and eye; and, in addition, compound fracture of right humerus. Evidence showed that this woman was *virgo intacta*. The compound fracture of the humerus was most probably due to violence from a screw-paddle, but the others were, in our opinion, caused by a knife; other circumstances revealed in the history of the case pointed in the direction of homicide. The case, however, could not be pursued for want of evidence.

CASE 34. Body of a woman, who had previously borne children. The body showed the following marks of violence:—a lacerated wound 1½ inches long, on upper right eyelid; a like wound, an inch long, on lower right eyelid; and a compound fracture of right nasal bone. The localised distribution of the lesions pointed either to repetitive blows, or to one blow from an irregular, blunt instrument, but it was impossible to say whether the wounds were produced before or after death.

If decomposition, too, be far advanced on a body upon which the wounds are present, it is impossible to give any opinion as to the ante- or post-mortem origin of the lesions. Should lesions be found on a body taken from a non-navigable river, or other like column of water, grave suspicion of foul play would be bound to arise; hence it is important to consider the character of the column of water, with respect to traffic by boats, or the possibility of the occurrence of accidents, such as falls from cliffs, in arriving at a conclusion regarding the cause of wounds on a body taken therefrom. In conclusion, in any given case the whole circumstances must be duly considered and weighed before any attempt is made to answer the question propounded, and in no case ought an opinion to be given in favour of the homicidal origin of the wounding unless the examiner can show satisfactorily that the lesion could not be produced in any other way, or could be accounted for in the light of other evidence.

II. DEATH BY SUFFOCATION

In this form of death are embraced those in which death has been caused by impediment to respiration but which is not due to pressure externally and immediately applied to the windpipe. It, therefore,

does not embrace death by hanging, strangulation, and throttling, but it includes deaths by smothering or overlaying, those due to foreign bodies in the windpipe or pharynx, and those due to irrespirable gases. It may be the result, therefore, of natural disease, of accident, or of violence suicidally or homicidally applied.

Death by suffocation may be caused, either :—

1. By preventing the action of the muscles of respiration ;
2. By mechanical impediments to the entrance of air which are placed over the mouth and nostrils ; or
3. By like impediments in the pharynx or air-passages.

It may arise from disease in the following cases :—

1. Tumours in fauces, throat, or larynx ;
2. Bursting of pharyngeal or tonsillary abscesses ;
3. Effusion of lymph or membranous exudations upon mucous membrane of air-passages ;
4. Accumulation of bronchial secretion, as in the bronchitis of young children or elderly persons ;
5. Rapidly accumulating pleural effusions, especially if bilateral ;
6. Pulmonary œdema ;
7. Copious hæmorrhage into bronchial tubes, as in phthisis ;
8. Bursting of aneurysms into air-passages or lungs.
9. From *Laryngismus Stridulus.*
10. From convulsions.

It may likewise result from such accidents as the following :—

1. Mechanical pressure on chest walls sufficient in degree to produce fixation of thoracic walls, as in fallen persons in panic-stricken crowds, in some cases of overlaying, in falls of sand or other material in sandpits, mines, collieries, or buildings ; or from hoist accidents, etc., in cities ;
2. Impaction of materials in pharynx or larynx. This is by no means uncommon in intoxicated persons who attempt to swallow imperfectly masticated food-stuffs. The impacted material may consist of (*a*), imperfectly masticated food, as tripe, or flesh meat, or chop bones ; (*b*), plates of false teeth ; or (*c*), objects which may be inhaled, or driven, into the air-passages during play or otherwise, such as the rubber toys, or squeak balloons of children ; or (*d*) regurgitation of fluids into the air-passages from the pharynx.
3. The overlaying or overlying of infants ;
4. From " smothering " ; where, for example, persons in a fit, or in any other helpless condition, fall face downwards on a comparatively yielding surface, such as a bolster, mattress, or thick rug ;
5. From breathing irrespirable gases, as H_2S, NH_4HS, Chlorine, CO_2, CO, and Coal-gas ; also from smoke in burning buildings ; or from the vapours of Iodine, Bromine, and Ammonia.

It may also be caused homicidally as follows :—

1. From " Burking " ; where pressure is applied at the mouth and nostrils, with fixation of the lower jaw, at the same time as fixation of the chest walls is produced by the weight of the body of the assailant. This was the method of the notorious Burke and Hare ;
2. As a mode of Infanticide ; by stuffing foreign bodies into the mouth and pharynx of newly-born infants, such as paper, or dough or other plastic substance ;
3. From Culpable Overlaying of Infants.

Post-Mortem Appearances.—The proximate cause of death being Asphyxia, the reader is referred to a former chapter for the signs of death from that cause. But there are certain points to which special attention must be paid in this connection ; as, for example, the absence of uniformity in the external appearances. It is usual to describe the facial appearances in this form of death as follows :—the face generally shows a more or less livid colour and congested appearance, the eyes are staring, the conjunctivæ blood-shot, the lips dark-coloured with a bloody froth issuing from the mouth, from which, also, protrudes an equally dark-coloured tongue.

It ought to be clearly understood that while it is true that these conditions may be found in *some* cases of death by suffocation they are by no means found in all. Indeed, on the other hand, another set of facial appearances altogether are found—viz.

(*a*) A more or less normal appearance of the face ;

(*b*) Absence of marked signs of congestion either of eyes or of lips, and absence of protruded tongue.

In short, the only sign approaching evidence of interference with the due aeration of the blood in such cases, is a *bluish tint of the lips and mucous membrane of the mouth*, along with, in children especially, *a livid tint of the nails of fingers and toes*. Yet in both classes of cases the proximate cause of death is Asphyxia, as clearly indicated by the external appearances. How is this to be accounted for ? It is quite clear that the time occupied in the asphyxiating process must vary in a series of cases, and it is equally clear that the rapidity or slowness with which the process is completed will determine, in large measure, the external appearances and their incidence. From our observations, we are inclined to formulate this guiding rule—that the more rapid and complete the asphyxiating process is, the more marked are the external appearances of lividity ; and the converse is equally true. From the external appearances alone of a body, therefore, it is difficult to say whether death has been caused by Asphyxia, except in those in which external lividity of face, lips, etc., is well marked.

In addition to the main signs of death by Asphyxia already discussed in a former chapter, some light may be thrown upon the cause of death by noting particularly the following points—viz.

I. *The Colour and Consistency of the Blood.*—In all deaths by asphyxia the blood is unusually fluid, and, *en masse*, is always much darker in colour than normal. But in deaths from the respiration of Carbon Monoxide, the colour of the blood is a cherry-red, not only in the main blood-vessels, but in all the organs of the body, due to the formation of a stable compound between the gas and the hæmoglobin. In deaths by CO_2 gas, the blood, though darker, does not indicate the production of a compound between that gas and the hæmoglobin, although immediately after death such has been found in the blood of the heart ; but it is of very evanescent existence.

II. *The Presence or Absence of Punctiform Capillary Ecchymoses on the Pleuræ, either pulmonary, costal, or diaphragmatic, and cardiac.*—In most of the cases of suffocation of children, and in certain of those in adults, such are found ; and, in addition, ecchymoses in other situations, as into the conjunctivæ, are also found.

In medico-legal practice, deaths from Suffocation may be resolved into those that are (*a*) Accidental; (*b*) Suicidal; and (*c*) Homicidal. The use of the term "accidental" is here employed not so much in the legal as in the popular sense; for it is obvious that many cases may at first sight appear to be accidental which, on closer investigation by the law authorities, may involve varying shades of culpability.

Of the so-called accidental causes, then, the chief, perhaps, are—

1. From panic-stricken crowds in public buildings or elsewhere. Hardly a year passes without the occurrence in some populous centre, at home or abroad, of a catastrophe of this kind. Illustrative of these may be cited the following:—
   (*a*) That of the opera-house at Milan;
   (*b*) That of a Sunderland theatre in June 1883, where over two hundred children lost their lives in a stairway during a stampede; and,
   (*c*) That of the Star Theatre, Glasgow, in which several young men and older adults lost their lives, the bodies of whom we examined.
2. From Suffocation by Smoke and Irrespirable Gases.
   Such deplorable occurrences periodically occur in coal-pits; and many other sources might be named.
   (*a*) Deaths from H_2S and NH_4HS in sewers.
   (*b*) Deaths from Ammonia gas, in artificial freezing works.
   (*c*) Deaths from Coal-gas. These occur in many circumstances, the prime cause of death being the CO gas which illuminating gas contains, and which will be referred to under the heading of Carbon Monoxide.
   (*d*) Deaths from Carbon dioxide (CO_2), in fermenting vats, in gas-holders in aerated water manufactories; and in various other circumstances.
   (*e*) Deaths from Carbon monoxide. This may occur in a great variety of ways: from collections of choke-damp in coal-pit workings, wells, or shafts; after explosions of enormous charges of gunpowder; from sleeping in the neighbourhood of lime-kilns, or upon smouldering heaps of "blaise" from iron or steel works; in bathrooms, where the water is heated by means of "gas geysers"; from coal-gas inhalation; from entering coal-tar stills or tanks, or boilers.
3. From collapse of sand-pits, graves, and of other masses of loose material.
4. From weak and helpless persons and persons in fits falling upon their faces upon soft material, as clothing, or clay, or mud.
5. From the overlaying of children.
   This is, unfortunately, too common an occurrence amongst certain classes in our populous centres. It is due to two main causes—viz. the drunken habits of those classes, and the lack of sufficient house accommodation. The English Registrar-General states that almost one case a day happens in London alone; while not a year passes in any populous centre in this country without a considerable number of deaths of infants being due to this cause alone. Most usually, the offender is a parent, but in three or four of the cases which we have examined the overlying was done by an older child who was sleeping in the same bed with the infant; in very odd cases, it may not be due to intoxication but to helplessness on the part of the mother from paralysis; in one case which we investigated the mother was hemiplegic, in fact she had been seized with this during her confinement, and her neighbour, who was acting as nurse, had thoughtlessly put the infant to suckle at the breast.
6. From blocking of the air-passages by foreign bodies. In addition to the causes already enumerated must be put that of regurgitation of vomited matters into the air-passages from vomiting during the helpless condition of a drunken debauch.

The foregoing list of conditions is only intended to be indicative of the more commonly occurring causes, and has been compiled mainly from our own experience in the examination of a large number of cases.

During our medico-legal experience we have examined the bodies of about 150 persons in which suffocation was the cause of death, as indicated by the signs of asphyxia.

The following Table shows the incidence and the causes :—

Table of Deaths from Suffocation

Bodies of infants found dead in bed beside their parents.
Bodies of persons where fixation of chest walls was produced by falls of material.
Bodies of persons where fixation of chest walls was produced by being caught between buffers of railway vehicles.
Bodies of persons who died from Fit, or other like seizure.
Suffocation from piece of Meat in Throat.
Suffocation from vomited matter in windpipe.
Suffocation from vomited matter in windpipe, produced by assault (kick in stomach).
Deaths from CO and CO_2 gases—
On blaise-heaps.
From lime-kilns.
In a boiler.
Deaths from coal-gas.
Smothering in pillow or bedclothes or otherwise, of intoxicated persons, or the aged ; or from other causes.

This list does not include several bodies whose death was caused in a panic-stricken crowd.

Traumatic Asphyxia.—There is a form of asphyxia to which the term " traumatic " has been applied, the leading features of which are a marked more or less deep red or violet discoloration of the face, neck, and parts of the body, and a very bloodshot condition of the conjunctivæ, with perhaps extravasations of blood of small dimensions. A few exemplary cases have been put on record but the following two will serve as illustrative cases.

Beatson [1] records a case in which a man, a collier by occupation and twenty-four years of age, was working with hutches at the bottom of the pit-shaft when the descending pit-cage came down upon him and almost completely doubled him up—the shoulders being crushed forwards and downwards on abdomen and pelvis. He was " pinned " in that position for about three minutes before he was released. Two hours after the accident he was conscious and exhibited no signs of shock, his pulse being 100, respirations 28, and temperature normal. His face and neck were greatly swollen, with congestion of skin, amounting to lividity, the congestion being most marked and the tint deepest around the eyes and mouth ; the conjunctivæ were bloodshot, the upper and lower eyelids being full, and there was a certain degree of *proptosis oculi* ; the lips and tongue were greatly swollen, and under the anterior part of the tongue was a large hæmatoma. Speaking generally, the line of demarcation of lividity ended in the neck, and the lividity did not prevail much below the level of the clavicles. Around the neck were circular white areas of skin indicating lines of pressure by a collar or a shirt neckband. The skin lividity was petechial in character, as the colour could not be dissipated by pressure with the finger. He made no complaint of pain in the chest or back, and there was no evidence of any fracture of thoracic osseous framework. His subsequent progress was uneventful. The discoloration gradually faded away without the usual gradation of colour exhibited in definitely marked ecchymoses, except that the skin of neck, cheeks, and chin were more yellow than the normal skin after disappearance of the reddish lividity. A most interesting sequel of the case is that the patient's eyesight has become much affected since the recovery from the accident, and signs of atrophy of both optic discs have developed, the ophthalmologist expressing the fear that the man may become blind. Beatson has seen only one other case in the person of a man whose body was entangled in a rope which was at the time being wound up by a windlass, and in whose case the lividity of face and neck was even more marked than in the case just described.

Sibbald Robertson [2] relates the case of a child of three years who was knocked down by a cable car, and caught between the " cow-catcher " and the

[1] *Scot. Med. and Surg. Jour.*, June 1908.
[2] *B. M. J.*, vol. ii., 1905, p. 1339.

ground. He was found, on rescue, to be tightly wedged between these, and difficulty was experienced in extricating him. When extricated he was first thought to be dead, but he began to breathe, his face being of a peculiar bluish-black tint. He had a cut on his forehead, abrasions on right side of chest front and back, and a bruise on left thigh. His face and neck were of an intense blue-black colour, and the line of demarcation was bounded by the clavicles, below which the skin was of normal colour. Pressure did not change the colour. On each conjunctiva was a lozenge-shaped ecchymosis, the pupils were normal, and there were no retinal extravasations. As in the previous case, the colour of the skin gradually subsided toward normal in the course of the next few days, and the discoloration did not undergo chromatic changes common in ecchymosis, although it was noted that even on the eleventh day after the accident the skin of face seemed darker or swarthy in colour.

Bach of Boston,[1] dealing with this subject, states that he has been able to find seven cases only of this condition on record, and that in one of the cases Wright of Massachusetts examined microscopically portions of the skin but did not find evidence of definite extravasations.

The exact pathology of the skin condition in traumatic asphyxia has not yet been worked out, but the circumstances in which the asphyxia, or rather threatened asphyxia, is produced point to congestion and high vascular tension in the blood-vessels of the skin and deeper structures being developed owing to the mechanical hindrance of respiration. The amount of lividity of and extravasation into the skin must differ in different cases owing to the differences in length of time, short of producing death by suffocation, in which the mechanical chest pressure operates. It is not difficult to conceive a case in which the thoracic pressure acted only for a minute or less, and in which the lividity of the skin would rapidly disappear on relief of the pressure, and another in which, the pressure acting longer, the lividity would be as in the foregoing case, accompanied by some measure of extravasation of blood fluids into the substance of the skin, this latter constituting, indeed, veritable ecchymosis.

Suicidal suffocation by mechanical means we believe to be very uncommon. It is difficult to comprehend the possibility of the occurrence of such cases. Such, however, have been recorded by foreign writers of persons who, by stuffing cloth-fabrics into the pharynx, have produced this result; or have attained the same end by shutting themselves into air-tight trunks or cabinets. In Horfield gaol, a prisoner committed suicide by forcing a piece of cloth down his throat by means of a wooden spoon. It was thought that the man had placed the cloth in his mouth and pushed it back by lying down and pressing the bowl of the spoon against the floor.

Dr J. Mill Renton has recorded a case of this kind which possesses some unusual features. A middle-aged man was brought to the workhouse by the police with a history of delusions. On examination, no definite signs of insanity were found, but he was placed under observation. In the evening of the same day, however, he suddenly became violent and excited, when he was placed in a padded room. After a time, he quietened down and went to sleep. An attendant visited him regularly. When seen at 9 P.M. he was fast asleep, but twenty minutes later it was observed that his bed-clothing had been thrown off. On closer examination he was found to be dead. When seen later by Dr Renton, the body was found lying on its back with arms outstretched. The face was placid; no marked cyanosis was present, but there was lividity of lips, ears, and finger and toe nails. There was some dried blood on lips. The mouth was closed, but the jaws were easily opened by the fingers. Inside the mouth was found a piece of flannel about 1 ft. long by 1 inch broad, and behind it were two strips almost similar in dimensions. The last of these two was so firmly packed over the epiglottis that it was withdrawn with some difficulty. He had obtained these strips by tearing his blanket, and had

[1] *Annals of Surgery*, April 1904.

suffocated himself by packing them into his throat. Dr Renton gives references to other cases in his paper.[1]

The song of "The Mistletoe Bough," it will be remembered, is founded upon accidental suffocation produced in an air-tight trunk. But suffocation is effected suicidally in other ways—viz. by the inhalation of irrespirable gases produced from charcoal brasiers, or by coal-gas being turned on in a room.

At Partick in March 1910, the dead body of a man was found lying on the stairway leading to the upper flat of a tenement dwelling. His head was enveloped in a newspaper which was tied in position by a handkerchief. In his mouth was one end of a rubber tube, the other end being applied over the gas-jet of the stair light, the tap of which was found turned on.

Homicidal suffocation may be produced in the case of the young—it is one of the forms of infanticide—and of those who are helpless from alcohol, or other like narcotic, or from age. The earliest recorded case of this kind is found in the Scriptures of the Old Testament, in 2 Kings, chap. viii. v. 15. "And it came to pass on the morrow, that Hazael took a thick cloth, and dipped it in water, and spread it over Ben-hadad's face, so that he died: and Hazael reigned in his place." From the context, we are informed that the victim was an old man, and helpless.

The tragedies of Burke and Hare were produced by suffocation. The mode by which they killed their victims, as proved at the trial for the murder of Marjery Campbell, was "by sitting on her body, covering the mouth and nostrils with one hand, and applying the other forcibly under the chin."

Sir Henry Littlejohn [2] records a most instructive case in which he made the post-mortem examination of the victim. He found a quart-bottle cork, in which were the marks of a corkscrew, impacted in the upper part of the larynx of the woman, the sealing-wax end of the cork being uppermost. Some of the ribs were found fractured. It was pleaded for the defence that the cork had been accidentally drawn into the windpipe while the woman was in the act of drawing the cork from the bottle with her teeth; but this was rebutted by the position of the cork and by its corkscrew marks. The jury, however, from insufficiency of evidence in the identification of the prisoners as the assailants, returned a verdict of "not proven." In another case, recorded by the late Dr Easton of Glasgow, mud had been forced into the windpipe of a newly-born child; and in another case, the first-named observer discovered a mass of dough in a similar position in another infant. In a charge of infanticide preferred against a woman at the Northern Circuit in Scotland, it was proved that she had caused the death of her newly-born child by forcing pieces of paper into its mouth. In a recent case, we made a post-mortem examination of the body of a man who met his death in the following way: – the deceased and the accused, both intoxicated, quarrelled, and in the course of the fight, which up till then appeared to be harmless of injury to either of them, the accused kicked deceased in the stomach. The deceased fell and did not rise; on being lifted, he was found to be black in the face and dead. The necropsy revealed the air-passages to be full of a vinous liquid corresponding to that in the stomach. There was not a trace of violence on any part of the body. We gave it as our opinion that the cause of death was suffocation due to the fluids in the air-passages which might have been forced up into the throat by the kick and which then regurgitated into the windpipe. The accused was found guilty of assault.

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[1] *B. M. J.*, vol. i., 1908, p. 493.
[2] *Edin. Med. Journal*, Dec. 1885, pp. 511-540.

Murder by Suffocation.—At the February sitting of the Circuit Court, Glasgow, 1906, a young man was charged with the murder of his mother,—that he "did on December 16 beat her and knock her down, seize, twist, and compress her nose, and force a handkerchief into her mouth, whereby he suffocated her and murdered her." We examined the body of deceased on December 18. The body was that of an elderly woman. Protruding from the mouth for a distance of 1½ inches was a piece of thin cotton cloth which looked like a piece of handkerchief, and which, on being wholly removed from the mouth, proved to be a woman's handkerchief. The mouth was examined prior to its removal. The gums were toothless. The cloth was found to be jammed half-way back the throat, and when it was removed, the tongue, which was slightly discoloured, was seen to be arched and pressed against the pharynx. The following marks of violence were seen :—(*a*) an area of bruising on right side of brow above outer angle of right eyebrow, (*b*) swelling and discoloration of the nose, and evidence of bleeding from both nostrils, (*c*) a bruised area about the middle of the lower jaw on the right side, and (*d*) abrasions and scratches, on both sides of windpipe, on back of right elbow and hand, and on inner sides of both knees. Internally, there was bruising of scalp tissues. The lungs were engorged with blood, bloody mucus being found in larynx and trachea. We also examined certain articles of prisoner's clothing and found mammalian blood-stains on them (*vide post*). There was no eye-witness of the commission of the crime, but there were certain circumstances which closely linked prisoner with it. The jury found a verdict of "not proven."

Fluids in Air-Passages.—The following cases illustrate a form of suffocation which is sometimes associated with violence.

1. Suffocation from fluid (beer) in air-passages. Assault upon deceased (1902).

Some men were drinking together in a public-house. The deceased and another of the company quarrelled, in the course of which the deceased was knocked backwards, striking the back of his head against projecting woodwork in the course of his fall. He did not attempt to rise. When his other companions went to his assistance he was found to be livid in the face and unconscious, and soon thereafter he died. On post-mortem examination, we found his body to be that of a powerful young man. There were slight wounds and abrasions on the knuckles of three of the fingers of his right hand, a trifling abrasion on the under surface of the chin, and a similar abrasion on the neck at the left angle of lower jaw. Deep bruising of the scalp tissues on the left side of head above the left ear was also found, but there was no fracture of skull or anything abnormal within the skull. On opening the windpipe, it was found to contain a yellowish, blood-tinged, beer-smelling fluid, of which a little over half-an-ounce was collected. The stomach contents consisted of semi-liquid matter, which smelled strongly of beer, and of partially digested food. The lungs and right heart were engorged with blood. We gave as our opinion of the cause of death that it was suffocation due to beery fluid in the windpipe and air-passages, which may have been ejected from the stomach, as the result of the fall, into the pharynx and thence regurgitated into the air-passages.

2. The deceased's body was found lying at the foot of a stair in a district of Glasgow, at a considerable distance from where he lived. His coat and vest and watch were amissing. On post-mortem examination, his body was found to be that of a muscular young man. External lividity was extensive in area and dark in colour. There were no external marks of violence on the body. Dissection of the scalp revealed deep bruising of the tissues over the brow. There was no fracture of skull, nor any evidence of anything abnormal within the skull, except that the meningeal vessels were engorged with blood. On opening the windpipe, it was found full of vomited matter which had an alcoholic odour, and when the chest was compressed more fluid of a like nature welled out of the opening. The lungs and right heart were found engorged with blood. The stomach contained a considerable quantity of solid and semi-solid matter which had a marked alcoholic odour. The internal organs were all found to be healthy. We reported that death was due to suffocation from vomited matter in the windpipe and air-passages.

3. In the body of a woman, found under suspicious circumstances, which we examined in June 1908, marks of violence were found externally on face, arms,

and leg, but all of a trivial nature. When the body was moved on its side, or when pressure was exercised on the chest, a slightly red-coloured fluid escaped from the nostrils. When the larynx and trachea were opened, they were found to be filled with the same coloured fluid, which had a definite odour of beer. The lungs were engorged with blood, and the smaller bronchi contained the same fluid. The right heart was full of dark-coloured blood. The aorta was much dilated and markedly atheromatous and the mitral valve thickened. The contents of stomach smelled strongly of beer. We reported that death was due to suffocation from a beery-smelling liquid in the air-passages, and that death may have been accelerated owing to the disease of the heart.

Dead Body of a Woman found sewn up in a Flock Mattress. Suffocation.— The following case, which presents some gruesome particulars, also indicates the difficulty of deciding the cause of death. In a single apartment house lived a man and woman, as man and wife, though not married. The woman disappeared from her usual haunts, and the man gave up his house and left the neighbourhood. The apartment was left untenanted for about three weeks. The caretaker of the tenement, wishful to prepare the apartment for a new tenant, asked a labourer to remove a bed-tick which was lying in the apartment at the window. The caretaker had perceived an offensive smell in the apartment, which was gradually becoming worse. On the man attempting to lift the bed-tick, he was astonished at its unusual weight. There was something hard inside, and to find out what it was he cut a small hole in the cloth. He then saw, more or less covered with the " flock," the discoloured head of a woman, which was later identified as the face of the missing woman. We examined the body after its removal from the bed-tick. It was that of a woman apparently in early middle life. It was much decomposed. The head, neck, and front of chest were black in colour, and the features of face were quite irrecognisable. The body was clothed in a jacket, petticoats, corsets, and underclothing, and black stockings, but no boots or shoes were on the feet. The exposed parts of body, as well as clothing, were more or less covered with matted wool-waste or " flock." There was evidence on the abdominal wall that the woman had borne a child or children.

Over left eyebrow was a lacerated wound measuring one inch long, which passed down to the bone. On the vertex of head was another wound in a healing condition, the unhealed part being covered with a small piece of lint. It measured originally about two inches in length. In the deep tissues of scalp in the right temple was an area of extravasated blood measuring $1\frac{1}{2}$ in. $\times$ 2 in. There was no fracture of skull. The lungs were far advanced in decomposition. They did not completely fill their respective cavities. On section, they were dark in colour. The trachea and larynx were empty, but their mucous lining was also dark in colour. Each pleural cavity contained many ounces of a dark-red liquid. The heart cavities were practically empty, and its structure was soft from putrefaction. The valves were normal. All the abdominal organs were normal, so far as could be determined. We reported that we were unable to state the cause of death because of the advanced state of putrefaction of the body and its organs, but that we were quite clear that the cause was not due to wounding.

Certain indications pointed to death from asphyxia, such as the dark colour of the lining of the air-passages, and the quantity of dark-red fluid in each pleural cavity. We have formed the opinion that, in some cases at least, the presence of such fluid in the pleural cavities may be due to transudation of the fluid portion of the blood, after decomposition has set in, from vascularly engorged lungs, as in asphyxia ; but in cases where the life of an accused person may be at stake, as in this case, and especially where decomposition is far advanced, as also in this case, we have hitherto declined to push this view.

In cases of overlaying, culpability of the parents is involved where it can be proved that they were in a drunken condition when the child was overlain, and where the death is proved to have been caused by asphyxia. It is not enough, however, to prove these points ; it is necessary that the prosecutor should prove that the asphyxia was produced by overlaying, and that this was culpably caused by the condition of the parents. This is a very difficult matter to prove ; and it is for this reason that so few parents, whose infants have been found dead in bed beside them, are brought to justice.

Till recently, overlaying of infants was only an offence at common law,

but by the passing of the Children Act, 1908 (8 Edw. VII. c. 67), it has become in addition a statutory offence. Part ii. s. 13 of this Act enacts as follows :— "Where it is proved that the death of an infant under three years of age was caused by suffocation (not being suffocation caused by disease or the presence of any foreign body in the throat or air-passages of the infant) whilst the infant was in bed with some other person over sixteen years of age, and that that person was at the time of going to bed under the influence of drink, that other person shall be deemed to have neglected the infant in a manner likely to cause injury to its health within the meaning of this part of this Act." In the examination of the bodies of such infants, it is most frequently the case that the examiner can affirm nothing more than that death occurred from suffocation ; it sometimes happens, however, from marks of pressure on the face—pressure marks of clothing, or compression of the nose—that he may be able to say that, probably, the cause was overlaying. Of the many cases which we have examined, it was but rarely that the face showed marked evidence of lividity. In most of them the face generally was either normal, or but slightly dusky ; but in all of the cases there was more or less lividity of the lips and mucous membrane of the mouth, and of the nails of fingers and toes. In several of them there was clear or blood-tinged froth at mouth or nostrils or both, and in nearly all of them was there some degree of protrusion of the tongue, that organ usually being protruded to some extent beyond the line of the gums. In all the cases of smothering there was very marked lividity and congestion of the face—ranging from a purple-black colour to a pale lividity—bloody froth at mouth and nostrils, lividity, in marked degree, of lips and mouth, and protrusion, more or less, of the tongue, In any case, moreover, in which suffocation is suspected, attention should be strictly paid to the colour of the post-mortem lividity. Anyone who has once seen the rosy-coloured hue of this in cases of carbon monoxide suffocation will never forget it ; but this usually indicates the presence of a considerable percentage of the gas in the atmosphere breathed, for although this gas is the intimate cause of death in coal-gas suffocation, the rosy colour of the post-mortem lividity is not apparent. In addition to this and the arterial hue of the blood of the body generally, spectroscopic examination of the blood must be made in the manner to be hereinafter described in the discussion on Blood.

III. DEATH BY HANGING, STRANGULATION, AND THROTTLING

Hanging may be defined as that form of death which is caused by suspension of the body in a ligature which more or less completely encircles the neck, the constricting force being the weight of the body itself ; Strangulation, as that form of death which is caused by a constricting force applied circularly round the neck ; and Throttling, that form of death where the constricting force is applied locally to the windpipe, the force being the hand or fingers of an assailant.

Hanging is, perhaps, the most common method by which suicide is effected. Of the total number of suicides in England and Wales between the years 1865-1894, it accounted for 34 per cent., and in Scotland, between 1877-1894, for 29 per cent. It would appear, therefore, from the returns for England for thirty consecutive years, that, as a mode of suicide, it prevails more in that country than in Scotland. In passing, it may be noted that Sibbald [1] has shown that as regards suicide generally, if a line be drawn on the map of Scotland from the Moray Firth to the Firth of Clyde, the lowest rates obtain

[1] *B. M. J.*, vol. ii., 1898, p. 691.

in those counties which lie north-west of that line—in other words, that suicide is more common among the Saxons than the Celts.

In these forms of death—leaving judicial homicide by hanging out of count for the present—the usual proximate cause of death is asphyxia, or, more particularly, comato-asphyxia.

The time occupied in the process before life is extinct depends mainly upon two factors—viz.

(*a*) the severity of the constricting force; and

(*b*) the point of application of that force.

The amount of the constricting force in hanging depends upon whether or not the body is completely suspended, since it will be greater the more weight is thrown upon the ligature. The point of the application of the force has somewhat to do with the post-mortem appearances found on the body after death, and also with the time occupied in dying, because of the amount of compression exercised on the large blood-vessels of the neck.

The experiments of Fleischmann[1] on himself show, at least, that the degree and rapidity of onset of suffocative symptoms produced are largely influenced by the situation on the neck of the ligature. When the ligature was placed between the lower jaw and the hyoid bone and was moderately tightened, the effect was to disturb the breathing, which, however, continued; but by the end of two minutes, he had to be disengaged from the noose. When it was placed over the larynx, the experiment had to cease at the end of 1½ minutes; and when it was placed over the cricoid cartilage, the experiment could not be borne for even a few seconds, because of the great embarrassment to respiration. Gosse has also shown by experiments on himself, that unconsciousness may be produced without undue pressure being caused on the air-passages. The effect of a ligature constricted round the neck is primarily the occlusion, more or less, of the air-passages, and the prevention, more or less completely, of air entering the lungs; and secondarily, by its incidental compression, in varying degree, of the main blood-vessels of the neck, the disturbance of the circulation between brain and lungs. It is likely, also, that the actual condition of the breathing at the moment of suspension will be a factor in the resulting blood-state of those organs; but in any given case this cannot be known, and, therefore, may be neglected from the practical point of view. Further, the amount of compression which is bound to be exercised on the phrenic and vagus nerves must be an important factor in the causation of death. Apart altogether from implication of respiration a person may die from the effects of suspension. This is well shown in a case recorded by Reineboth,[2] where a man, upon whom tracheotomy had been performed for malignant disease of the throat, suspended himself by the neck, the line of ligature being above the site of the cannula which was at the time in position. On post-mortem examination no signs of death by asphyxia were found, but the blood-vessels of the base of the brain, and the substance of the pons and medulla were found engorged with blood. In the bulk of cases of suicidal

[1] Ogston, *op. cit.* p. 524.

[2] *Vierteljahrsschrift für gericht, Medicin.*, 1895.

suspension the ligature will be found either between the thyroid cartilage and the hyoid bone, or between the latter and the lower jaw; and the effect of the more or less vertical suspension by a cord in either of these situations is to jam the soft structures together—the floor of the mouth against the roof—so as more or less effectually to cut off the entrance of air. As in deaths from asphyxia from any cause, so in these forms the heart continues to beat for a few minutes after the cessation of respiration, and, therefore, attempts at resuscitation of a suspended person may prove successful if the body be cut down within five or six minutes after the act of suspension; beyond this period, there is but little chance of success in the re-establishment of breathing. Scott, the famous American diver, gave public exhibitions of suspension and its effects upon himself; but he did it once too often: on his last appearance in this rôle, he was permitted to hang for thirteen minutes, but all efforts thereafter for his resuscitation proved unavailing. Dr Chowne [1] relates that a man named Hornshaw performed in public in the like way on three different occasions, but was successfully resuscitated each time. It will be remembered, too, that in his novel of "The Black Dwarf," Sir Walter Scott deals with the rescue and resuscitation of a person who had been suspended.

In the examination of the body of any person found suspended, there are three separate parts of the line of inquiry as to the cause of death which demand special consideration—

I. The General External Post-Mortem Appearances;
II. The Local Conditions of the Neck;
III. The General Internal Post-Mortem Appearances.

Under the first, the conditions and appearances of the following parts of the body deserve careful attention—viz.

1. Of the Face.
2. Of the Genitals.
3. Of the Rectum and Urinary Apparatus.

I. The General External Post-Mortem Appearances.

1. *The Condition and Appearance of the Face.*—In Guy and Ferrier's work [2] the following picture is drawn of the facial appearances:—"The eyes are brilliant and staring, and seem to be bursting from their sockets: the eyelids open and injected, and the pupil dilated; the tongue, swollen and livid, is forced against the teeth, or more or less protruded from the mouth, and compressed or torn by the contracted jaws; the lips are swollen and the mouth distorted; and blood, or a bloody froth, hangs about the mouth and nostrils." We have quoted this for the purpose of affirming that the description does not conform to the usual experience; it certainly does not accord with our own nor with that of other observers. In most of the cases which we have seen, the eyes have either been shut or partially open, the pupils in all cases dilated; the position of the tongue has varied from that of normal to that of protrusion more or less beyond the line of the teeth, but in no case have we seen it torn, or any appearance of blood or a bloody froth about the mouth or nostrils. A more accurate general description would be as follows:—The face is usually pale, but may be dusky

[1] *Lancet*, vol. i., 1847, p. 404. [2] *Op. cit.* 5th edit., p. 288.

in hue, the eyes are either shut or partly open, the pupils usually dilated, and the tongue may either be normal in position or be protruded more or less in front of the line of the teeth. The lips are ordinarily bluish in colour, and the tongue may share the like coloration. Professor Ogston[1] gives a record of 40 cases of deaths by suspension, of which 36 were suicidal and 4 judicial. In 21 cases, the features had a look of calmness and placidity, while in only one suicidal case had they the appearance of anxiety. "In none of the cases did the colour of the face present anything characteristic. In only one case was prominence of the eyes encountered. In 39 of the cases the pupils were more or less dilated, while in one they were contracted." In our own series of cases, the only two phenomena which were constant in all were: (1) Pale bluish lividity of lips and mucous membrane of mouth and tongue, and (2) dilation of the pupils. It will be observed that both of these signs are common to all deaths by asphyxia, whatever be the nature of the determining cause.

2. *The Condition of the Genital Organs.*—Medical jurists are divided in opinion as to whether the male genitals after this form of death are in a state of turgescence with emission of semen, or are in an opposite condition. That the former condition is not constant is apparent from the recorded observations of different writers. Casper, for example, says of the many cases which he has examined, that he had not found in any case any evidence of genital erection, and has but rarely seen a condition of even semi-erection. Guyon,[2] on the other hand, states that of 14 males who were hanged at the same time, in all of the bodies was erection observable. Devergie never saw either erection or semi-erection after suspension. Ogston states that 11 of his 40 cases showed genital excitement, 7 to the extent of full erection and 4 of semi-erection. In the series of cases which we have seen, in which were 11 males, no such genital disturbance was manifest. It may, therefore, be taken that genital excitement is an inconstant phenomenon. It has also been asserted that seminal emission has been seen in certain cases. Ogston says of 8 of his 40 cases that "seminal fluid had been discharged," but he does not indicate whether that opinion was arrived at from the merely physical appearances of the fluid or from microscopic examination. We have seen fluid at the *meatus urethræ* in nearly all our cases, but in none of the cases did microscopic examination reveal spermatozoa.

3. *Condition of the Rectum and Bladder.*—Ejection of urine or fæces, or of both, is by no means infrequently found in cases of hanging in females, but loss of power of the sphincters is common to all deaths by asphyxia. It is, however, met with in other forms of death; we have seen ejection of both, for example, in sudden death from syncope.

Probably very important evidence will be derived from careful examination of

II. **The Local Conditions of the Neck.**—The incidence and character of the markings on the neck may afford some indication of the manner by which death has been produced. It is very advisable that all marks on the neck should be critically examined in order to see whether

[1] *Op. cit.* p. 527.

[2] *Révue Médicale*, 1823.

death is really attributable to suspension, or whether it has been due to throttling first and suspension afterwards. Any indication of scratches must be noted with relation to the question whether or not they were likely to have been produced by the ligature; for example, scratches on neck or face in presence of a soft plastic ligature would be bound to evoke suspicion. The line of the ligature, also, must be carefully noted. Usually, in suicidal suspension, it follows the line of the lower jaw, then passes obliquely upwards behind the ears, where it is commonly lost. But it is obvious that this will entirely depend upon the situation of the noose; for example, if the noose be at the back or side of the head, which is very common, the line of mark would in all probability be as already indicated, but if, on the other hand, it be under the chin, then its incidence would be entirely different. The reason for the ligature line being close to the lower jaw in the bulk of cases is the very simple fact that as the body sinks in the act of suspension the ligature will gradually slip up the neck until it attains a point of fixture, which is the line of the lower jaw; but, here again, the relation of the body to the point of suspension and to the floor or ground must be considered, since a variety of angles will be produced so as to affect the incidence of the point of constriction. We have seen the front line of the mark cross, in one instance, the thyroid cartilage, and, in another, over the hyoid bone; but in the bulk of our cases the mark was situated as described, between the hyoid bone and the line of the lower jaw.

It is well to bear in mind, further, that a suicide may pass the ligature twice round the neck before he suspends himself; in which case there will be a double mark—viz. one more or less circular, and another, oblique. Again, a composite ligature may be used, such as a thin rope doubled, or a series of strands of cord. All of these factors indicate different marks which, unless borne in mind in the examination of a body which has been cut down, may at first produce confusion in the mind of the examiner. In all such cases, therefore, the ligature itself ought to be inspected.

In strangulation, the ligature line takes a circular course round the neck, and it is apt to be lost at some particular part of the neck, either at back, or front, or on one side; there are, however, exceptional cases in which the circular mark is complete.

In throttling, the marks are ordinarily found on the lateral aspects of the larynx or trachea, and usually correspond to a thumb mark on one side, and a larger mark, or series of marks, on the other, due to the compression of the fingers. Where, on the other hand, the hands of the assailant have been applied from behind the victim—in which case compression will be applied all round the neck—the mark will correspond more to that of strangulation, and is likely to be more linear, comparatively, in front than behind.

From the mark on the neck, therefore, may be inferred in a general way the character and the incidence of the ligature, in addition to its mode of application. In examining the body of a man who had suspended himself from the knob of a window-shutter about four feet from the floor, while his companion was asleep in bed in the same apartment, we found a very unusual form of mark. On the left side

of the neck it appeared as a single furrow, but on the right side it was composed of three separate furrows, with little intervening ridges of skin, which were of a livid blue colour. The explanation was that the man had used a series of strands of ordinary ham-string as a ligature. In cases of suspected infanticide where a mark is found on the neck of the infant, it is necessary to recollect that it may be due to constriction produced by the umbilical cord during the act of birth. By reason, however, of the comparatively soft structure of which the cord is composed, and of the less amount of constriction which it can exercise under ordinary circumstances of parturition, the mark is not usually deep, and it does not cause the indurated effect, or the parchment-like, dry appearance of an artificial ligature mark; therefore, in many cases, it may be differentiated from a ligature applied with homicidal intention; this, at least, is our experience.

Moreover, there may be indications in the vicinity of the mark which will point to the nature of the ligature used—where the ligature itself is not available for inspection—such as scratches or abrasions. These may have been produced by a rough, coarse ligature, or in some other way, such as by the finger-nails of the victim who may try before loss of consciousness supervenes to undo the constricting force, or by the finger-nails of an assailant in throttling.

The colour characters of the ligature mark also vary.

They have been divided into four kinds—viz.

1. Those of a dirty-yellow or pale-brown colour—the mummified or parchment-like mark;
2. Those of a bluish or dirty-red colour;
3. Those of a dark-blue or purplish colour.;
4. Those without any colour whatever.

These colour-markings, at one time, gave rise to considerable discussion among medical jurists with respect to their bearing on the questions of suicide or homicide, and of origin before or after death. The general opinion now, however, is that in the large percentage of cases, the mark and its attendant appearances are purely post-mortem productions. This, however, is not true of every case. It is especially not true where ecchymosis is found in the mark, because its presence indicates that the violence which produced it was operative either during the life of the victim, or was applied immediately after death while molecular life of the tissues existed. The consideration of this question opens up a very large question which is apt to arise in all cases of death by asphyxia—viz. whether ecchymoses may not appear in a more or less limited fashion on the external surface of the body from purely natural causes, and quite apart from violence. We have, for example, seen such spontaneous ecchymoses on the conjunctival mucous membrane in cases of drowning, but we have not personally observed them in the cases now under discussion. Consideration of this larger question is deferred until the effects of violence are considered.

As to the kind of ligature employed the suicide is not particular; he is apt to take what is nearest at hand suitable to his purpose. Ropes, probably, are most common; but we have seen a bundle of ham-strings, a woollen cravat, and a leather belt serve the purpose equally

well. To these may be added pocket-handkerchiefs, bandages, braces, leather straps, twisted straw-bands, sleeves of jackets, bed-sheets, and other materials.

III. The General Internal Post-Mortem Appearances.—In the main, these point to death by asphyxia, or rather, by comato-asphyxia, for it is but rare to find the signs of asphyxia alone. Here, as in death by Suffocation, sub-pleural punctiform hæmorrhages may be found, in addition to the signs already described.

Judicial Homicide by Hanging.—The sentence of death which is pronounced by a Judge upon a prisoner who has been found guilty, after trial, of an offence punishable by the extreme penalty of the law, is a statutory one, and, generally, is to the effect that the guilty person shall be carried from the bar to the prison of ——, thereafter to be detained till the —— day of —— next, and upon that day, between eight and ten o'clock of the forenoon, within the walls of the said prison, by the hands of the common executioner, shall be hanged by the neck upon the gibbet until he be dead; and the body thereafter shall be buried within the walls of the said prison. This is pronounced for doom, and may God have mercy on his soul. During the delivery of the sentence the Judge must wear the "black cap." In Scotland, not less than 15 days or more than 21 days after judgment, if south of the Forth, and not less than 20 or more than 27 days if north of the Forth, are the periods of time fixed by statute. By the Children Act, 1908, s. 103, it is enacted that "sentence of death shall not be pronounced on or recorded against a child or young person, but in lieu thereof the court shall sentence the child or young person to be detained during his Majesty's pleasure," etc.

In 1765, when Blackstone published his "Legal Commentaries"—a work which is still a classic—no fewer than 160 offences were punishable by death. This state of things existed till 1832, when, on 11th July of that year, Parliament passed an Act abolishing the punishment of death for the majority of these offences, and substituting lesser punishments in its place (7 & 8 Geo. IV. cap. 29).

As the consequence of that Act, there are now only four crimes punishable by death in England—viz.

(*a*) High Treason.
(*b*) Murder.
(*c*) Piracy with Violence.
(*d*) Burning of his Majesty's Ships, Magazines, or Arsenals.

But in Scotland, the list is much larger—viz. *Assault under the Act of* 10 *Geo. IV. c.* 38; *Beating and Cursing Parents* (*Act* 1661, *c.* 20); *Hamesucken*; *Robbery*; *Stouthrief*; *Rape*; *Incest, and Unnatural Offences*; *Wilful Fire-Raising*; *Piracy*; *Plagium*; *Furtum Grave*; *serious Thefts*; *Horse Stealing*; *Cattle Stealing*; *and Sheep Stealing* (*if more than one sheep*). In these cases, the prosecutor, before sentence is pronounced, usually records a restriction of the pains of law. But the pains of law are unrestricted for murder. From the sentence pronounced, therefore, it will be seen that it is not fulfilled until the person be dead, and that, if in the act of carrying it out the rope should break, the act must be repeated, unless his Majesty's clemency be extended to the prisoner. Both of these incidents have happened. In every case of judicial homicide, a medical man is appointed to be present at the execution—usually the surgeon of the prison in which the execution takes place—after which he must examine the body from its external appearances only, as a post-mortem dissection is not permitted, in order to certify at the inquest which is held thereafter, later in the day, that the person who has been executed is dead according to law.

The object of the public executioner in this country is to produce rapid, if not instantaneous, death, either by dislocating or fracturing the upper cervical vertebræ. This is effected by that functionary by the adoption of two measures —viz. (*a*) the arrangement of the rope; and (*b*) the drop or fall in which the body at the end of its descent receives a violent jerk. Calcraft used a short drop of about two feet, and arranged the noose so that the knot or metallic ring was placed immediately below one of the ears. Marwood, his successor, used a drop averaging about six feet, and placed the rope eyelet under the

chin, so that the head, at the point of arrest in descent, should be violently jerked backward. The present executioner regulates the drop according to the weight of the person to be executed, and arranges the rope—which must bear a strain of two tons—after the fashion of his predecessor.

That this object does not seem to be achieved always seems to be evidenced by a case recorded by Ramsay Smith from personal observation of a victim of judicial hanging. The subject was a medium-sized, thick-set, well-built man of 40 years, and of good health. On the lever being pulled by the executioner, the subject dropped without a sound and hung without a tremor. The knot of the ligature was on the left side of the neck, between the ear and the occiput. Two minutes later, the heart was found to be beating at the rate of 160 beats per minute, at three minutes, at the rate of 120 per minute, every third beat being duplicated, at eight minutes after, at the rate of 60 per minute, every fourth beat being missed, at eleven minutes, at the same rate, but irregularly intermittent, and only ceased to beat at the end of fourteen minutes and forty-five seconds from the time of the drop. Examination later showed that the neck was discoloured around the rope mark, the face was congested, the tongue was swollen and protruded, and the pupils were intermediate in size between contraction and dilatation. The penis was enlarged but not erected, and there was a clear discharge, like prostatic fluid, from the meatus.[1] The foregoing signs point to death by comato-asphyxia, and not to syncope.

The lesions which result from judicial homicide most usually are: (1), Dislocation or Fracture of the upper cervical vertebræ; (2), Rupture of spinal cord, near its junction with the brain; (3), Rupture of cervical muscles; (4), Dislocation or fracture of laryngeal cartilages; (5) Other minor lesions. It sometimes happens, however, that more extensive lesions than these are produced. At an execution in Worcester a few years ago, the head of the victim was partially severed from the body, a gaping wound of the neck being produced; on rarer occasions, also, the head has actually been completely severed from the body. At an execution in Kilmainham Gaol, Dublin, in 1889, the right side of the neck was torn from the windpipe to the back, rupturing the cervical muscles and blood-vessels, and the spinal cord.[2]

The following were the appearances seen on the bodies of two men upon whom the capital sentence had been performed. The first was that of a man who was executed at the legal hour of 8 A.M., whose body was cut down at 10.30 A.M. The face was pale, the forehead slightly livid, the eyes nearly closed, the mouth closed, the tongue was not protruded, the pupils were dilated. The mark of the noose was livid; and on the right side of neck, above and below the ligature, the tissues were swollen and œdematous. Posteriorly, the physical signs indicated luxation of the spinal column, with or without fracture. The second was also that of a man. Immediately after the drop was given, the body gave no sign of muscular movement of any kind. The body was cut down at 9 A.M., and the following were the appearances found:—There was a very slight degree of lividity all over the body, especially on the hands; the face was pleasant to look at, and there was no degree of swelling. The lips were pale, and the mucous membrane of the lips, grey. The pupils were slightly dilated and equal. There was a slight abrasion of the skin of the face on the left side near the angle of the lower jaw, obviously caused by the gun-metal eyehole of the rope. Below the jaw, and encircling the neck, was a constriction forming a groove round the neck. It was not deep, but it was broad—about one-eighth of an inch broad, and was twice as broad on the left as on the right side. The head could be moved in all directions with ease. On the left side of the neck, between the mark of the rope and shoulder, the muscles and tissues felt hard like bone, probably due to rupture. Close to the junction of vertebral column and head, a gap was found into which the knuckle of the forefinger could easily be put. Four hours later, *rigor mortis* had developed in the neck and lower jaw, the latter being fairly stiff. The body was, thereafter, buried within the prison walls in terms of law.

In judicial executions in other countries where suspension is practised, it would appear as if the object of the suspension was to produce death by suffocation rather than death by shock. In an execution in Vienna of a notorious murderer, the following was the manner in which the sentence of

[1] *Medicine*, Feb. and March 1902. [2] *Lancet*, vol. i., 1889, p. 763.

death was fulfilled. The executioner had two assistants who placed the victim in position on the scaffold. The executioner himself, who wore a tall hat and brown kid gloves and was dressed in black, jumped to the top of the steps behind the suspended victim, whipped a white silken loop out of his pocket, passed it over the top of the spike (at the top of the scaffold) and under the throat of the condemned man, and finally commenced to compress his face. With his left hand over the jaw and mouth, and his right hand over the forehead and eyes, he squeezed vigorously. One of the assistants meanwhile hung on to the hands of the culprit, and the other, kneeling on the ground, seized his legs, and with both hands pulled them downwards with his whole strength. It took the criminal four minutes to die. In another execution in the same city of a young vigorous man of twenty, death was only accomplished at the end of thirteen minutes.

In Spain, the judicial form of homicide is strangulation, which is produced in this way: the victim is placed in a stout chair on the back of which is a pillar or post, to which is affixed a steel collar or *garrote*. This collar being adjusted round the neck of the victim, the executioner, who stands behind the victim, by manually turning a screw tightens the collar, and so produces strangulation. In Turkey and other Eastern countries, strangulation is effected by means of the bow-string.

One of the first practical questions which the medical examiner is expected to answer is: Was the person alive before suspension, or, in another form, Had the body been suspended to cloak some other form of homicidal death? Before arriving at a conclusion, careful attention must be paid to every detail, because, occasionally, it is not a simple question to answer. If the internal post-mortem appearances point to death by asphyxia, then special attention must be paid to the marks upon the neck. The reason for this will be apparent when it is stated that a person may have been strangled and the body thereafter suspended: and as the signs of death from asphyxia will be seen in both, no light will be thrown upon the *cause* of the asphyxia. Dr Gosse, at the International Congress of Forensic Medicine, 1889, mentioned a case in which his suspicions were aroused by the presence of two marks on the neck, and what might easily have been mistaken for suicide was found to be a murder.[1] The marks upon the neck may enable an examiner to decide. It is difficult to lay down hard and fast rules for guidance, since a ligature put twice round the neck may simulate the circular mark of strangulation and the oblique mark of suspension. If, however, the examiner sees the body *in situ*, or, at least, with the ligature attached to the neck, he will be able to decide the question at issue by a consideration of the relation of the marks on the neck to the possibility of their being produced by the ligature found. If a body be found suspended, and on post-mortem dissection the signs of asphyxia are absent, one would be justified (except in such a case as that recorded by Reineboth, *vide ante*) in concluding that death did not occur from suspension, and, therefore, the examiner in the absence of marks of violence should look carefully for another cause of death, such as poisoning. Where marks of violence are discovered on a suspended body, all the more care is needed in the examination. Casper [2] relates an instructive case of this kind. A sailor was killed by a stab in the heart in a brothel in Amsterdam. The women washed the body of the blood, put a clean shirt on it, and suspended it by the neck. On examination of the body, the presence of the above wound coupled

[1] *The Lancet*, vol. ii., 1889, p. 451. [2] *Op. cit.* vol. ii., p. 191.

with the absence of the signs of asphyxia, showed without difficulty the true state of affairs. Had a careless examination been made, however, it is not impossible to conceive how this act of homicide might have been mistaken for one of suicide.

Assuming that it has been ascertained that death was caused by suspension, the next query to engage the attention of the examiner—and to answer as far as he can—is, Was the suspension or strangulation suicidal, accidental, or homicidal ?

It is a statistical fact that death by suspension is a favourite mode of suicide. Reference to the Registrar-General's returns for 1886 to 1895 shows that, in England and Wales, out of a total of 6780 persons who died by hanging, 6771 were from suicide ; and it is a well-ascertained fact that, taken over the three kingdoms, more men than women choose this form of suicide. There is, therefore, in the large percentage of cases, a strong presumption of suicide. Formerly it used to be taught that if, in such cases, part of the body of the victim rested upon the floor or ground, the case was more likely to be one of homicide than of suicide ; but that doctrine has long since been rightly pronounced erroneous, for in many cases of undoubted suicide,—we would go the length of saying in the bulk of cases,—more or less of the bodies of the victims is found so resting. The writings of Tardieu, Ogston, Casper, and others abundantly show this. Our experience is that in every single case falling within our observation, some portion of the body was found resting. The amount of the body so resting may vary in extent from the major portion of the trunk downwards to merely the tips of the toes. In one of our cases the point at which the rope was attached was but three feet from the ground, and the lower part of the body from the hips downwards was resting on the floor. In another, the legs from the knees downwards were resting. Grant records the case of a man who suspended himself from the handle of a door two feet nine inches from the floor, and who was found dead in the sitting posture.[1] Suicides occasionally adopt novel methods. In one case, a woman laid herself on a bed, attached the running noose of a rope round her neck, tied the other end of the rope to a heavy piece of metal which she heaved over the iron-bar of the bed-frame, and was thus strangled. At the same time, it must not be forgotten that a suicide may give himself a drop. In a case occurring in 1907, the suicide, in the absence of his family at church, tied a piece of ordinary rope round the banister railing of the stairway in his house, placed a piece of newspaper round his neck and over it the noose of the rope, and then precipitated himself into the well of the stairway. His body was found hanging about 2½ feet above the floor of the hall. The distance from the point of attachment of the rope on the banister to the noose on the neck was 10 feet, which was the amount of the drop. Examination showed that the neck had been dislocated.

The question becomes more complicated, however, when upon the body of the suspended person wounds produced by blunt or sharp weapons are found. It must be borne in mind that a determined suicide, failing to achieve his purpose by another method, may resort ultimately to suspension. This is well illustrated by a case which

[1] *The Lancet*, vol. ii., 1889, p. 265.

occurred in Duke Street Prison, Glasgow, where this mode of suicide was unquestionable. The man first tried to suspend himself but the ligature broke; he next tried to smash his skull by butting his head against the walls of his cell, by which he produced considerable wounds; again he tried to suspend himself from the ceiling by means of a bed-sheet which he affixed to a strap round his neck. When the cell-door was opened later, he was found suspended, and dead. It is not unknown, moreover, for a suicide to attempt suicide first by cutting his throat, and failing to produce the effect desired, to suspend himself. Ogston relates a case [1] where a man first cut his throat with a razor, from which he lost much blood, after which he went into an outhouse and hanged himself. It sometimes happens, too, that the attendant circumstances, apart from the mere suspension, indicate suicidal action prompted by insanity; for example, in 1896, a man employed in an electric engineering work in Glasgow, hanged himself from the hook of a spring-balance weighing machine, after fantastically clothing himself in a lady's chemise and white frilled drawers, over the former being a pair of corsets—having previously divested himself of his male attire. He had arranged a small mirror so as to see himself suspended.

Accidental hanging, although of comparatively rare occurrence, is by no means unknown. A case is recorded from Middlesbro' in which a lad went into a cowshed to play. There was a swing attached to a beam which extended across the upper part of the shed. He had climbed up to this beam with the intention of sliding down one of the ropes of the swing, but in his descent a woollen cravat which he wore round his neck caught a large nail fastened in the beam, and he became suspended. Fortunately his father, requiring him, on going to look for him found him in this position, and cut him down. When rescued, he was black in the face and unconscious, but on application of restorative measures he was resuscitated. In another case which occurred near Preston, a boy had mounted an apple-tree for some fruit: he slipped between the branches, and his jacket, which was buttoned at the neck, turned up round his neck and strangled him. When found he was dead.

We have seen three curious cases of accidental strangulation. In the first, the body of the victim was found lying on top of a partially overturned, open-backed, "form," the larynx caught by the edge of the rail; in the second, the neck of the old man was found resting on the edge of the iron framework of a bed; and in the third, the constriction of the throat was due to the strap-network of a sofa-bottom through a gap in which the head had passed. In all of these cases, circumstances pointed to the victims being in a state of helplessness, either from intoxication, a fit, or from feeble old age.

Highet records a case of accidental strangulation of a boy, aged four. His head had been caught between the upper bars of a gate upon which he had been swinging.[2]

At the Dublin Assizes in 1892, a case—R. *v.* Montague—of accidental hanging involving culpability of the mother, occurred under somewhat remarkable circumstances. The mother was charged with the crime of manslaughter. From the evidence it appeared that in order to punish her child—a girl of three years—she tied the child's arms above the elbows with a stocking, which she then passed round the body. To the stocking behind she attached one end of a cord, and fastened the other to a ring in the wall of a dark closet about 5½

[1] *Op cit.* p. 532.
[2] *B. M. J.*, vol. ii., 1900, p. 1760.

feet from the floor, and about 2½ feet above the girl's head. At the end of three hours, which was the term of punishment, the mother went to let the child out, but she found that her child was dead, having been suspended by the cord. It is difficult to account precisely for the cause of the suspension, but in any case, a mark was found on the child's neck at the lower part of the trachea. The mother was found guilty and sentenced to one year's imprisonment.

Homicidal Hanging.—From the difficulties attendant upon the successful accomplishment of this act, the crime is comparatively rare. "Lynching" is the modern method of its accomplishment, but this is fortunately confined to America. The victim is taken from the prison and hanged by the mob pitilessly. This proceeding is contrary to the law, and where the ring-leaders are known, they may be punished; usually, however, the crime is winked at by the authorities. Except in cases of helplessness from age or from any other enfeebling cause, it may be considered that the act could not be perpetrated by one assailant. Usually, therefore, more than one is involved in its commission. One of the sensational crimes of Paris was perpetrated in this manner in 1888,[1] in the murder of a man named Gouffé. The culprits were a girl named Bompard who had formed an illicit acquaintance with the victim, and a man named Eyraud. The former had an interview with the victim in her room, where the arrangements for effecting the murder had been previously arranged. In an alcove in the room, the background of which was a curtain, was a sofa, on which the victim, with the girl Bompard on his knee, was seated. She playfully passed a silken noose round the neck of her lover; the accomplice Eyraud was meanwhile secreted behind the curtain. In the roof of the alcove, a compound pulley had been fixed, which was hidden by the curtain. When the girl passed the loop round the victim's neck, she adroitly passed the free end, on which was a loop, to her accomplice behind the curtain, who immediately attached the loop over a hook at the end of the rope suspended from the pulley, and, at once, by pulling on the rope with the aid of the pulley, suspended the victim. After the death was effected, both of them proceeded to rob the body of its valuables; thereafter, they put it into a box, conveyed the box to some distance from the scene of the crime and left it there. On the body being discovered fourteen days later and an examination made of it, it was found that the hyoid bone was fractured. Links in the evidence pointed to the guilty knowledge of Eyraud and Bompard of the crime, whereupon they were arrested. Later, the female prisoner confessed to the commission of the deed, and narrated the mode, as detailed above, in which it had been accomplished.

Many instances are recorded, too, of suspensions by parents of their children; and Ogston [2] relates one case of a woman who was tried in Edinburgh in 1827 for hanging her husband, which she effected by passing a noose round his neck while he was asleep, and pulling him up.

In all of these cases, suspicion ought at once to be aroused if, upon the body, are found such severe lesions of the neck as could not be accounted for by the position of the body and its relation to surrounding objects. From the narration of the above cases, the absence of injuries from resistance on the part of the victims is easily accounted for by the fact that they were taken unawares; in other cases, where resistance was possible, marks of violence would likely be found. There are additional reasons why homicidal suspension is comparatively rare, and among these is the greater ease of accomplishment, comparatively speaking, of strangulation, or, under certain circumstances, of throttling. In the Rainhill tragedy, 1892, one of the five victims was murdered by strangulation in the following way:—a pillow-slip had been passed over the head, and was tied round the neck by a piece of rope which was passed twice round the neck and tied in a double knot in front. Next to the skin of the neck was found a second piece of rope which tightly encircled the neck, producing deep indentation of the tissues. At the Circuit Court, Dundee, April 1889, a man was sentenced to death for murdering his wife by strangulation. From the medical evidence, it appeared that she had been stunned by a blow on the temple, then strangled, and that her body was cut up after death. There was a mark of only one ligature on the neck, varying in width from one-eighth to one-third of an inch, which indicated that the direction of the con-

[1] Lacassagne—*Archives de l'Anthropologie Criminelle*, 1890.
[2] *Op. cit.* p. 532.

stricting force was downwards, outwards, and backwards,—a direction impossible for a right-handed person, as the deceased was.[1] Throttling is always homicidal, as it is difficult to conceive a suicide clutching his own throat for sufficient time to produce death, since the onset of unconsciousness would cause the clutching hand to be relaxed. At the same time it is difficult to exhaust the ingenuity of the suicide in the device of novel plans to effect his purpose. In very many cases where the question of suicide, accident, or homicide is raised with reference to such forms of death, the actual proof, it must be remembered, may fall to be determined as much, indeed, if not more, by the moral evidence and the local circumstances, than by the evidence afforded the medical jurist from the examination of the body.

1. *Deaths by Throttling.*—In May 1904, we examined the body of a middle-aged woman which was found in a house under suspicious circumstances. The face and neck were dark livid in colour. Bloody fluid from nose and mouth had flowed on to the cheeks, and was in a dried condition. Lips and buccal mucous membrane were also dark livid in colour. The front portion of the tongue protruded between the teeth, that part being livid and bruised. Over the left eyebrow was a lacerated wound 1⅛ inches long, the lips of which were sealed with dried blood, and there was swelling of the lower left eyelid. Over bridge of nose was another wound ⅝ths of an inch long. On each side of the larynx were discoloured marks of bruising accompanied by swelling. At junction of right clavicle with sternum was a discoloured swollen mark, the size of a large pigeon's egg. Dissection of the parts of the neck around the larynx showed on the left side of mid larynx an area of extravasated blood measuring 2 in. × 1¼ in., and on right side at a point a little higher up than the area on left side, an area measuring half-an-inch in diameter, with corresponding areas of extravasation over the larynx itself. There was, however, no fracture of cartilage, although its lining membrane was swollen and tumified. The right heart and both lungs were engorged with blood.

From the distribution of the discoloured bruises on the neck over the larynx, we were of opinion that they were probably produced by the hand or fingers in the act of throttling.

2. In the same month and year, a man was tried at the Circuit Court, Glasgow, on the charge of having in his house in Airdrie on Feb. 27, murdered his wife by beating her with his fists, compressing her throat, throwing her down and crushing her throat with his booted foot. For the details of the post-mortem examination we are indebted to Dr Kirkland. There were bruises found on face, over the larynx, and on upper limbs. Dissection showed (*a*) vertical fracture of left wing of thyroid cartilage of larynx, slightly to left of middle line, (*b*) fractures of cricoid cartilage, one about middle of right half, and another on left half to left of middle line, both in front. Internally, there was found a perforation in mucous membrane of larynx opposite lower end of last-noted fracture, extravasation of blood in mucous membrane above the right vocal cord, and general hyperæmia of the mucous membrane, the surface of which was covered with bloody mucus. The accused was found guilty of culpable homicide.

3. In December 1909, at the High Court, Glasgow, a man was tried for a charge of having murdered his wife by throttling her. From the evidence, it appeared that they had had a quarrel while in bed, during which she struck accused, and he, in turn, seized her by the throat, when she died. He fled from the house into the country, where during the night he gave himself up to the police by walking into a country police office and telling the foregoing story. The woman was found in bed dead. On post-mortem examination of the body we found a pale bluish mark across the voice-box, and on dissection, ecchymoses of a limited character on each side of the cricoid cartilage. The lungs were far advanced in tubercular disease. There were no definite signs of death from asphyxia. We gave it as our opinion that the violence applied to the throat did not appear to have been severe in character, and that death might have happened from syncope, as the combined effect of the quarrel and the compression of throat in a person so far advanced in consumption. He was found guilty and a short sentence of imprisonment was passed.

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[1] *The Lancet*, vol. i., 1889, p. 696.

CHAPTER VIII

MEDICO-LEGAL FORMS OF DEATH (*continued*)

IV. DEATH BY LIGHTNING AND ELECTRICITY

In ancient times, the bodies of those who were struck by Lightning were either buried on the spot where they were killed, or were permitted to decompose in the place where the stroke fell upon them. These places were fenced around, lest anyone should unawares contract pollution from them, as it was believed by the ancients that those who were lightning-struck had incurred the anger of Jupiter. Hence these places were to be avoided on the principle that the gods chastened those with whom they were angry, and the places, therefore, were sacred to the deity. So the Romans called such ground *bidental*, or forked—possibly, from the physical appearance of the lightning-flash. In Great Britain the number of deaths annually varies between twenty and forty—depending upon the prevalence of thunderstorms.

The medical jurist is only consulted in respect of those bodies found in public or private places which bear the marks of injury of which lightning may be the probable cause, in contradistinction to other forms of violent death, or to certify or give evidence concerning those cases the cause of which is obvious.

Deaths by Lightning occur chiefly in the spring and summer in the temperate zones and in the hot season in the torrid zone. Generally speaking, the human body is a bad conductor of electricity. According to Ranke, the conducting-power of muscle for the electric current is three million times weaker than mercury, and fifteen million times weaker than copper, while nerve tissue, on the other hand, conducts the current almost as well as a rod of metal. This last-mentioned fact accounts for the proximate cause of death by lightning-stroke —viz. concussion, or shock through the nervous system.

Before discussing the appearances and post-mortem signs on bodies struck by the electric fluid, it will be well to consider some typical cases of Lightning-stroke. The following may be taken as illustrative. The facts first to be narrated are a resumé of those of a case the full description of which was given to the Clinical Society of London in Nov. 1879.[1]

1. A farm-labourer, taking refuge during a thunderstorm under a willow-tree close to a shed in which three of his companions had taken shelter, was struck by the lightning. The course of the lightning was to go in by the door of the shed and out by the window—which it carried before it, depositing it in the field adjacent. The occupants of the shed were not hurt—only scared—and when the storm had somewhat passed over they went out to look for their

[1] *The Lancet*, vol. ii., 1879, p. 655.

companion. They found the tree, under whose branches they had left him, denuded of its bark, and their companion's boots standing at its foot. The man himself was lying on his back a couple of yards off, and though he was fully clothed when he was last seen by them, he was now naked, and nothing of his apparel was left on his person except the left arm of his flannel vest. He was conscious. His body, however, was marked by burning, and it was found that his leg was broken. The field around was strewn with fragments of clothing. His watch had a hole burnt in the case, and the chain was almost entirely destroyed. The man stated that he was struck violently on the chest and shoulders, became enveloped in blinding light, and was hurled into the air, coming down on his back "all of a crash," but never losing consciousness. Three hours later he was seen by Dr Wilks—who describes the facts. He was then quiet and composed, but complained of some pain in each leg, and of a general sense of burning, fiery heat. He was deaf. The hair of his face was burned, and his body was covered with marks of burning, superficial on the chest, but deeper on the abdomen and right thigh. Down each thigh and leg



Fig. 35.—Effects upon Clothes of Men struck by Lightning at Hampstead Heath on June 14, 1888. (*By permission of the Royal Meteorological Society.*)

was a broad indurated band of burning which passed along the inner side of the knee and ended below at the left inner ankle and at the right heel respectively. On the left foot was a lacerated wound with a comminuted fracture of the *os calcis*. The bones of the right leg had sustained a compound fracture, and the tibia protruded through the skin in the course of the burn. The man eventually made a good recovery.

2. At Kilmalcolm, near Paisley, in May 1899, two men working at a building were struck down unconscious, part of their clothing was destroyed, and one of them sustained severe burns on the right arm and hand.

3. In June 1888, two men working on a farm near Hampstead Heath, while busily engaged at their out-door dinner meal, were struck. One was knocked senseless, the other was only momentarily stunned. The latter, on recovering consciousness, discovered that his trousers were on fire, that the knife with which he had been cutting his food had been knocked for some distance out of his hand, and that the steel buckles had been torn from his trousers. The former was burned on the right side from shoulder to foot. (Fig. 35.)

4. A workman who was killed by lightning on the highway on his way to work, sustained the following injuries—viz. his lower lip was cut to the extent of an inch, the tip of his nose was denuded of skin, the hair of the left side of his

body, beginning with the left eyebrow, was slightly singed, but his clothes bore no marks of singeing.[1]

5. A farmer who had gone out of his house to look after some cattle, was struck about thirty yards from his house where he was found dead lying on his face, with his right hand in his trousers pocket. His felt hat was torn to pieces, and both cloth leggings were torn almost from top to bottom. At the upper anterior angle of the left parietal bone was a wound about the size of a penny, extending to the bone, and from it was a red line of burning, about a quarter of an inch in breadth, which ran down the neck and over the middle of the clavicle to the epigastrium. The trunk of the body, the thighs, and legs were also burned. On the under surface of the left foot was a wound of the size of a

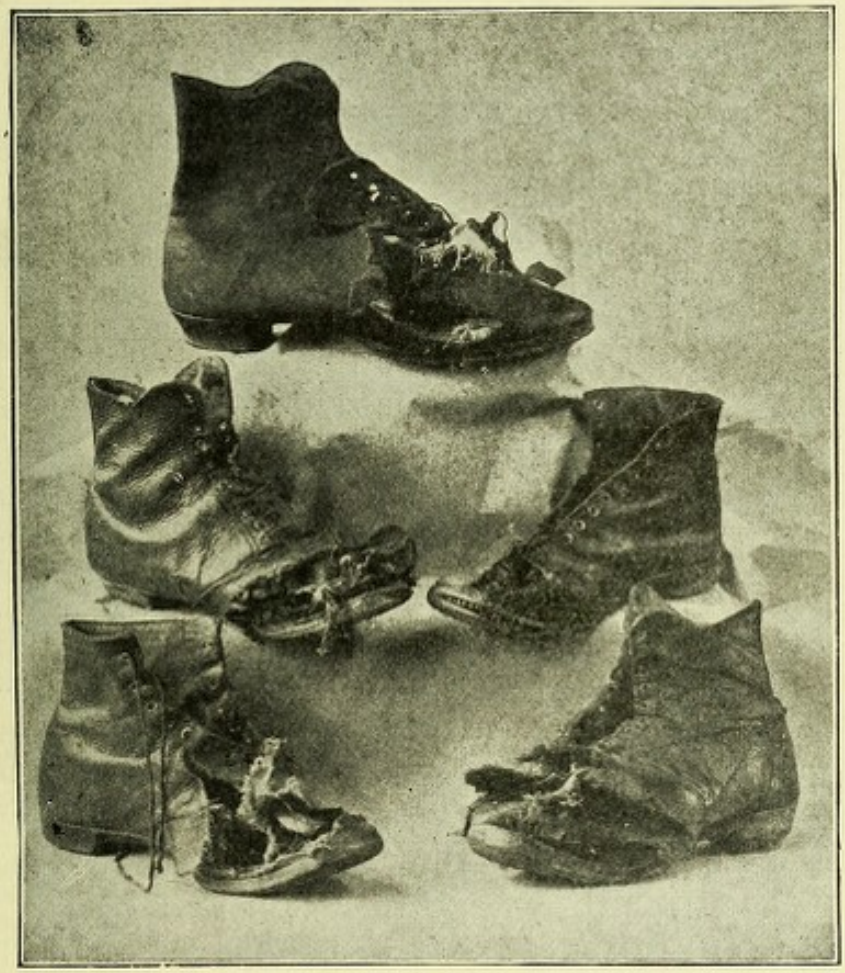


FIG. 36.—Effects upon Boots of Choristers struck by Lightning at Atcham Church, Shrewsbury. (*By permission of Mr J. Laing, Shrewsbury.*)

threepenny piece, and on the left groin were two vesicles about the size of a man's thumb. The hair of the scalp, neck, and body was burnt and singed in the neighbourhood of the bands of burning. The blood was abnormally fluid. The face was livid.[2]

6. In another case, a farmer near Airdrie who was driving a horse and cart was seen by two servants to be struck by lightning. The horse and cart were both knocked over, and were found lying on their sides, the animal, however, being quite uninjured. The farmer was dead. His necktie and whiskers were burned.

7. Dr Dunscombe-Honiball gives an account of lightning-stroke in British Guiana [3] where such occurrences are very common. He tells of a party of

[1] *B. M. J.*, vol. ii., Oct. 1, 1898.
[2] *Ibid.* vol. i., 1897, p. 1178.
[3] *Ibid.* vol. i., May 12, 1900.

male East Indians, numbering fifteen, who had taken shelter in a small hut, and out of that number two were killed outright, two were rendered completely insensible, and six suffered in varying degrees from shock. Of the two men killed, one had a compound fracture of the right temporal bone, the fracture extending into the middle fossa of the skull through the petrous portion of the temporal bone and tearing the brain membranes. There was scorching of the whole front of the chest, abdomen, and thighs, the chest marks being of a distinctively arborescent appearance ; the other had only sustained abrasions of the left side of the chest over the cardiac region accompanied by scorching, and an abrasion below the right knee. He records another case which illustrates a point not yet observed in any of the foregoing cases — viz. the magnetisation of metallic articles after lightning-stroke. This man was walking along with two of his fellow-workmen carrying a four-pronged agricultural fork over his right shoulder, with a saucepan slung on its handle. He was instantaneously killed by the lightning-flash. His hat was torn to ribbons, and the fragments thrown yards away ; the tin saucepan was smashed in, and one of the prongs of the fork was found to be magnetic. He had sustained a compound fracture of the skull.

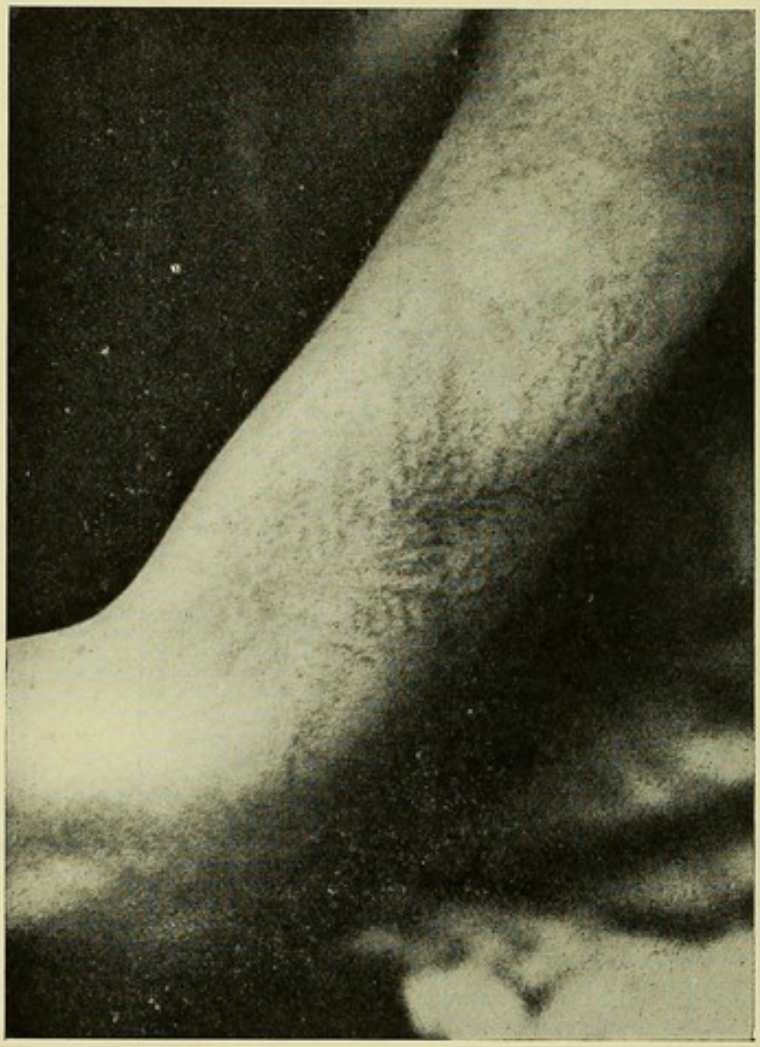


Fig. 37.—Arborescent Markings on Arm of Boy struck by Lightning. The photograph was taken four hours after the accident. In eleven hours after the accident the markings had entirely disappeared.

Lynn Thomas has recorded two remarkable cases.

On July 17, 1903, two linesmen, *A* and *B*, employed by the National Telephone Co., were at work on a main road in Wales, when a severe thunderstorm with torrential rain came on. They took shelter under a large elm close by a lane leading to a farmhouse. They were seen sitting there a few seconds before they were struck. When found soon afterwards, both were unconscious. They were taken to Cardiff Infirmary. One of them, *A*, was burned, and his clothes and boots more or less rent and torn. The other, *B*, had no visible external injury, but had sustained a fracture of the base of the skull with bleeding from the left ear. When they were discovered after the lightning had struck them, *A* was found practically naked in the lane three feet from the place on which he was seen sitting, lying on his right side, his body damming the water flowing into a pool. The lightning had come into contact with his body by boring a hole through the brim of his cap ; it then removed a ½-inch strip of hair from that point vertically to the nape of the neck, the scalp being quite smooth, and without any evidence of singeing or burning. On the nape of the neck there was a narrow brownish longitudinal line of discoloration for about an inch before the current spread into the areas of burning, which were mostly

of the second and third degree, over the back, the right arm, the right loin and hip, and the right leg and foot. The burns on the ankle and sole of foot were more serious than those in other parts of the body, probably because the current passed out of the body at this point. The face, the hollow of the spine, the front of the trunk of body, the genital organs, one arm, and both forearms had no burns. He had slight hæmorrhage from both ears but no perforation was observable in either ear. He recovered.

The man *B* had been hurled a distance of eleven feet in the opposite direction to the man *A*. There was no burning of or injury to his clothing. Examination of the tympanic membrane of the left ear, from which there was hæmorrhage, showed a rent near its margin in its upper half. Thomas was of opinion that this lesion was the result of the basal fracture and not directly of the lightning-stroke. This man also recovered.

Further examination of the place of the accident showed that the electric fluid had first struck a top branch of the elm-tree and had then passed down the trunk. At a point a few feet above the heads of the seated men there was a large piece of bark of trunk torn away. Part of the fluid struck the man *A* as described, and leaving him by his boots, both of which were torn and cut, of which some of the nails were blown, it passed across the hard smooth surface of the lane, and went to earth about sixteen feet away, and in so doing bored a two-feet trumpet-shaped hole in the soil.[1]

The foregoing facts are interesting in respect that while one of the victims was struck by the fluid, was rendered unconscious, and was largely burned, the other was not struck by the fluid, some mechanical power, either directly or indirectly associated with the lightning-flash, being exerted, however, sufficient to lift his body into the air and to deposit it eleven feet away. The fact that the unconscious men were found each at some distance from the places where they were seen sitting, and in directions opposite to each other, points to some disruptive force being exercised between them at the time the fluid passed between their bodies. The illustrations which accompany the narration of the above facts lend additional interest.

On July 9, 1905, about 5 P.M. lightning struck a gospel tent near Waringstown, Ireland, in which a congregation of about 250 persons were assembled. Very heavy rain preceded the lightning, and dripped through the canvas roof. The tent was supported on two large wooden poles with a ridge-pole between, and about seven feet above the ground an iron wire or cable ran between the poles for the purpose of suspending lamps for lighting the tent.

The seats were placed on each side of a central passage above which this wire ran, and it was noteworthy that it was in this vicinity that the persons struck received the more severe injuries.

The lightning-flash struck the pole nearest to the entrance, travelled down the pole to the point where the iron wire was attached, then across to the other pole, leaving a furrow $\frac{1}{4}$ inch deep and 1 in. broad on the first pole, wrenched out an iron staple holding the iron wire and splintered the wood of the second pole for a length of about 2 feet, and to a depth of $\frac{1}{2}$ in. to $\frac{3}{4}$ in.

In all 60 persons were simultaneously struck, and were thrown upon the floor of the tent in varying states of insensibility. Some recovered consciousness quickly, others at longer intervals ; but in the end all recovered consciousness with the exception of two men, one of whom appeared to have been killed outright, the other surviving for some minutes after having been struck.

Injuries.—Most of the injured complained of severe pains, numbness, and, afterwards, of soreness in the legs, especially the calves ; some of painful spasms of the diaphragm with a hiccough ; others of cardiac pain ; others of pains in muscles of chest, shoulder and back. A small number of elderly persons showed signs of cardiac failure. All exhibited, more or less, symptoms of shock.

Burning.—Fifteen of those struck showed burns, but generally of small extent. Several were only about the size of a shilling or florin, and these were mainly situated on neck, chest, shoulders, and in some cases were accompanied by singeing of the hair. *Linear burns were not uncommon.* One woman had a red linear mark running from middle of the neck on to the shoulder ; a girl had across her chin a red linear burn, about $2\frac{1}{2}$ in. long, believed to have been

[1] *B. M. J.*, vol. ii., 1904, p. 1155.

caused by the wire in an incandescent state striking her. Two young women who, at the time, were wearing silk blouses, sat together near the wire. One of them had burns of the right shoulder of size of half-a-crown, with vesication.

This girl wore a watch in her belt secured by a long chain which passed round her neck. The blouse along the trace of the chain showed a black mark, although the blouse was not burned, the neck of the girl was burned along the chain-track. Her watch was fused at one spot to the size of a split-pea.

One of the women who was struck on this occasion had had a previous experience of lightning-stroke.

Arborescent Burns.—One lad exhibited in his groin the outlines of a small fern plant; another had on the side of his body the representation of a tree.

Fatally Injured.—Of the two men who were killed one was about 65 years of age. He had a black discoloration on the front of the breast, and a slight mark on the right brow. There were no marks of burning on his clothes. He breathed for a few minutes after he was found. The other, aged 35, had a broad, dark mark on the front of the abdomen, and a dark mark about one inch wide running down the outside of both legs from mid thigh to ankle, as also a mark on the outside of right arm. His trousers were burned in lines corresponding to the marks on the legs. He died instantly.[1]

On the bodies of two young labourers who were struck at Goring, near Worthing, in June 1907, there were marks like very delicate seaweed or frost-designs on window-panes.

On a golf-course near Glasgow, in the end of June 1907, a young man, aged 36, who was in the act of striking a ball with an iron club during a thunderstorm, was struck and killed by lightning. The following were the appearances which we found on his body:—The fluid entered his body through a cloth cap which he was wearing and tore his clothing into ribbons. At several parts, the clothing showed singeing. The watch which he carried had a celluloid covering over the watch-glass. The watch-glass itself was pulverised into fine powder, and the minute hand had disappeared. On the right side of his brow, near the roots of hair of head, there was a lacerated wound, more or less circular in shape, with

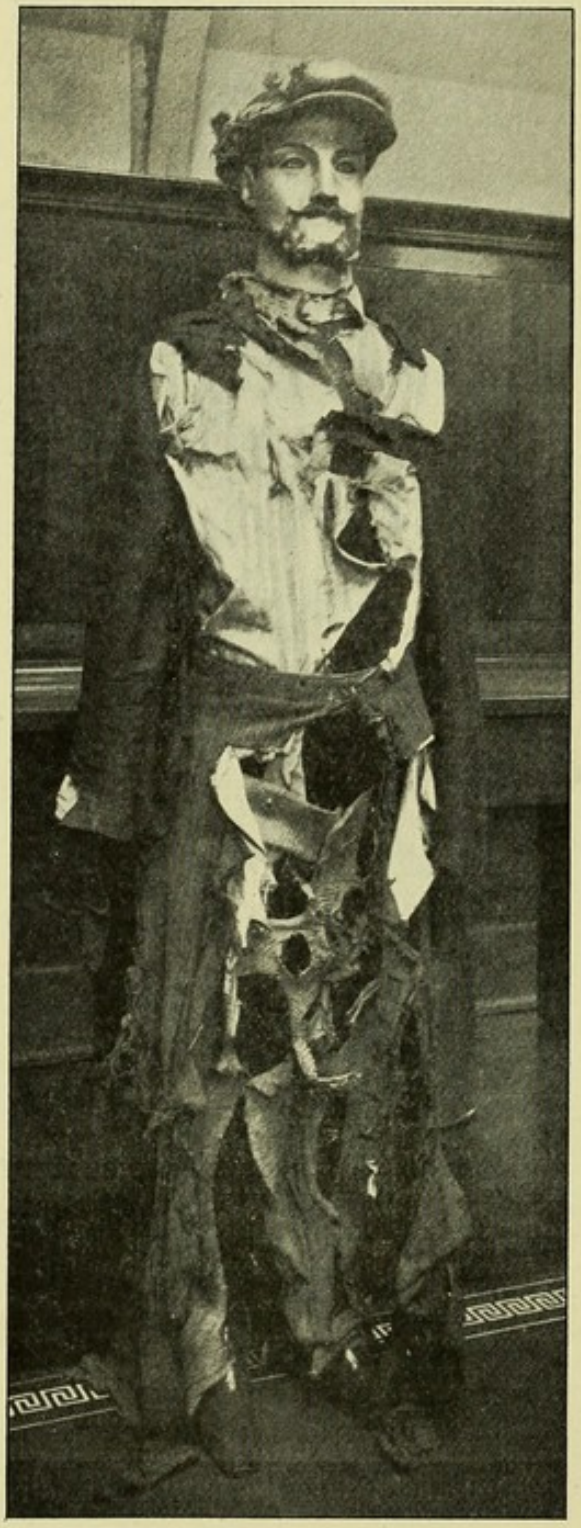


FIG. 38.—Effects of Lightning-Stroke on Clothing—Clothing fitted on lay figure. Body of man was wounded and burned.

[1] *B. M. J.*, vol. ii., 1905, p. 1522.

scorched, almost charred, edges, about ¾ in. in diameter. The hair of the scalp above this wound, the hair of the right eyebrow and of the right side of the moustache, was singed and burned. There was a mark of burning along the level of the right clavicle. The hair over the pubes was singed. There were also marks of burning on the right thigh, the inside of the left knee, and on both feet. The boots were torn from the feet, were split, and the soles wrenched from the uppers. The watch was tested the day after, but was not found to be magnetised. (Fig. 38.)

8. Only one more case need be recorded in order to exemplify other markings on the body—viz. the arborescent marks of burning. Dr Yule Mackay [1] records a case, illustrated by a photograph, of a boy who, with three companions, took refuge in an empty stable during a thunderstorm. The stable was surrounded by lime-trees which formed an awning over it. The four boys were standing in the doorway, three in front and one behind, the boy in question being one of the front row. The four boys were struck, but the three in the front row were marked by the arborescent prints on the arms, chest, or legs, while the boy who was standing behind was only marked on his face and neck. Three of them were partially stunned, and the fourth was rendered completely unconscious. The boy in question was thrown violently to the ground by the stroke and was severely hurt about the face and forehead. The arms were paralysed temporarily ; indeed for some time after he regained consciousness he was unable to remove his hands from his pockets, where he had placed them before the accident. After he got home, by reason of his complaint of the burning heat in his arms, his clothing was removed, and arborescent markings were found extending from the left elbow to the shoulder and radiating across the left chest. The marks were of a ramified, tree-like form, not unlike that of a yew, or the fronds of a fern. Four hours after the accident the marks were bright enough to be photographed, but four and a half hours later they were hardly visible. There was no vesication or shedding of the skin afterwards. The clothes were uninjured, and a knife and buttons which the boy had about his person were not affected in any way. A metal water-pipe or roof-gutter on the stable was curled up by the same stroke, and the leaves of the lime-trees which overhung the doorway were perforated like leaves eaten by caterpillars. (Fig. 37.)

Of the lesions found after lightning-stroke those known as lightning prints are probably the most interesting. They were first described, we believe, by Andreas Poey, of Havana, in 1861, in a pamphlet which contains the record of a large number of cases, many of which appear, however, to be exaggerated as to their particulars. Stricker,[2] Rindfleisch,[3] and others [4] have also recorded examples of such prints. These prints, or markings, have been compared by Pfaffe of Stuttgart to Lichtenberg's figures, which are produced when a charge of positive electricity from a Leyden jar is passed through a needle to the surface of a glass plate which has been dusted over with the powder lycopodium. Various theories have been put forward to account for their causation, but they are believed to be due to coagulation of the blood in the minute capillaries of the skin from the electric fluid. (Fig. 39.)

The lesions which may be met with after Lightning-stroke may, therefore, be summed up as follows :—1. Wounds of almost any description ; 2. Fractures, simple, compound, comminuted, single or multiple ; 3. Burns of almost any shape, linear, streaks, patches, or arborescent-like ; 4. Ecchymoses ; 5. Singeing of the hair of scalp, face, or body ; 6. Impressions of metallic articles on skin.

In addition to the lesions illustrated in the foregoing cases there are certain subjective conditions which result from this accident, such as blindness, deafness, paralysis, loss of memory, delirium, and con-

[1] *Glasgow Medical Journal*, vol. xx., p. 321 *et seq.*

[2] Virchow's *Archiv.*, vol. xx. and vol. xxviii.

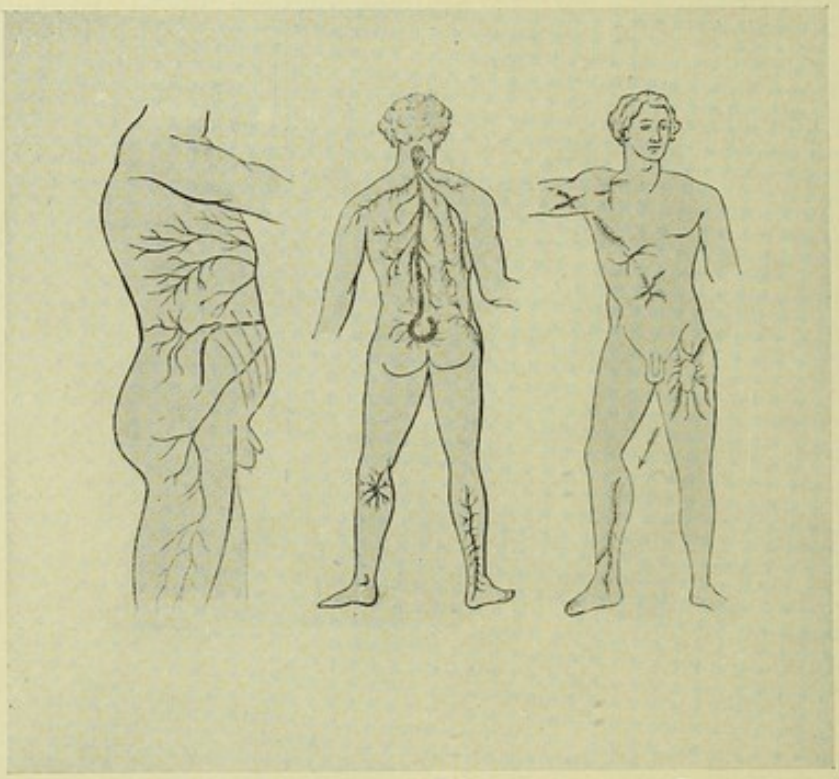
[3] *Idem*, vol. xxv.

[4] Casper's *Vierteljahrsschrift*, 1863 ; *Australian Medical Journal*, 1870 ; *B. M. J.*, vol. i., 1876, p. 102 (Jefferies) ; *Lancet*, vol. ii., 1878, p. 187 (Waugh).

vulsions. In June 1909, near Fraserburgh, a woman was paralysed in the right arm from lightning-stroke for some time, but she recovered the power in the limb.[1]

A very marked sign is the magnetisation of metallic articles found on the person, or of articles which were being carried by the individual when struck.

The proximate cause of death by Lightning is neuro-paralysis or shock. The post-mortem signs, therefore, are in many cases remarkably negative. At the same time, observers who have seen many cases of death by this agency affirm that in every case some indicative lesion will be found. In most of the cases one or more lesions of the kinds enumerated above is likely to be found, and in all cases where a combination of wounding with burning is found under circumstances



A B C

Fig. 39.—Arborescent Markings after Lightning-Stroke.
A, from Rindfleisch ; B and C, from Stricker.

in which lightning-stroke is a tenable hypothesis, careful examination of the electric state of metallic articles on the body should be made.

The dictum of the celebrated John Hunter, that in deaths by lightning there is an absence of *rigor mortis*, must now be held to be disproved. Dr Dunscombe-Honiball has placed this question beyond doubt. Of the cases already described from his record, in the first, *rigor mortis* was markedly present twenty hours after death, in the second, it was also present, and in the third, it was present eight hours after the death. The statement that the blood is abnormally fluid must also be traversed. The cavities of the heart are usually empty, or those of one side may contain a little blood. Dr Honiball tenders this caution, which we repeat as a wise caution : Be not too sure that

[1] *See* also Campbell Watt, *Transvaal Med. Jour.*, Dec. 1908.

in every body found dead after a thunderstorm, and where no marks upon it are found, that death was due to lightning-stroke, for it may happen that death was due solely to cardiac syncope owing to sudden and startling fright. This advice is wholesome, because there are not a few people who are preternaturally afraid of a thunderstorm.

Death by Electricity.—It is usually taught and believed that the cause of death by lightning and of that by static electricity is identical, and that the differences between the one and the other are only differences of degree. That the electric fluid is a potent factor in both goes without saying, but as one writer forcibly puts it : [1] Has an electric shock ever amputated a man's fingers, or fractured a skull (quite apart from the possibility of these lesions having been produced by any mechanical cause) ? That there are other factors in the production of the lesions of lightning-stroke seems apparent, but it is difficult to state what they are. When Woodman and Tidy published in 1877 their work on Forensic medicine, deaths by electricity were almost prophetically predicted in the following words :—" Now that galvanic batteries are becoming common in scientific institutions and private laboratories, it is by no means unlikely that some deaths (accidental or otherwise) may happen from the sudden discharge passing through the human body." These words would have been still more prophetic if, at that date, it could have been foreseen that this agency was so soon thereafter to be harnessed and utilised in installations for heating, lighting, and motor purposes, and, further, as a mode of judicial homicide. These have all been realised since that date. The experiments conducted by the late Sir Benjamin Ward Richardson and Dr Sedgwick in our own country, and by Nothnagel in Germany, as to the effects produced upon the bodies of the lower animals by the passage through them of electrical discharges, are well worthy of study. The former worked with the electrical apparatus of the Polytechnic Institution, London, which is of enormous proportions and capable of discharging miniature flashes of lightning. From that apparatus, they were able to obtain three different sparks or discharges depending upon the correlation of the component parts of the apparatus ; the first discharge, obtained from the secondary wire charged from the primary, measured twenty-nine inches in length ; the second, when the break was used, measured from ten to fifteen inches, was blue in colour, forked, and continuous in character ; and the third, when a huge Leyden jar was charged from the coil by three discharges, was of a dangerous character. The lethal effect of these discharges differed ; the first did little harm to the animals, the second caused powerful tetanic contractions of the muscles, and the third was usually fatal. Nothnagel's experiments [2] were partly repetitive of these, and partly broke fresh ground. The animals experimented upon were rabbits, the electrodes being placed underneath the skin on account of the fur and skin dispersing the electric current. His experiments were intended to discover the results which would follow the passing of an electric discharge through the animal's body, the electrodes being placed at different points of the body. When one electrode was placed beneath the claws

[1] *B. M. J.*, vol. i., May 12, 1900.
[2] *The Lancet*, vol. i., 1880, p. 863.

of a hind foot and the other below the skin of the groin, complete anæsthesia of the foot was produced after the discharge was passed, and irrespective of the direction of the flow of the current; the same phenomenon being seen with the fore limb and axilla. When one electrode was placed under the claws of a fore limb and the other under the skin of the tail, anæsthesia of both foot and tail was produced, presumably due to the greater intensity of the discharge at the points of entrance and exit. Long before this time, Arago, from his experiments on magnetism and electricity, expressed the opinion that when lightning struck men or animals placed near one another, either in a straight line or in an open curve, the action of the stroke would be always most severe at the extremities of the line or series. This has been amply demonstrated from time to time; for although all of a series may be struck down, only those at the extremities are likely to be killed. In one instance thirty-two cows standing in a row in a cow-shed were struck by lightning, thirty were knocked down by the stroke, but only the cow at each extremity of the series died. In another case, five children were seated on a form in school when they were struck by lightning; the first and last were killed, while the others were merely shaken, and quickly recovered. At Brest, in May 1906, a girls' school was struck. It entered a window under which was a form on which twenty girls were sitting at their lessons. All were hurled from their seats, the form being splintered into small pieces and catching fire. Five of the girls were burned rather badly, and one died from the effects of the shock. At Chicago, Illinois, eleven persons huddled together in a zinc-lined shanty were killed by one flash of lightning.[1] It would seem, therefore, that there is some parallelism between the effects of electrical discharges at the contact points on the body of an animal and the effects of lightning-stroke upon a series of human beings or animals in line.

The following cases may be taken as typical of the fatal effects of electricity :—

1. A labourer, aged 22, was killed by coming in contact with the wires which conveyed electricity from a dynamo to the mansion of Hatfield. The power used for generating the electricity for 117 lamps of the Brush system was an engine of 16 horse-power, which was situated in a sawmill behind the mansion. From this place, the wires ran along the garden-wall about three feet from the ground, and were neither insulated nor protected. This man was at work near this point hanging a telephone wire, and had been sent to ease the wires at the corner of a wall to prevent them being cut. Immediately thereafter the wires were heard to shake, and the man was seen to fall. On his fellow-workmen running up to him, he was found dead. It was supposed that he had stumbled, and, trying to prevent the fall, had grasped the electric wire in his hands. At the time, his hands and clothes were dripping with rain, the day being very wet. There were no lesions to be seen upon the body, and the medical evidence at the inquest showed that death was caused by violent shock to brain and nervous system and paralysis of the heart.[2]

2. At the Health Exhibition in London, a man was killed while at work in the dynamo shed. It was shown in evidence at the inquest that the deceased was observed to put his hands on the machine, whereupon he was seen to be convulsively held to the machine, then to fall back. When picked up, he was

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[1] *New York Med. Record*, Ap. 12, 1902.
[2] *B. M. J.*, vol. ii., 1881, p. 1027.

dead. The only external lesion found upon the body was that of a slight burn between the forefinger and thumb of the left hand.

3. Of more recent cases, probably those connected with electrical apparatus, such as the breaking of a telephone wire and its contact with the electric wire for working the tramway at Liverpool, are the most instructive, since they further illustrate some points not clearly indicated in those preceding. On February 11, 1901, a telephone wire snapped over the top of an electric wire which supplies the motor power of the tramway line in London Road, Liverpool. The broken wire came in contact with the electric wire and fell down among the outside passengers of a passing tramcar. The wire having encircled the leg of one man caused his instantaneous death; a second man was also killed by the shock, and fourteen other passengers were also affected, sustaining injuries which necessitated their removal to the Infirmary. The clothes of one of the persons caught fire and blazed. On examination of the patients at the Infirmary, nearly all were found suffering from shock, and a few were burned. The marks of burning were of a greenish colour caused by the fusing and volatilisation of the copper wire. In one of the fatal cases, marks resembling burning were visible on the bare forehead, and in the case of another, there were marks on five parts of the body which were covered by clothing. On the abdomen was a white slough about the size of half-a-crown, surrounded by blisters, and a like condition on one thigh. Blisters were also present on both legs and on the toes of one foot. What is somewhat remarkable, is the fact that though the marks had the physical appearance of burns, the clothing over the marks bore no evidence of burning or singeing. The electric wires of the tramway system are kept at a pressure of 500 volts.

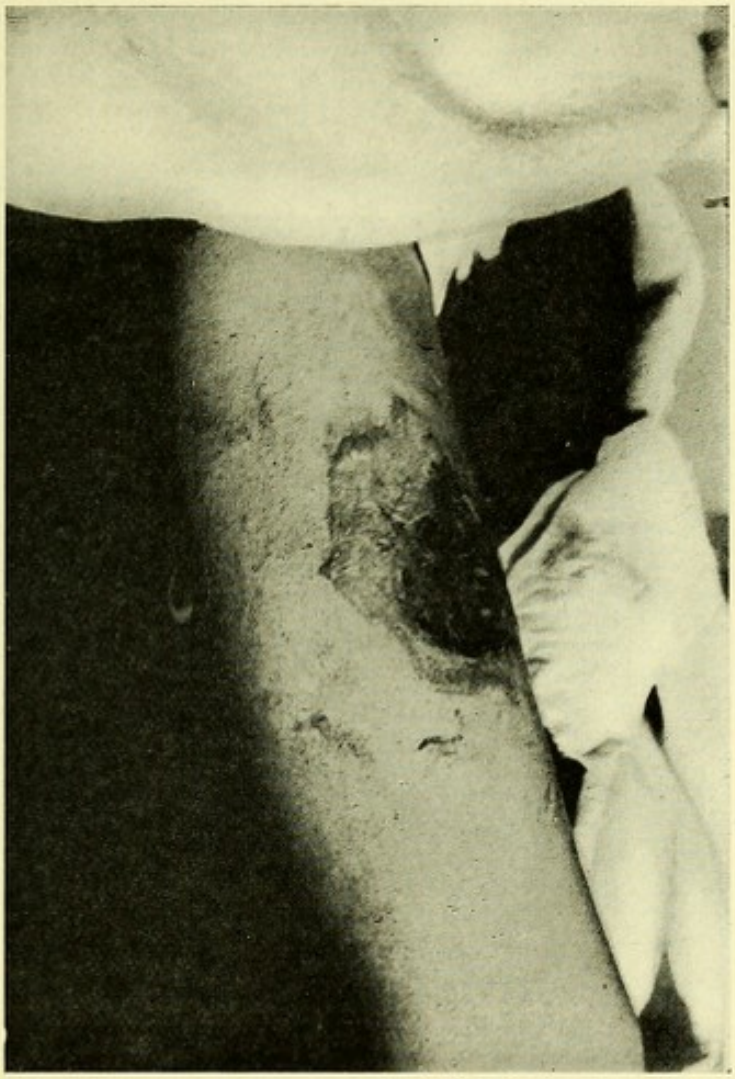

FIG. 40.—Electric Burn of Right Thigh. (*Vide* Figs. 41, 42.) This lesion was caused by the presence in the trousers' pocket of the man of a bulky bunch of keys which completed the electric circuit through his body, his right hand being in contact with another part of the electrical apparatus. Over the seat of this burn a hole was burned in the trousers. The keys looked as if they had just been taken out of a hot furnace. The burn had the appearance about its centre of depressions corresponding to the heads of the keys, and looked as if a red-hot poker had been repeatedly thrust into the thigh. Around the burn the skin was much swollen and of a dusky-red colour.

4. Mr Smurthwaite [1] gives an interesting account, with illustrations, of the case of a man who sustained injuries from an electrical discharge. The man when admitted to the Southport Infirmary on Feb. 12, 1898, was in a semi-unconscious condition, and was suffering from severe burns of the right hand

[1] *B. M. J.*, vol. i., 1901, p. 573.

and thigh. (Figs. 40, 41, and 42.) He was employed in the local electric works. His injuries were caused by his having come in contact with a switch. The man, who had at the time a large bunch of keys in his right trousers' pocket, was leaning with his right thigh against an unprotected brass fitting in the act of adjusting the brushes on the motor with his right hand, when he felt the shock. A circuit was evidently completed through the agency of the bunch of keys, because a large hole was burnt in his trousers over the seat of the pocket in which they were, and the adjacent part of his thigh was charred. The keys themselves had the appearance as if they had just been taken out of a hot furnace. A fellow-workman who heard him shout at the moment of the shock, on running up to him, found him fixed to the machine in a condition of tetanic spasm, and his back bent in the position of opisthotonos. On being knocked off the machine by his fellow-workman, he lay on the ground as if dead for about ten minutes, when he slightly moved his eyelids, but could not speak. The burn on his thigh was of peculiar shape; about the centre of the burn or

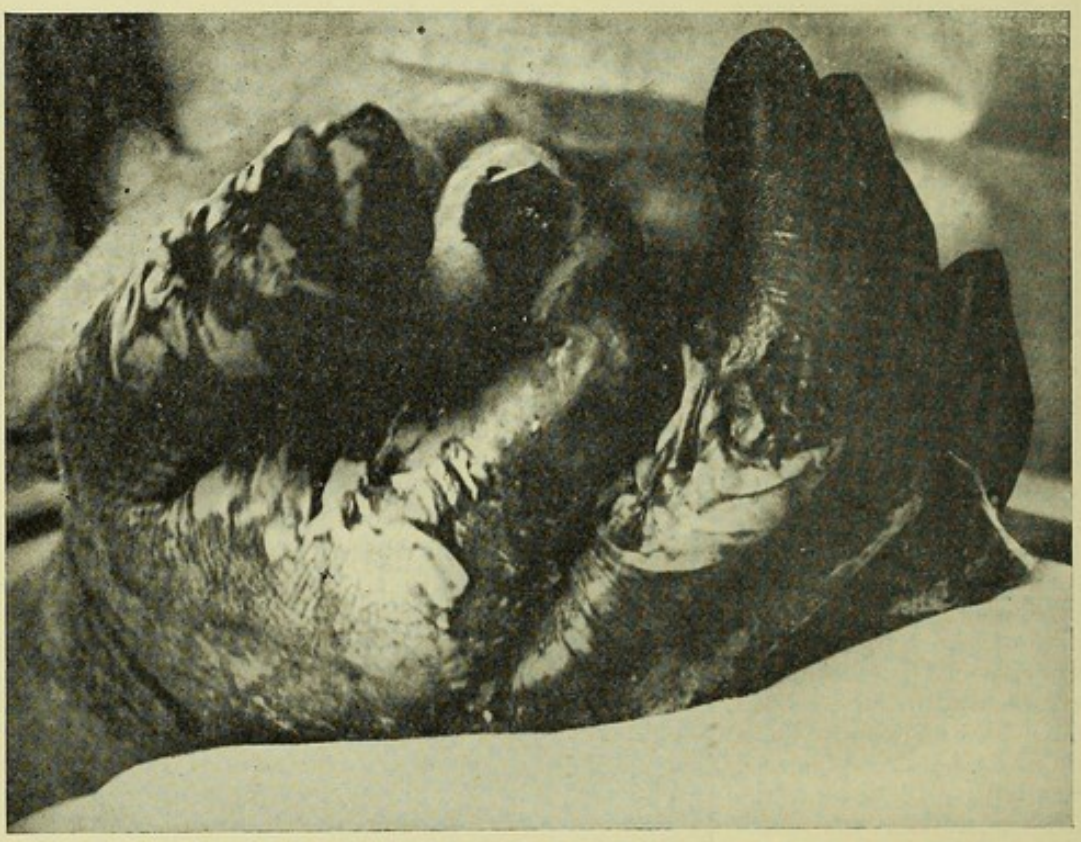

FIG. 41.—Electric Burn of Right Hand—36 hours after accident—from contact with electric machinery passing 2150 volts. This illustration was kindly lent to the author by Dr Baildon, Senior Surgeon, Southport Infirmary. *Vide* account of the case by Mr H. Smurthwaite, M.B., etc.

wound there was a number of depressions which evidently corresponded to the heads of the keys, and for about two inches round about this burn, the skin was very much swollen and of a dusky-red colour. This wound sloughed so much, later, that the muscles of the thigh were exposed. (Fig. 40.) The burns on the hand and fingers were very severe. On the second day, the first phalanx of the thumb and the first finger at the metacarpo-phalangeal joint had to be amputated. He eventually recovered. The points of interest in this case are the following:—(1) The accidental completion of the circuit by the keys in the man's pocket through the body to the hand which grasped the machine; (2) the large amount or high pressure of the electric current, 2150 volts, which passed through the body without fatal issue; and (3) the formation of severe burn-lesions at the points of contact.

5. In the Court of Session, November 1901, an action was tried by a lines-man against a firm of electrical engineers for damages in respect of personal injuries sustained by the pursuer. It was alleged that while pursuer was about

to fasten a guard wire to a pole, the platform rail of the tower upon which he was standing swung from under him forcing him to cling to the spare wire, which proved to be "live,"—being charged, it was alleged, with 700 volts of electricity,—from which he was badly burned. A fellow-workman, seeing his peril, knocked him off the wire, else he might have been killed.

6. A man was admitted to the Glasgow Royal Infirmary on November 19, 1901, in an unconscious condition, his arms and head being severely burned. The man was employed in the Corporation Electric Works, and accidentally fell on the "bus bars" connected with the switchboard. The switchboard has a voltage of 6500 volts. The bus bars are made of copper and convey the electric current from the switchboard to the cubicles, by means of which the electric current is distributed to different districts of the city. The bus bars are three in number and are two feet apart. The following burns were found upon the body—viz. (1) On Right Arm: (*a*) a burn of 6th degree running from lower



Fig. 42.—Electric Burn of Right Hand. Another view of Fig. 41.

ends of radius and ulna on dorsal surface to lower ends of three outer metacarpal bones; (*b*) a burn of 5th degree all round forearm from wrist to four inches up the forearm; and (*c*) a burn of 5th degree in front of elbow-joint; (2) On Left Arm: (*a*) a burn of 6th degree over whole of palm of hand and palmar surfaces fingers and thumb; (*b*) a burn of 5th degree along the whole anterior aspect of forearm and in front of elbow-joint; (*c*) a burn of 3rd degree extending for 3½ inches from wrist up the back of forearm; and (*d*) a patch of burning of 2nd degree under left axilla. On the head, the following burn was found: an area of burning of 6th degree above and behind the left ear, measuring 4½ inches by 3½ inches. The muscles of both arms were very strongly contracted. The breathing was of the Cheyne-Stokes type. He died eight hours after admission, having been unconscious all the time.

It occasionally happens, however, that deaths are caused by electricity without leaving much, if any, evidence on the body externally. The two following cases in our experience illustrate this:—

In December 1906, we made a post-mortem examination of the body of a

young man who had died from having caught a "live" wire. On the hypothenar prominence of the left hand was a mark, one inch long by $\frac{3}{8}$ths of an inch broad, in which the skin had a seared or roasted appearance, and was drawn up into a ridge on either side of a hollow, the base of which showed spiral markings. The skin around this was hard. The muscles of the forearm and arm were tense and contracted. The heart had evidently stopped in diastole; the right chambers were full, but not distended with blood. The large veins contained a good deal of blood.

In December 1905, a young man was at work on the platform from which the high tension switches are controlled which convey a current of 6500 volts, in one of the sub-stations of the Corporation Electricity Department of the City of Glasgow. Evidently under the impression that the current was off, he caught hold of one of the switches, and the electricity passed through his body, killing him instantaneously, his body clinging to the switch. When the current was turned off, his body dropped to the floor. There was no mark found on his body.

In February 1909, an apprentice electrical engineer was engaged fitting up electric wires. While handing some material to a fellow-workman, his arm accidentally came in contact with a live wire, and he received a powerful shock. His mate, at great risk to himself, managed to free his body from the wire, but it sank to the floor apparently lifeless; artificial respiration was at once commenced, but it was unsuccessful in restoring animation. No marks were found on the body on examination.

Since the use of electrical power in coal-pits, for haulage, coal-cutting, etc., has become more general, we have had occasion several times to deal with deaths of workmen from coming in contact with live wires.

The question has arisen whether the lesions of apparent burning seen on the body after electric discharges are identical in every particular with those of burning by fire. The observation in the Liverpool cases that such marks were found on the body where no corresponding marks were found on the superjacent clothing would lead to the opinion that the cause was not, at least, direct contact with an incandescent body. Mally [1] has made a clinical and experimental study of these lesions, and he states that they may be caused when the body, or a part of it, either comes between two conductors or between a single conductor and the earth. The former point is well illustrated by the Southport case, the latter by the Liverpool cases. But he affirms that there are absolute differences between so-called electric burns and ordinary burns, which are mainly as follows:—the former are painless, dry, and aseptic, are usually more or less rounded in shape, and reaction in the surrounding tissues is slow in supervening. He says that these characters are due to such conditions as the following:—very high elevation of temperature, a feeble amount of heat, and a short period of action.

The cause of death from industrial electric currents, whether the currents are alternate or continuous, is cardiac arrest, and this may result from even comparatively low voltages. In a Bradford case in 1889, a man, standing in damp boots on earth into which there was a leakage of electricity, on touching an electric lamp with perspiring hands, was killed by a current of 225 volts only. On the other hand, recovery has followed a shock from 2500 volts. It may, therefore, be taken that the liability to death from electricity depends more upon other conditions than the amount of voltage of the current.

It has been our duty to make inquiry regarding not a few deaths by electricity occurring under very varied conditions industrially, as for example, in tramcar accidents, in cases occurring in pits, and in cases in public works, in which electricity is used for motive and lighting purposes. One important factor in the likelihood of a fatal accident by electricity is the condition of the hands and clothing of the person at the

[1] *Rev. de Chir.*, March 1900.

time. Wet or perspiring hands and wet clothing tend to divert the electric current into the body much more readily than the opposite condition.[1]

The best treatment of those affected by electric shocks is artificial respiration in a warmed atmosphere. It ought to be remembered that the greatest precautions must be taken by rescuers in disengaging the persons of those attacked when within the electric circuit. In the absence of rubber gloves, a thick garment rolled round the hands, or a long, wooden-handled broom, should be employed when disengaging the body of a person in contact with " live " parts, in order to insulate, as far as possible, the body of the rescuer from shock. The need for this is well exemplified in a case which happened in May 1909, on the Paris Circular Railway near St Ouen. A boy chasing insects on the line came into contact with the electric cables carrying 10,000 volts. He was instantly killed. A young man went to the rescue, and as he was trying to lift the body of the boy he fell dead beside it, holding the boy's body in his arms. A second man made a similar attempt to recover both. He received so severe a shock that he died, despite the efforts made to resuscitate him. It was not until the current was cut off that the bodies of the victims were recovered.

Weber of Zurich made several experiments on himself regarding the effects of various voltages on the body. When with moistened hands he grasped a wire carrying 30 volts his arms, wrists, and hands became practically paralysed, and he could not move hand, arm, or finger, the pain in his body being so acute that he could not endure it longer than ten minutes. With a wire carrying 50 volts, he could not endure it longer than two seconds, and even during that period his hands and arms were completely powerless to disengage his grasp. When with dry hands he made the test, like results followed when the current reached 90 volts. His conclusion was that there is danger, even when the hands are in a dry condition, in grasping the conductors of two alternate currents, whenever the difference between the intensity of the two conductors exceeds 100 volts ; and the reason, to his mind, why electrical engineers seem to have an apparent impunity from higher voltages is that they are constantly on their guard from this knowledge and are insulated by dry shoes, whereas workmen are more careless and may be working in damp shoes.

Electrocution.—This is now an established method in America of inflicting the last penalty of the law. In 1888, the Legislature of the State of New York passed a statute, based upon the report of a State Commission, whereby it was enacted that the above method of judicial homicide should be substituted for hanging. The Statute came into operation in the beginning of the following year. The method has received the above somewhat inelegant title.

The following is the manner in which the death-sentence is carried out, and the mechanism employed for the purpose. The apparatus consists of a stout chair with an inclined back, which is securely fastened to the floor or ground with bolts. To the chair are riveted two strong leather bands, which are put in such a position that one can be fastened across the chest, and the other, over the head of the criminal. The chair itself is connected with the electric current

[1] *Cf. B. M. J.*, vol. i., 1902, p. 598 ; *New York Med. Record*, 1899.

by means of two carefully insulated conductors with the pole-switch by which the electric current is conveyed to the body of the victim. These conductors are brought into contact with the body of the criminal at two points—viz. with the crown of the head, by means of a curved copper rod ending in a knob covered by felt, which is kept pressed forward and downwards by means of a spiral spring, and at the nape of the neck, by means of a metal plate covered by felt which is kept in position by a rubber or leather collar which is put round the neck. The felt at the extremities of the conductors, when the apparatus is to be used, is saturated with a solution of zinc sulphate, or ammonium chloride. When execution is to be performed, the condemned man is placed in the chair, the straps are adjusted, and the conductors placed in position, and, after a veil is placed over the face, the current is turned on. Since the institution of this method, however, the position of the second conductor or electrode has been changed from the nape of the neck to the outer side of the right leg, at the junction of the upper and middle third. In order to make certain that death has taken place the current is passed three times through the body, with a short interval between.

Dr Joseph O'Neill[1] gives a description of the execution of a man in Sing-Sing Prison. After the current had been passed through the body once, "there was a blowing sound like the neigh of a horse, saliva came from the now open mouth, and the carotid artery began to pulsate." The discharge was repeated and kept up for 30 seconds, at the end of which time, examination by the phonendoscope revealed neither respiration nor cardiac pulsation. Cremasteric reflex was present, however, half-an-hour after death. Post-mortem lividity appeared very rapidly in the dependent parts. A necropsy was at once made of the body.

In March 1899, a woman was similarly executed in the same prison. The first electric discharge killed her, but it was repeated a second time to make the fact absolutely positive. In such cases, according to Mr Homer Bennett,[2] the only external signs found upon the body are slight blisters of the skin of the leg at the point of contact of one electrode.

If we may judge from the opinions of the medical press of the United States, medical opinion is divided respecting the rapidity, efficiency, and painlessness of this mode of execution. So recently as the end of 1908, Dr Shrady, one of the coroners of the City of New York, expressed his belief that the electric shocks administered in the "death-chair" do not kill, and that death is inflicted by the doctors who make the necropsy of the body. To this Rockwell,[3] from observation of the results of execution by electricity as carried out in Sing-Sing Prison, replies that the method is sure, decent, and painless. As a member of the Advisory Commission appointed by the State of New York, he was present at four executions performed by electricity, in each of which death was instant and quiet, there being neither contortions nor burning of the body. He further states that before execution by electricity was adopted by that State, nineteen animals, including bulls, horses, calves, and dogs, were killed by electricity in presence of the commission. This opinion of Rockwell is also confirmed by Spilka,[4] whose view is founded on 31 cases of execution by electricity in different prisons during six and a half years. He made a post-mortem examination in 25 of these cases, and the appearances found warranted him in declaring that death was undoubtedly instantaneous and painless. It may well be that the convulsive tetanic contortions of the muscles at the time of the discharge are interpreted erroneously as manifestations of consciousness instead of insensible muscular contractions, which they really are; and therefore, opposition to the method is offered. But a more cogent objection has been urged against its use—viz. that the bodily resistance to electric discharges differs not only in different individuals but in the same individual at different times, and, hence, it is impossible to regulate the amount or intensity of discharge required. To this, however, there is the ready rejoinder, that more than enough current under any given set of conditions may be and is employed.

This leads us to the consideration of the question, What force of electric discharge is likely to prove fatal? For the purposes of electrocution, the

[1] *Atlantic Medical Weekly*, Sept. 17, 1898; *B. M. J.*, vol. ii., 1898, Oct. 15.
[2] *American X-Ray Journal*, June, 1900; *B. M. J.*, vol. ii., 1900, p. 177.
[3] *Boston Med. and Surg. Jour.*, 1908. [4] *B. M. J.*, Sept. 19, 1908.

current used is one produced by an alternating dynamo, with an electro-motive force of 1700 to 2000 volts. The current strength is about 7½ ampères, and the number of alternations 16,000 per minute, According to Dr O'Reilly,[1] in a recent case, a current of 8 ampères at 1760 volts was applied for 4 seconds, and then was reduced to 2 ampères at 200 volts, and kept up for 56 seconds.

Of the several cases of death by electricity from accident which have been recorded in Great Britain and on the Continent, the large bulk of them has been due to contact with wires which conveyed the current to an installation for lighting purposes, or to contact with parts of a dynamo at work. In all of these, death was due to that part of the discharge which had been diverted from its usual channels into and through the body of the victim. It has been observed that certain wires carrying strong currents sometimes give off very slight shocks in certain cases, whereas others, with weaker currents, have proved fatal. For example, in the Southport case the voltage of the machine with which the man's body came in contact was 2160 volts, and it did not prove fatal; and in the Liverpool case the current was only of 500 volts, and yet it killed two persons. From the current used in electrocution one would have expected the Southport sufferer to have been killed. The factor which determines the likelihood of a fatal issue would, therefore, appear to depend upon the receptive state of the particular person at the time of receipt of the electric discharge as well as the intensity of the discharge.

The mode of determining the strength of any current is by Ohm's law: *the current is the equivalent of the electro-motive force in difference of potential divided by the resistance.* In electrical language, the practical unit of current is called an ampère, of electro-motive force or potential a volt, and of resistance an ohm. The electro-motive force dangerous to life is from 300 to 350 volts. It remains, therefore, to determine the resistance in ohms which the human body at any given time will offer to the passage of electricity through it. This has already been obtained, approximately, by experiment. The hands, when perfectly dry, offer a resistance of 30,000 ohms; when perspiring ordinarily, of about 10,000 ohms; and when dripping wet, of only 7000 ohms. This last resistance will be more readily appreciated when it is stated that one of the Atlantic Cables offers a resistance of about 8000 ohms. If the resistance of the hands when perspiring ordinarily be taken as 10,000 ohms, and the smallest fatal electro-motive force as 300 volts, then according to Ohm's law: $C=\frac{E}{R}$, or $C=\frac{300}{10,000}$, which is equivalent to a unit divided by 33·333; therefore, when the potential is great enough to discharge a current of 1·33 ampère through the body, fatal results will follow. The difference of potential or electro-motive force differs, however, in the two principal systems of electric lighting—viz. the incandescent and the arc. In the former, the difference in potential rarely exceeds 150 volts between any two points of the circuit outside of the lamps; consequently, neither at any of these points nor at the terminals of the dynamo is a fatal shock likely to follow contact. But it is very different in the latter system. The larger the number of lights in series on the circuit (and they are frequently so placed) the greater must be the electro-motive force required to produce the light, because of the greater sum of resistance offered by the carbons of each lamp. When, therefore, the terminal wires are caught in a circuit which includes eight lamps, the difference of electric potential becomes so great as to send a current through the body which is dangerous to life. It ought, further, to be remembered that the most severe effects of a discharge are perceived at the moments of opening or closing the circuit, or, in a closed circuit at the moment when a current at the vanishing point becomes re-established. It must be obvious, at the same time, that the effects indicated can only happen from naked, or imperfectly insulated, parts of the machine or circuit; such, indeed, are impossible with perfectly insulated parts or wires. The Board of Trade Regulations forbid currents exceeding 250 volts to be introduced into dwelling-houses; hence, where domestic lighting is supplied from the electric mains, transforming apparatus to reduce the difference of potential, or as it is often called the pressure, must be interposed between the house-wires and the main supply.

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[1] *Engineering*, vol. lxix., p. 769.

V. DEATH BY BURNING AND SCALDING

This is by no means an uncommon form of death; and the lesions found upon a body present a variety of appearances. Burns and Scalds may be produced in the following ways :—

1. By a very elevated temperature, the medium being either dry or moist; (*a*) by solid bodies in an incandescent condition; (*b*) by liquids near or at their boiling points; (*c*) by steam.
2. By Corrosives, solid or liquid.
3. By Friction.
4. By Lightning, Electricity, and Rœntgen or X-Rays.

A burn may be defined as a lesion which is caused by the application of heat or of chemical substances to the external or internal surfaces of the body, the effect of which is a more or less marked destruction of tissue. This definition, therefore, includes all lesions whether produced by fire, water, or by the combustion of tissues due to chemical action. A scald may be defined as a lesion which results from the application of a liquid at or near its boiling point, or from the gaseous form of a liquid—as steam. On a body which has been subjected to the influence of fire, the lesions found may be graduated from the simplest erythematous blush, up through the different surgical degrees of burning, to roasting and charring of a greater or lesser portion of the body; whereas, on a body subjected to the application of scalding fluids or steam, the most marked effect is vesication, more or less widespread. But on bodies subjected to the action of corrosives, it will depend upon the kind of corrosive used what the lesions will be; for example, from the corrosive mineral acids and alkalies, vesication, if not entirely unknown, is but rarely found; but where Greek fire—which is composed of phosphorus dissolved in carbon disulphide—has been used, vesication will probably be found, because when the $C S_2$ evaporates the phosphorus becomes oxidised by the oxygen of the air and is set aflame. The law, however, does not differentiate between the causes of lesions, and denominates them all by the general term of burns. As a general rule, all bodies which have been taken from a building which has been burned, or is afire, present some appearances of the effects of fire; but it must not be supposed, therefore, that all of these deaths have been due to the effects of fire. On the other hand, some persons may have died asphyxiated by the smoke; others may have died from shock, or the influence of terror; certain others, again, may have met their death from the results of injuries either from themselves having fallen from a height, or from débris falling upon them. In such cases, therefore, while the external appearances indicate the effects of burning, the internal appearances—where such can be discerned—may point to different proximate causes of death.

In Glasgow, November 1905, fire broke out during the night in a large lodging house for men, and the number of the victims was thirty-nine. Next day we inspected the bodies. The ages varied from 22 upwards. Many of the bodies, indeed most of them, bore evidences of contact with fire. The signs of burning, in several instances, showed that some of the burns were produced before, and

some after, death. In some cases the area of burning was very extensive, and in three instances the bodies had assumed the "pugilistic" attitude. Several of the bodies did not bear any of the external signs of death by asphyxia from smoke and the gases of combustion; indeed, in seven cases only were there marked external signs of death by asphyxia, and in all of these the tongue was protruded to varying distances beyond the line of the teeth, and in each the tongue was blackish in colour, partly from lividity and partly from deposited soot.

The medico-legal points which emerge for discussion are the following:—

1. Are the lesions found likely to have been produced by any of the fore-mentioned causes?
2. Were they produced during life, or after death?
3. Do they alone account for the death?

I. Are the Lesions found due to Burning?—The lesions and appearances found upon a body which are caused by fire may be summed up in the following:—

(*a*) Vesicles, more or less widespread;
(*b*) Roasted patches of skin, or of deeper parts of the body;
(*c*) Singeing or burning of the hair of the body and of the clothing;
(*d*) Deposits of carbonaceous material on the body.

Those caused by Scalding liquids are:—

(*a*) Inflammatory erythema of skin;
(*b*) Vesication.

Those caused by Corrosives:—

(*a*) Inflammatory redness of skin;
(*b*) Ulcerated patches of skin;
(*c*) Vesicles (where Greek fire has been used);
(*d*) Discoloration and staining of skin and clothing.

It is necessary, upon occasion, to establish the cause of the lesions from their character and from other appearances found on the body. The diagnosis, therefore, between burning by fire and by scalding may be established by the presence or absence upon the body of certain lesions. Wherever singeing of the hair or clothing, or of both, deposition on the skin or clothing of carbonaceous material, and charring of tissue are found, fire may be declared to be the cause. And if to these is added vesication, the picture is complete. If vesication is extensively present and the others absent, it may be affirmed with accuracy that a boiling fluid, or steam, has been the cause. At the same time, it must be kept in mind that, in certain cases, vesication may be produced apart from the application of either a boiling liquid or steam, as, for example, where a portion of the body has been allowed to soak in a decomposing animal fluid, such as urine, and in a medium in which the heat consequent upon such fermentative action is prevented from quickly radiating. Even in these cases, however, heat is essentially the prime cause of the vesication. Such vesicles are, most usually, found under the following conditions—viz. (*a*), where a patient is bed-ridden; (*b*), where there is neglect in the removal of discharges involuntarily passed; and (*c*), where the vital resistance of the tissues is lessened by disease. It was our duty upon one occasion, under such conditions as the foregoing, to report to the criminal authorities respecting the merits of a charge of mala-praxis

made by one medical man against another of neglect of a patient, but the facts exonerated from blame the practitioner against whom the charge had been made.

The lesions found on a body where corrosives have been applied are characteristic of the particular corrosive applied. Corrosives differ in their intimate action upon the tissues; Sulphuric Acid, for example, by the rapid abstraction of water from the tissues and the consequent rise of local temperature; Nitric Acid by the formation of new compounds, as Picric Acid; Nitrate of Silver, by hyperoxidation of tissue, and the formation of the albuminate of silver and the liberation of nitric acid; and Greek fire by direct combustion of the tissues from the rapid oxidation and burning of the phosphorus. The diagnosis of lesions by corrosives from those by fire or by a heated fluid or steam, may be established by the following points—viz.

(*a*) The absence of vesication;
(*b*) The presence of colour-stains on skin or clothing;
(*c*) By chemical analysis of the stains.

But marks of burning may be found upon a body and on the clothes which may not be caused by the application of fire as such, as the following case which we investigated will show.

A man employed in a saw-mill disappeared from his usual place during working hours. His prolonged absence caused a search to be instituted, but he could not be found within the works. The workmen employed in the neighbourhood of the shaft in which the driving-belt of the machinery revolved, had their attention attracted later by the odour of burning flesh and clothing, which they found to proceed from this shaft. On the machinery being stopped, the body of the missing man was found lying at the bottom of the shaft, between the wall of the shaft and the driving-belt. On examination of his body, marks of burning were found upon the body and on the clothing. There were other marks of violence on the body which indicated that in falling into the shaft he had met his death by being violently tossed up and down by the driving-belt. From the presence of vesication on the body, it was further evident that the burning was produced while he was still alive. There was no fire in that place, or in the near neighbourhood. The only conclusion which could be arrived at was that the friction of the driving-belt against his clothing and body had generated the heat which first set afire his cotton jacket, and later, produced the burning of the body. It was impossible to say whether or not the man was conscious when he fell into the shaft.

II. Were the Lesions produced Before, or After, Death?—This is a question to answer which demands careful and deliberate consideration, and the answer entirely depends upon the presence or absence of evidences of *vital reaction* in the lesions found. The presence of vesication, the character of the fluid, if any, which is contained in the vesicles, and the inflammatory changes in and around the vesicles, must determine the answer. If a vesicle present the following characteristics it may be safely concluded that vital reaction had occurred—viz.

(*a*) If it contain a fluid which is serous, and is proved to be such by the presence of albumen and chlorides;
(*b*) If there exist an inflammatory areola on the circumference of the vesicle;
(*c*) If the base or floor of the vesicle be inflamed, and the papillæ of the skin swollen and reddened;

(*d*) In the event of the vesicle being burst, if pus be present.

If this last fact be found it would indicate that the person had lived for at least 36 hours after the burning. On the other hand, it may with accuracy be affirmed that the vesicle was of post-mortem origin, if the following characteristics are present—viz.

(*a*) If the vesicle be limited in size, and its contents scanty;

(*b*) If it contain air, or a small quantity of non-albuminous fluid with no chlorides;

(*c*) If there be entire absence of inflammatory reaction.

But many times, the question has arisen, Is vesication possible, or likely to be found after death of the person? The experiments of Christison[1] on this point are of considerable value. One of these was as follows:—To the body of a young man, comatose from opium, he applied a red-hot iron; half-an-hour after his death, he reapplied the same hot iron in three different places. *Vesication resulted from all the trials; but it was only at the points of test made during life that a true vesicle containing albuminous fluid was found, those made after death containing only air.* Taylor records a case in which on the body of a man who had just been drowned and who had been put into too hot a bath, vesications containing *bloody serum* were formed. Certain other observers as Champouillon, Leuret, Wright of Birmingham, and Chambert,[2] are of opinion that vesication may be produced within some hours after death. Casper,[3] also experimenting in the same direction, was forced to the conclusion that vesicles are not ordinarily produced after death, but if and when they are produced, they never contain serum, but only watery vapour. Devergie asserts that they cannot be produced even ten minutes after death. The keynote to the answer, however, is to be found in the existence or non-existence of molecular life in the tissues which remains for variably short periods after somatic death, and in the presence or absence of blood-circulation.

To sum up on this point: *It may safely be laid down that a vesicle which contains marked evidence of vital reaction, in the ways formerly indicated, has been produced during life; that a vesicle, limited in area and in contents, may be produced in certain cases during the existence of molecular life in the tissues; and that a vesicle which contains air or watery vapour, and which has no inflammatory signs of reaction, may be deemed of post-mortem origin.*

III. Do the Lesions found upon a Body sufficiently account for the Death?—This question must be looked at from two different points of view; first, in relation to the burning as a means of cloaking the commission of some other form of crime, and second, in the absence of other causes, with respect to the area and extent of the burning and its pathological consequences. The former aspect will be dealt with later. In considering the latter, attention must be paid to the following points, which, moreover, can only be stated as general propositions, although they may have especial significance in particular cases:—

1. *The age and general health of the person burned—judged from the appearances of the body itself.*

[1] *Edinburgh Medical Journal*, April 1831.

[2] *Ann. d'Hyg.*, 1859, vol. i., p. 342. [3] Vol. i., p. 301, *op. cit.*

As a general proposition, it may be affirmed that children succumb quickly to the primary effects of burning or scalding from *shock*, and to the secondary effects from inflammation of serous membranes, such as pleurisy, peritonitis, and meningitis, from perforating ulcer of the duodenum, and from absorption of septic matter. As we ascend the scale of age the more significant factor is :

2. *The area or superficies of the body which is affected.*

It may be said as a general truth, that the danger to adult life from burning or scalding is in direct proportion to the extent of body-surface involved, rather than to the severity of the burn itself, if concentrated or limited in area. Dr Smart of Haslar Hospital [1] accurately measured, in a series of cases of scalding, the superficies of integumentary surface involved, and, after eliminating other factors in the cases, came to the conclusion that when 350 square inches of body-surface were involved, life was placed in the greatest jeopardy; and although in individual cases recovery may result where a larger area was involved, that more usually, death was the inevitable sequel. Burns or scalds, therefore, although but comparatively superficial, which involve one-third, or one-half of the surface of the body must be reckoned as necessarily fatal. Many years ago, in connection with a disastrous boiler explosion which took place in the Glasgow Iron Works from which several deaths by scalding resulted, we were able to verify the above statement, as in every case in which one-third of the body-surface was involved death ensued.

IV. Is there Evidence of Lesions on the Body, other than those due to Burning, which might alone account for the Death?—This question will obviously arise where it is suspected that the agency of fire has been invoked to hide crime of another sort, and it will entirely depend upon the condition in which the body is left after exposure to the fire, whether an answer can be given. In any case, however, where human remains, so treated, are found in a private place where they had no right to be, *a priori* suspicion is at once established. This has happened in certain notorious cases, among others that in which Dr Parkman met his death (*vide ante*).

In a trial in Paris in 1885, a man was tried for the murder of a woman by poison. He had tried to dispose of her remains by burning. Certain facts pointed definitely to this, such as the odour of burning flesh from the house of the prisoner, which went on for days and nights, the emanation of thick black smoke which issued from the chimney of his stove—all of which happened during hot July weather—and the production at the trial of three phials, the first of which contained soot from the flue of the stove of the prisoner, the second, soot from a flue in which a carcase had been burned for comparison, and the third, arsenic, which was extracted from the body of the prisoner's first wife. The prisoner was found guilty. Many other cases might be quoted, but the above are sufficiently illustrative of that category of cases in which but scanty remains of the body are left. Fodéré narrates a case in which a murderer killed several victims with an axe, and afterwards set the house on fire. The medical man who first examined the bodies certified that the cause of death was burning. But in the meantime, another victim was found about 100 paces from the house, on whose body were marks of violence, and owing to the suspicion of foul play to which this fact gave rise, the other bodies were exhumed and re-examined,

[1] *B. M. J.*, vol. ii., September 23, 1876.

whereupon it was found that the marks of burning were only superficial—not sufficiently deep, indeed, to obscure the marks of wounds from an axe.

Burning may, likewise, be caused by Corrosives. They are commonly employed to maim, not to destroy life. Vitriol-throwing used to be almost solely confined to the Continent of Europe, although occasionally met with in this country. Now, however, it appears to be more common. The acid is thrown upon the face, with the object of destroying the eyesight or spoiling the features. In Scotland, this is a crime both at common law and by statute.

The Act which deals with it is 10 Geo. IV. c. 38, sect. iii. "And be it enacted, That if any Person in Scotland shall, from and after the passing of this Act, wilfully, maliciously, and unlawfully throw at or otherwise apply to any of his Majesty's subject or subjects any Sulphuric Acid, or other corrosive substance calculated by external Application to burn or injure the Human Frame, with Intent in so doing, or by means thereof, to murder or maim or disfigure, or disable such his Majesty's Subject or Subjects, or with Intent to do some other grievous bodily Harm . . . being thereof lawfully found guilty, Actor, or Art and Part, shall be found guilty of a Capital Crime, and shall receive Sentence of Death accordingly." Section iv. enacts that if it shall appear at the trial that under the circumstances of the case, if death has ensued, the act or acts done would not have amounted to the crime of murder, such person shall not be held guilty of a capital crime or be subject to the aforesaid punishment; and section v. gives the Public Prosecutor power to restrict the pains of law in any case.

Vide Macdonald's "Criminal Law," pp. 145, 158.
Hume's "Commentaries," vol. i., p. 328, *note* 6.

Cases—James Wood, 1836, 14 years' transportation; 1. Swinton, 283.
Ann Dewar or Beaton, 1842,[1] 6 months' imprisonment; 1. Brown, 313.
Fitchie, 1856, 4 years' penal servitude; 2. Irvine, 485.
Fitzherbert, 1858, 15 months' imprisonment; 3. Irvine, 63.
Robertson, May 12, 1899, 5 years' penal servitude; High Court of Justiciary.

The law of England on this subject is embraced in the 24 & 25 Vict. c. 100, sect. 29:

"Whosoever shall unlawfully and maliciously cause any Gunpowder or other explosive substance to explode, or send or deliver to or cause to be taken or received by any Person any explosive Substance or any other dangerous, or noxious Thing or put or lay at any Place or cast or throw at or upon or otherwise apply to any Person, any corrosive Fluid or any destructive or explosive Substance, with intent in any of the Cases aforesaid to burn, maim, disfigure, or disable any Person, or to do some grievous bodily Harm to any Person, shall, whether any bodily Injury be effected or not, be guilty of Felony, and being convicted thereof shall be liable, at the discretion of the Court, to be kept in Penal Servitude for life or for any term not less than Three years—or to be imprisoned for any Term not exceeding Two years, with or without Hard Labour, and with or without Solitary Confinement, and if a male under the age of sixteen years, with or without whipping."

As has already been pointed out, the diagnosis in such cases will depend on the following points—viz. (1) The character of the lesions; (2) marks of staining, due to chemical action; (3) the absence of signs produced by fire or scalding liquids; (4) discovery by analysis of the corrosive used. The lesions are uniform in their general character—that is to say, they do not present the same multiformity of

[1] Lord Moncrieff's charge to the jury in this case contains a valuable statement of the law applicable to the statutory charge.

appearance as those by fire, or the singularity of vesication as by fluids or steam. The colour of the stains upon skin or clothing may afford a guide to the nature of the corrosive : thus, nitric acid causes a yellow stain due to formation of picric acid, sulphuric acid and caustic alkalies leave reddish-brown or dirty-brown marks, hydrochloric acid and carbolic acid, whitish or greyish-yellow stains on skin and mucous membrane ; but in some cases the colour of the stain upon the clothing may be varied by the original colour of the fabric. Sulphuric acid is probably the acid most commonly employed, but occasionally others are used.

The following case is illustrative of serious injury produced by the use of nitric acid. A young woman named Gordon was charged at the Circuit Court, Glasgow, in February 1905, with having assaulted another woman by throwing " at and upon her a quantity of nitric or other acid with intent to do her grievous bodily harm, and in consequence the said A. D. was burned and grievously injured in her body and has lost the sight of both her eyes," contrary to the Act of Geo. IV. c. 38, sect. 3. It appeared in evidence that the accused was the wife of a man who had deserted her and who at the time accused committed the act was cohabiting with the assaulted woman. From the medical report in the Infirmary journal, the area of corrosion was found to be a very wide one ; the neck and chest were one mass of yellow skin, which for the most part showed only superficial corrosion, but which at places showed evidence of necrosis.

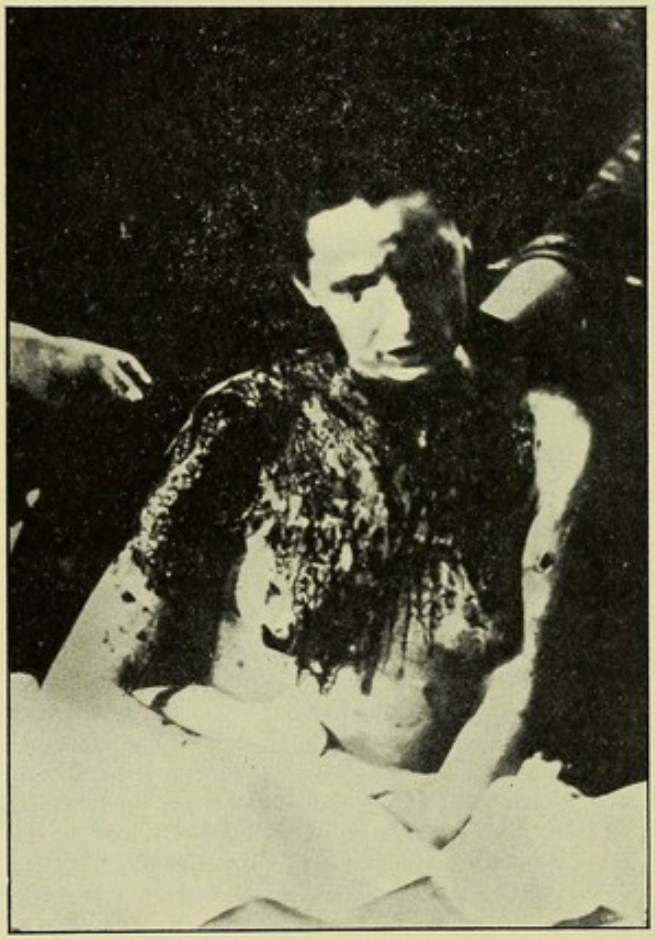

Fig. 43.—Effects of Nitric Acid Throwing. Severe burning of upper part of body, and loss of sight of both eyes. (Author.)

On the face were discrete yellow spots, some of which were on the eyelids, and on examining the eyes, the corneæ were found to be opaque and the conjunctivæ to be swollen. The acid had run down both arms and front of chest on to the upper half of abdomen, reaching to within three inches of the umbilicus. The assault took place on November 14, 1904. By November 26, the burns on the body were sloughing, and deep sloughs were separating chiefly from the left side of chest and shoulder. Patient's temperature kept high, between 102° and 104° F., due probably to septic absorption from the necrosed areas. By December 1, all the sloughs had separated, and temperature was normal. The eyes went from bad to worse ; first, the sight of the left eye was destroyed, then necrosis of the lower half of the upper eyelid of the right eye took place, accompanied the while by gradual destruction of the eyeball. By the beginning of March, the report bears that the body burns were healing slowly, and that the remains of both eyeballs were sunken in their sockets. The accused was found guilty, and was sentenced to five years' penal servitude. (Fig. 43.)

The following may be taken as typical illustrations of the effects of corrosive fluids upon the faces and bodies of those upon whom they have been cast :—

1. In February 1907, a young woman was tried at the Circuit Court, Glasgow, for having thrown sulphuric acid over the face and body of her sweetheart. She pled guilty to assault by vitriol-throwing under common law, and in view of the slight injuries which her act had produced, and other circumstances peculiar to the case, was sentenced to imprisonment for two months.

2. In Leicester, in the same month and year, a young woman lost the sight of one eye from the effects of vitriol thrown at her by a man, who desired to revenge himself upon another woman for whom he had mistaken his victim.

3. In London, April 1907, at the Old Bailey, a Frenchwoman was charged with having thrown vitriol at her paramour with the result that the sight of his left eye was destroyed, and his face permanently injured.

4. We were asked by the Crown Authorities to examine certain stains upon various articles of clothing due to a substance which had been thrown upon the wearer by another woman, the assaulted woman having been sent to hospital because of the effect of the substance upon her eyes. The examination showed that the stains were of a slight yellow colour, that the substance was not corrosive, and that the fluid evidently consisted of a mixture of powdered mustard in paraffin oil. There was no prosecution of the offender, because on medical examination after apprehension she was found to be of unsound mind and was sent to an asylum.

Very severe burning may result from corrosive fluids due to accident.

Two men were working a siphon on a wooden platform over a tank of sulphuric acid in a chemical work near Stevenston, Ayrshire (1907). The platform gave way and both men were precipitated into the tank. One managed to scramble out, but the other failed to get out. Assistance having quickly arrived, his rescuers catching hold of his jersey tried to pull him out, but the garment gave way. When he was rescued, however, he was found to be terribly burned. He died two days later. The man who scrambled out of the tank was much burned on thighs and legs, but he recovered.

V. Are the Lesions of Burning found of Accidental, Suicidal, or Homicidal Origin ?—In most cases, the solution of this question will rest upon other than medical evidence. It may be safely asserted that by far the largest proportion of cases of deaths by burning and scalding occurs by Accident ; that they are rarely suicidal ; but that deaths by Homicide are by no means uncommon. Accident accounts for a great variety of cases ; as, for example, old, helpless, or intoxicated persons falling into the fire, children falling into vessels of scalding water, adults falling into scalding vats of materials in the course of manufacture, or into molten metal, children pulling over upon their persons vessels containing boiling liquids, or attempting to drink boiling fluids, or playing with lighted material and setting their clothing, or bed-clothing, or even their homes, on fire ; so also from fires in buildings, from scalding in boiler explosions, or in baths,[1] from explosions of fire-damp in coal-pits, explosions of coal-gas, from gunpowder, or from paraffin-oil lamp accidents.

The Children Act, 1908, Part ii., s. 15, enacts on this matter as follows :—" If any person over the age of sixteen years who has the custody, charge, or care of any child under the age of seven years, allows that child to be in any room containing an open fire-grate not sufficiently protected to guard against the risk of the child being burnt

[1] *Lancet*, vol. i., 1889, p. 141.

or scalded, without taking reasonable precautions against that risk, and by reason thereof the child is killed, or suffers serious injury, he shall, on summary conviction, be liable to a fine not exceeding ten pounds; provided that this section shall not, nor shall any proceedings taken thereunder, affect any liability of any such person to be proceeded against by indictment for any indictable offence."

Homicidal burning or scalding is much less common than from accident, but from time to time deaths are caused by the wilful application of fire. It has been accomplished by throwing boiling water, by throwing a lighted paraffin lamp which has set on fire the clothing, or by a violent attack with a red-hot implement on a vulnerable part of the body; and by other methods.

The following are illustrative cases :—

1. At the High Court of Justiciary in March 1886, an elderly woman was charged with having assaulted and caused the death of two children of the ages of four and three years respectively, by putting them on a fire of live coals. The medical evidence from the post-mortem examination showed that the children had died from shock and exhaustion consequent upon extensive burns. She was found guilty of culpable homicide.

2. At the same court, in 1894, a man named Paterson was charged with having assaulted a woman named M'Guire, and with his fists and a red-hot poker beat her and violently assaulted and murdered her. On the body four kinds of lesions were found—viz. burns, wounds, bruises, and fractures. There were fifty different burns on the body of different sizes, all of which were superficial except two, one of which was deadly. The fatal burning was due to the penetration, *per vaginam*, of the peritoneal cavity by the heated poker. The medical witnesses were of opinion that the cause of death was peritonitis, caused in the manner already stated. The prisoner was found guilty, and was sentenced to death.

3. Some years before this, a man was charged with having caused the death of a boy by pushing a red-hot poker up into the anus. This was done by a tailor, who, working in an underground workshop, the window of which looked out on the pavement,—the front space in front of the window being covered by an open grating,—pushed the poker up through between the bars of the grating with the object of frightening some boys who were constantly annoying him at his work.

4. The following case was one in which we made a post-mortem examination of the body of a woman who died from burning, the result of a man having thrown a paraffin-oil lamp at her. The body presented very extensive marks of burning. The whole of the face, neck, back part of the scalp, the front of the chest as far down as the nipples, the back of the right shoulder, the whole of the right arm, forearm, and hand, all bore evidence of burning—involving, to some extent, the true skin. On the right side of the chest were some vesicles. Death was caused by meningitis and pleurisy, consequent upon the burning.

5. In another case a mother was taken into custody on the charge of having, while she was in an intoxicated condition, put her infant of four months into a scalding bath. The body of the infant showed induration and inflammation of the skin of both lower limbs. On the left leg, extending from the knee to the little toe, was a band of burning from which the epidermis was denuded, and on the right cheek was an oval-shaped vesicle of half-an inch in diameter. The cause of death was evidently shock and congestion of brain and lungs.

6. At the Circuit Court, Glasgow, December 1902, Margaret Duffy was indicted with having set on fire the house occupied by William Clayton and his wife, and of having caused the death of the said William Clayton, and thus murdered him. At the post-mortem examination of the body of the deceased man, we found that the whole body bore the marks of burning by fire. The body generally had assumed the characteristic pugilistic attitude found in bodies which have been exposed to considerable heat. From the mouth and nostrils proceeded a copious blood-tinged frothy mucus, and the tongue protruded beyond the line of the lips. The hair of head, face, and body had been

either completely burned or been more or less severely singed. The night garments which the deceased wore were reduced to a cinder on the left side, but were less affected by the burning on the right side. Generally speaking, the marks of burning on the body itself were most severe on the left side. On the right side, several vesicles, differing in size from a threepenny piece to that of a large medal, were found. These contained a reddish-tinged albuminous fluid. The left arm was largely destroyed, the parts in the neighbourhood of the elbow especially being carbonised. The left leg and thigh were reduced to a charred condition, and on attempt being made to straighten the knee and ankle joints the tissues broke through like charred wood. The vessels of the meninges of the brain, and of the brain itself were engorged with blood. The lungs and right heart were also engorged. Our report was that death was due to suffocation, the result of asphyxiating gases generated in the process of burning, and to burning, that the deceased was alive at the time of exposure to the burning, but that the very severe effects of burning found were probably produced after death.

The evidence at the trial was that the prisoner had been heard to threaten

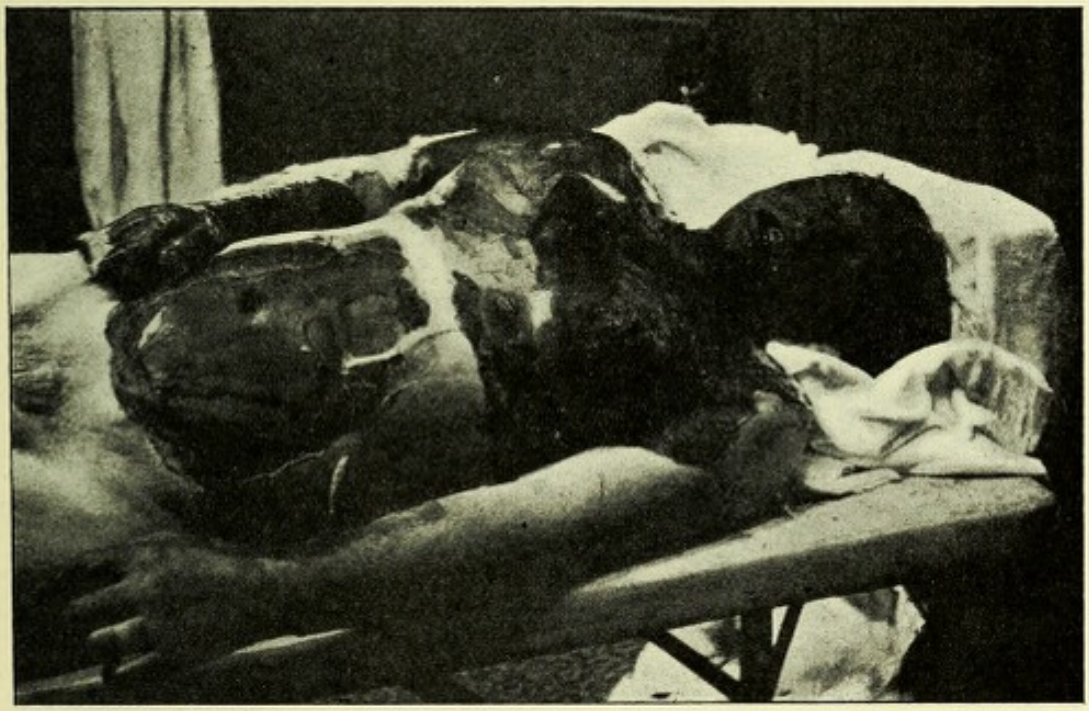

FIG. 44.—Effects of Burning from a lighted paraffin-oil lamp having been thrown, which set on fire the clothing of this woman. She lived for 48 hours after. (Author.)

that she would set the deceased on fire, that around the doorway of the one-apartment dwelling in which deceased and his wife lived, paraffin oil had been freely poured and had been lighted, and that this must have been done after the deceased and his wife had retired to bed. The evidence of the wife of the deceased, who escaped in her nightdress although badly burned, was that she was awakened by a feeling of suffocation, that she saw smoke in the apartment, and that the doorway and the bed which stood near it, and in which she and her husband were then lying, were on fire ; that she tried to awaken her husband and, thinking he was following her, that she managed to open the burning door and thus escaped. There was no eye-witness that the accused had placed the paraffin oil at the deceased's doorway, and had lighted it. The jury returned a verdict of " not proven."

7. In November 1906, we examined the body of a woman, whose husband was alleged to have assaulted her by throwing at her a lighted paraffin-oil lamp. The body was that of an obese woman. It bore extensive marks of burning on the face, neck, front of chest, and, to a more limited extent, on front of abdomen. The face was blackened and charred. The hair over brow was singed and burnt. The burning covered the front and sides of the neck, but

did not extend backwards to nape of neck. The entire front of chest, extending downwards over both mammæ to pit of stomach, and laterally over clavicles to shoulders, was one large area of burning. Over the abdomen was another area of burning which measured 9 in. × 8 in., and in front of left groin, another which measured 6 in. × 2½ in. The front of left shoulder, the armpit, and the inside of arm down to the thumb and inner side of hand, and the same extent of surface of right arm, were severely burned. The back of body was free from marks of burns. All the burns involved the true skin. Internally, the brain vessels were found engorged and the brain substance œdematous and congested. Notwithstanding the extensive area and severity of the burns, the woman survived for 48 hours after receiving them. (Fig. 44.)

8. In March 1907, we made a post-mortem examination of the body of a woman, which generally bore the marks of burning by fire. In particular, the front and top of head, the whole of the face and neck, the front and upper part of chest down to upper level of breasts, the arms and axillæ, forearms and hands, the whole of the lower portion of trunk of body and hips, back and front, and the lower limbs, except the feet and limited parts above each ankle, were more or less burned. The only portion of the body which might be said to have escaped was the trunk of body from upper level of mammæ to upper level of hips, back and front, but even here isolated areas of vesication were found. This was due to the protective effect of the corsets which the woman was wear-

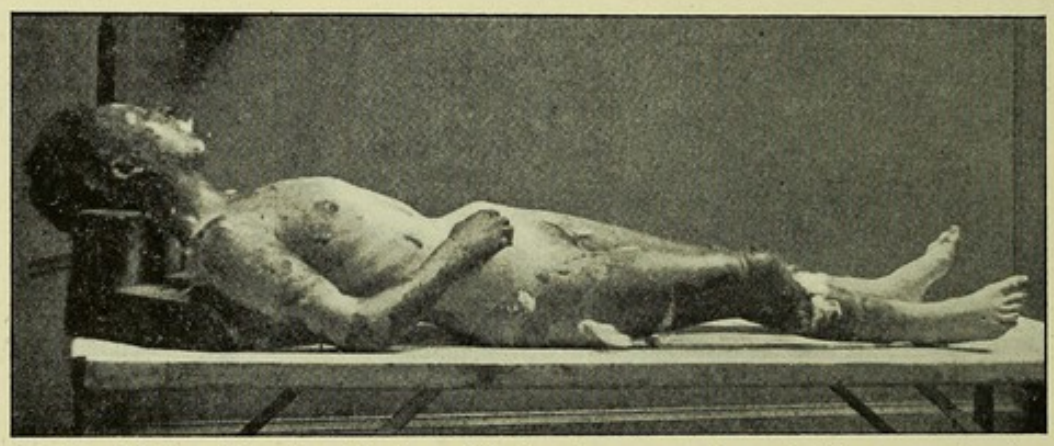

FIG. 45.—Effects of Burning of body and limbs of a woman whose clothing was set on fire deliberately by her husband. (Author.)

ing at the time she was set on fire. The hair of body, of front part of head, the eyebrows and eyelashes was singed and burned. In the above areas of burning, the skin was raised in large vesicles or the epidermis in large patches was amissing, leaving the *cutis vera* exposed and reddened, or, in more limited parts, there was burning of the entire skin. Fully one-half of the entire skin superficies of the body was involved.

Internal examination showed œdema and swelling of scalp on the top, sides, and back of the head, engorgement of vessels of meninges of brain, with commencing meningitis. Death was due to shock. The assailant, the woman's husband, was tried on a charge of murder at the May sitting of the Circuit Court. It was stated in evidence by an adopted daughter, an eye-witness of the crime, that about six months before, the accused threatened to set his wife on fire. On the occasion in question, while partially intoxicated, accused snatched a newspaper, which was doing duty as a table-cover, from the table, lighted it at the fire, saying he would set her on fire, and applied the lighted paper to the deceased's skirts. The clothing being mainly cotton at once took fire and burned quickly. After the burning was extinguished, deceased was conveyed to a hospital in Glasgow, where she died soon after admission. The accused was found guilty of culpable homicide, and he was sentenced to 15 years' penal servitude. (Fig. 45.)

9. In the High Court of Justiciary at Edinburgh, in April 1908, a young woman was brought up for sentence on a charge that, having on March 14,

given birth to a male child, she did place it in the fire, in the kitchen range and killed it. She was sentenced to 15 months' imprisonment. (*Vide* also p. 241.)

To these cases must be added those in which the assailant proceeds to saturate the clothing of his victim with an inflammable oil and then deliberately to set fire to the clothing. Homicidal burning may even be one of the forms of punishment assumed by lynch law.

In March 1901, a negro in Navarro County, State of Texas, was apprehended upon a charge of a brutal criminal assault upon a white woman, of which, it was alleged, he confessed his guilt. Without any active resistance on the part of the authorities, he was taken out of gaol by an infuriated mob, tied to a stake in the yard of the Court-house, his clothes were saturated with kerosene, and in presence of an immense crowd of men, women, and children, he was deliberately set on fire and burned to death. An inquest was held on the body by the coroner, whose official verdict was as follows:—"That the deceased came to his just death at the hands of the incensed and outraged feelings (*sic*) of the best people in the United States, the citizens of Navarro and adjoining counties. The evidence, as well as confession of guilt by deceased, shows that this punishment is merited and is commendable. Given under my hand and seal at Corsicanna, Texas, this the 13th day of March, 1901."

Of the very many cases of burning and scalding which we have had to examine, in those which were fatal death was produced in some in an unusual manner. In one case, for example, a man fell into a cauldron of boiling maize in a distillery, and on the body being recovered, it was in the condition of "heat-stiffening," and it had assumed the pugilistic attitude occasionally seen in such cases. (Fig. 46.) The arms were extended from the shoulders, and the forearms, partially flexed. The legs also were partly flexed at the knees. From an analysis of our cases, including those narrated, we find that one was caused by gunpowder, two by molten metal, one by boiling porridge, two by heated metal, one by red-hot poker, six by scalding fluid, one by falling into a tub of scalding water, two by setting bedclothes on fire, three by fire in different ways, fifteen by steam, two by lying upon heated "blaise" heaps (post-mortem burns); one where, in addition to marks of scalding, the body was severely smashed in a railway accident, and two from lamp accidents. A very interesting case was as follows:—By reason of smoke issuing from the doorway of a house, accompanied by smell of burning, the door was broken open by a policeman and the neighbours. On entering the kitchen whence the smoke was issuing, they discovered the body of a woman seated on a chair by an ordinary deal table, all—clothing, table, and chair—being ablaze. They extinguished the fire. Everything was left till we made

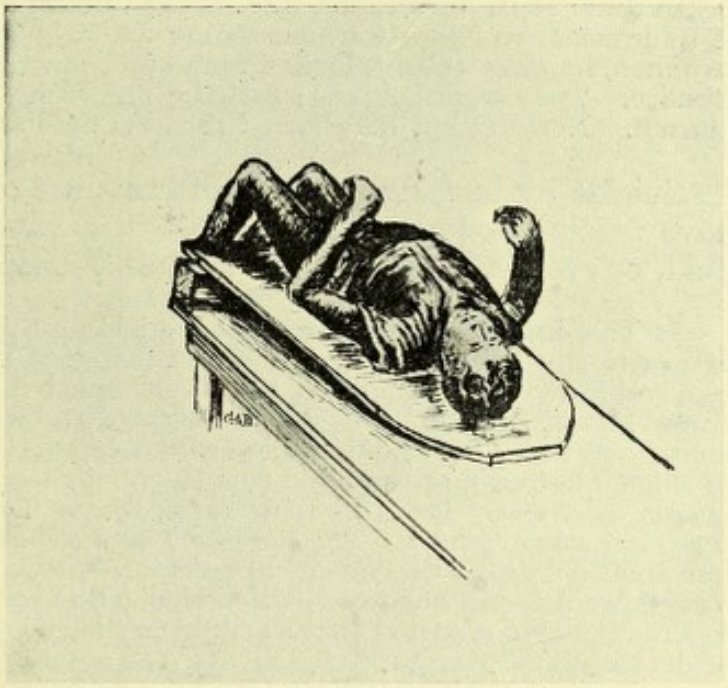

FIG. 46 represents the "pugilistic" attitude sometimes assumed in bodies where death is caused by Burning or Scalding. The above is a drawing of a photograph of the body of a man who fell into a vat of boiling maize liquor in a distillery. (Author.)

our examination; and the following was what was seen:—the dead body was in a sitting posture in an arm-chair which stood close beside a table. On the table was lying an overturned paraffin lamp with the reservoir empty, the wick end being toward the body: its funnel was found, unbroken, under a chair five feet away, whence it had evidently rolled. The clothing of the deceased was burned to a cinder; the face, breasts, chest, arms, hands, abdomen, and thighs were much burned generally, and in parts were literally roasted; vesicles, containing serum, were found on the forehead, arms, chest, and abdomen. The hair on the front of the head was burned and singed. The tongue protruded from between the teeth, and there was a bloody froth discharge from the nose. Abundant deposits of carbonaceous matter were found, especially on face and chest. There were no wounds or other marks of violence upon the body. From these appearances, it was evident (1) that the woman had died of acute suffocation from the dense fumes and smoke of the burning oil; (2) that the lamp had fallen, or had been overturned by her, and that the ignited stream of oil running into her lap had set her clothes afire, giving rise to the above appearances. The case was made further clear by the statement of her husband, who was not in the house at the time of the occurrence, that he had gone out leaving her asleep on the chair in which the body was found, under the influence of alcohol. In another case, a woman under the influence of liquor, proceeded to fill her oil lamp and to light it, conducting the whole operation on her lap when sitting. In filling the reservoir she spilt some oil on her clothing, and when trying to light the wick with a piece of lighted paper, she set fire to her clothing, from which she was burned severely all over the body. She died from shock within a few hours after the occurrence.

In June 1901, a workman was engaged filling coals into the charging hole of a furnace, two fellow-workmen being similarly engaged close at hand. The two men, hearing a shout, looked round and saw the other man in the burning furnace. They were helpless; and the unfortunate man was unable to help himself. Nothing but his charred remains were afterwards found.

Suicide by burning is rare, but cases are on record of persons who have precipitated themselves into baths, vats or cauldrons of boiling fluid, or even into the molten metal of a furnace, and in other ways.

1. This insane patient committed suicide by plunging herself into a bath of practically boiling water. She had managed to obtain possession of the removable key for turning on the water, filled the bath, and, fully clothed, threw herself into it. The worst effects of the scalding were seen on neck, chest, and back, front and sides of abdomen, entire buttocks and upper part of thighs, left arm, armpit, and shoulder, both forearms and hands, both legs, ankles, and feet. Over all these areas the epidermis was removed and the true skin was inflamed. The combined area of body surface involved was not less than one-third the entire superficies of the body. Internally, the brain vessels were found engorged with blood. She succumbed to shock within a few hours. We reported that shock from the effects of scalding was the cause of death.

2. In May 1907, at Belfast, a young woman, 19 years of age, committed suicide by putting paraffin oil on her hair and clothes and setting it alight. At the coroner's inquest, it was shown in evidence that she had confessed that the burning was caused by herself. Her body and face were terribly burned.

In determining whether any given case of burning is accidental, suicidal, or homicidal, more information is likely to be obtained, as has been said, from the moral than from the medical evidence.

The two following cases illustrate varying degrees of culpability:—

1. On March 16, 1906, at Blarney Petty Sessions, an asylum attendant was charged with having feloniously killed an inmate of the asylum by placing

him in a bath of scalding water, so that he died from the effects. The patient died five days after the incident. The magistrates, on the evidence, were of opinion that there was not such neglect as would require them to send accused to the Assizes for trial.[1]

2. At Edmonton, Alberta, Canada, a man was tried in 1905 for the murder of another man, the remains of the victim having been subjected to the influence of fire. Some Indians saw two men enter a hut, and, after some time, only one emerge and go away. Impelled by curiosity, they inspected the hut and found the remains of a fire, but no trace of the man. More exact search by the police discovered some portions of clothing and some charred bones and flesh. Four of the pieces of bone found were, on examination by Professor Primrose of Toronto, shown to be the posterior part of the right parietal bone, the jugular process of the occipital bone, and the others the head and glenoid cavity of the scapula, respectively. Of the charred portions of flesh, the tissues of lung, stomach, aorta, cardiac muscle, and striated muscular fibre were recognised. Stains on the clothing gave the spectrum of reduced hæmoglobin, showed corpuscles, and yielded hæmin crystals. The accused was tried and found guilty after trial and sentenced to death. Owing to a technical default in the evidence a new trial was granted, with, however, the same result.[2]

Post-Mortem Appearances.—While the external appearances on the body have been more or less fully described, something remains to be said respecting the internal appearances. Since death is likely to happen after burning from different causes—viz. Shock, Asphyxia, Inflammation of the serous membranes, and, occasionally, from Perforating Ulcer of the duodenum, it is important in every case where the body bears externally the marks of burning to examine most carefully for signs of these. Again, it is possible that certain of such cases may die from carbon-monoxide gas which is present in smoke; in which case, the blood ought to be examined for the spectrum of carboxyhæmoglobin.

Hæmatology of Burns.—Cummin,[3] who was professor of Midwifery in the University of Glasgow between 1834 and 1840, was the first to point out, as early as 1823, the relation of congestion of internal organs and effusions in serous cavities to fatal cases of burning, and in 1865 Schultze drew attention to the changes in the blood corpuscles produced by heat. Bardeen[4] has summarised the chief blood changes in cases of burning as follows:—(*a*) slight increase of specific gravity; (*b*) the erythrocytes are morphologically injured by a temperature of 52° C (125·6 F.), breaking up into fragments which lose their hæmoglobin; (*c*) there is leucocytosis, chiefly polymorphonuclear; (*d*) toxins are found in the blood plasma. Locke[5] showed, in ten cases of severe burning treated in the Massachusetts General Hospital, that in each case the erythrocytes immediately increased in number; in non-fatal cases in a few hours to from one million to two millions per cubic millimetre, and in fatal cases, to from two millions to four millions; that there was a rapidly increasing leucocytosis, amounting in non-fatal cases to 30,000 or 40,000 per cubic millimetre, and in fatal cases usually to more than 50,000; that there were slight morphological changes in

[1] *B. M. J.*, vol. i., 1906, p. 707.
[2] *Ibid.*, vol. ii., 1905, p. 974.
[3] Cummin. *Edin. Med. and Surg. Jour.*, vol. xix., 1823, pp. 337-344.
[4] Bardeen, Johns Hopkins Hospital Reports, 1898-1899, vii.
[5] Locke, *Boston Med. and Surg. Journal*, October 30, 1902; *Lancet*, vol. ii., 1902, p. 1478.

the erythrocytes; that there was an increase in percentage of neutrophiles, but not so high as in inflammatory leucocytosis; that there was considerable destruction of leucocytes, especially in severe burns, the presence of myelocytes in small numbers in severe burns; and a marked increase in number of blood-plates.

Spontaneous or Preternatural Combustibility.—Among the earlier writings on medical jurisprudence cases are found recorded in which, it is alleged, the bodies of persons have spontaneously taken fire. Present-day opinion, however, is entirely opposed to the possibility of spontaneous combustion, for the simple reason that the human body, compatible with life, consists of about 75 per cent. of its weight of water. If, moreover, the accounts of most of the recorded cases are critically perused, it is not usually difficult to divine or discover conditions which lead to the conclusion that the cause of the combustion lay outside the body. Further, we may steep a carcase for months, or even years, in methylated spirit and at the end of the time set it on fire, but it will never be consumed in the efficient and rapid manner alleged to be the case of bodies spontaneously consumed. We are, therefore, forced to the conclusion that, up till the present time, no single undoubted case of so-called spontaneous combustion during life has been seen; and we are further warranted from the facts in saying that everything contraindicates its possible occurrence.

But while so much may be said of the living body, what can be said of the dead? Certain curious facts have, indeed, been further observed in the living. Beatson [1] states a case in which a man, subject to foul gastric eructations, one night got out of bed, struck a match to see the time, and in the act of blowing out the light, his breath took fire and made an explosive noise sufficiently loud to awake his wife. Martin [2] records another case of an elderly man who was the subject of severe atonic dyspepsia, the chief feature of which was frequent eructations of foul gas. One morning, after a light breakfast, just as he was lighting his pipe with a match, he was obliged to eructate; instantly there followed a blinding flash and a slight report, due to the ignition of the eructated gases. The hair of his beard and eyebrows was thoroughly singed. But such cases, unquestionably, are rare. It is well established, however, that during and consequent upon the action of certain micro-organisms upon composite organic substances, inflammable gases are generated; for example, that is so well known as a result of the bacterial treatment of sewage, that, at certain installations of the system, these gases are utilised for lighting purposes, as far as the quantity produced will permit. Such results have likewise been recorded of the dead human body by Gull,[3] Reynolds,[4] and others. In the statement of the facts by the first-named observer, it is affirmed that when punctures were made into the hyperdistended abdomen, inflammable gases escaped, which burned spontaneously on contact with the air with a flame like that of carburetted hydrogen. In Reynolds' case, certain extensive and deep marks of burning were

[1] *B. M. J.*, vol. i., 1886, p. 295.
[2] *Lancet*, vol. ii., 1902, p. 991.
[3] *Med. Times and Gazette*, 1885.
[4] *Med. Chron.*, 1891.

found on the body, mainly on trunk and thighs, but there was no flame seen. So far as we are acquainted with such gases, the only spontaneously inflammable material which would so act is vaporised phosphorus, or phosphuretted hydrogen, but either of these is hardly likely to be evolved from the body in that chemical form. At the same time, before the refrigerating apparatus was installed in the Morgue at Paris, phosphorescence was a not unusual phenomenon, the popular name of which is " corpse candles." The inquiry naturally arises, Were any observations made in such cases respecting the temperature of the abdominal cavity at the time these spontaneously inflammable gases were issuing from the cavity? Obviously, this phenomenon could only arise under one of two sets of conditions: either that the substance evolved was in such a state that by its rapid oxidation by the air it burst into flame, or that it issued from the body cavity at such a high temperature that it only required oxidation to make it inflame. Whether the free and continuous use of alcohol has such an effect upon the tissues as to make them more inflammable is not yet clearly decided; one thing is clear, that the inflammability cannot be due to the mere presence of the alcohol in the tissues, since the same results cannot be produced by steeping animal tissues in alcohol; and whether or not the subtle processes of physiological chemistry effect such changes and the formation of more highly inflammable products as to increase the general inflammability of the tissues of the human body, is a question which is still in the region of pure conjecture, and, therefore, any medico-legal bearing which it might have ought either to be entirely neglected, or ought not to be founded upon.[1]

BURNING FROM RŒNTGEN RAYS OR X-RAYS

The more prevalent use of X-rays in surgery and medicine for diagnostic, curative, and other purposes has revealed the possibility of production of lesions after exposure thereto. These lesions have in the past been, sometimes, of a severe and extensive character, and, not infrequently, refractory to treatment. Erythema in varying degrees probably succeeds even short exposures in the average person, but it commonly passes quickly away. The chemical rays of light—viz. the blue, violet, and ultra-violet, cause *erythema solare*, or sunburn, a condition which is rarely observed in dark-skinned or brunette persons, but is much more readily induced in fair-skinned, ruddy, or blonde persons, in whom the erythema may amount to a dermatitis of a mild form which ends in desquamation, or even to an acute dermatitis, eczematous in character. Constant exposure to the sun's rays tends in the former class of persons to increased pigmentation of the skin, which must be looked upon as a protective agency induced by Nature. The chemical rays have a rapidly destructive effect on micro-organisms, and the Finsen light, which concentrates these rays, exercises a bactericidal effect in a few seconds. Not a few persons who have been engaged in working with X-rays have suffered from dermatitis of exposed parts, not to speak of loss of hair from face and head in males in some cases.

[1] *B. M. J.*, vol. ii., 1905, p. 609.

Some of these, as Hall-Edwards,[1] have described their personal experiences of chronic X-ray dermatitis of the hands, which includes degeneration of the finger-nails and the formation of warty growths, which may become epitheliomatous in character, as has been recorded of more than one X-ray operator. Acute X-ray burns, according to that observer, may be divided into four classes like ordinary burns, and chronic X-ray dermatitis forms a fifth class. It would appear, also, that dermatitis once so contracted has an increasing tendency to recur on subsequent exposures. Acute X-ray burns of a very severe character have been recorded. Radcliffe Crocker[2] records the case of an apprentice to a surgical-instrument maker, whose employer was trying to secure a radiograph or skiagraph of the spine by one hour's exposure. Next day the skin had become of a deep red colour over the area exposed. On the ninth day vesication began to form, and for the next two succeeding days the vesicles increased in size and number. After treatment, the skin had nearly resumed its normal appearance by the eighteenth day. Drury[3] records another case in which, an attempt being made to demonstrate a renal calculus, a large sore formed at the epigastrium which obstinately resisted all attempts to cure and which gave off profuse discharge for a long period. King of Toronto[4] records the facts of the case of a man who, after many exposures of over an hour each, not only suffered from facial dermatitis, but also lost all the hair of left side of head in front of the ear, of the left whisker, and left side of moustache.

It is not unlikely, owing to accumulating experience, that such mishaps will be less common in the future, since operators, by improved devices, graduated exposures, and other measures, have become more familiar with the effects of the rays.

In respect, therefore, that such mishaps have given rise to actions of damages against operators, it is necessary that more than ordinary caution must be exercised in giving an opinion respecting implied culpability or carelessness on the part of an operator; indeed, an opinion should only be given after full knowledge of all the facts of the case and even then with much prudence.

SKIAGRAPHY IN MEDICO-LEGAL WORK

Radiography or skiagraphy has come to be of considerable value in medico-legal work in the diagnosis of fractures and dislocations, the location of bullets in gunshot wounds in living persons, and in other ways. Skiagrams when taken by an expert person, and from more than one point of view, are most useful in civil actions, as they are now admitted in evidence in law-courts when sworn to as true by those who took them. We believe that they were first used in a Scottish law-court in February 1897, in the case of Taylor *v.* Dick. This was a case in which a boy, playing in a public street in Dunfermline, was hit by a bullet which entered his body between the fourth and fifth ribs. The bullet was located by the X-rays on one side of the vertebral column

[1] *B. M. J.*, vol. ii., 1904, p. 993.
[2] *Ibid.*, vol. i., 1897, p. 8.
[3] *Ibid.*, Nov. 7, 1896.
[4] *Canadian Practitioner*, Nov. 1896.

about the level of the fifth rib on the left side.[1] Valuable references to the uses of skiagraphy in its medico-legal relations will be found as under.[2] The rays have also been employed in one case at least to determine whether or not an infant at birth was or was not mature. Cameron[3] narrates a case in which the X-rays were used in a case in which the fœtal age at birth of a live child was a question of some importance relative to the probable date of conception.

VI. DEATH BY CRIMINAL NEGLECT AND STARVATION

Cases of death from these causes occur annually in this and other countries in one or other of the following circumstances—viz. (1) sheer privation, as in famines; (2) accidental entombment in pits, mines, or landslips; (3) neglect on the part of parents or guardians; (4) wilful withdrawal of food; (5) wilful refusal to take food.

The criminal law takes cognisance of those cases which are due to Wilful Neglect and Simple unintentional Neglect. In addition to the crime of wilful starvation being an offence at common law, it falls, especially in the case of children, under statute law. The Children Act, 1908 (8 Edw. VII. c. 67) has consolidated and amended the law concerning children, and among many other matters it deals with the protection of infant life and the prevention of cruelty to children. In these regards, it has repealed The Infant Life Protection Act, 1897, and of the Prevention of Cruelty to Children Act, 1904, the following sections—viz. sections 1, 5 to 11, 13, 14, 16, 20, 21, 25, 26, 28, and certain words and definitions in other sections.

Part I. of the Act deals with Infant Life Protection. Its main provisions are as follow :—

Section 1. (1) Where a person undertakes for reward the nursing and maintenance of one or more infants under the age of seven years apart from their parents, or having no parents, for a longer period than 48 hours, such person shall, within 48 hours from the reception of such infant, give notice in writing to the local authority.

(2) Where a person undertakes for reward the nursing, etc., of an infant already in his care without reward, the entering into the undertaking shall, for the purposes of this part of the Act, be treated as a reception of the infant.

(3) Such notice shall state the name, sex, and date and place of birth of the infant, the name of the person receiving the infant, the dwelling within which the infant is to be kept, and the name and address of the person from whom he received the infant.

(4) If the receiver of an infant for nursing for reward changes his residence, he shall within 48 hours thereof notify in writing the local authority of the change, and if the change be to the district of another local authority, he shall give to that local authority the like notice to

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[1] *B. M. J.*, vol. i., 1897, p. 436.

[2] Ward Ross, *Med. Leg. Jour. of New York*, Sept. 1898; Golding-Bird, *B. M. J.*, vol. i., 1901, p. 1390; *American X-Ray Journal*, Jan. 1899; Scudder, "Treatment of Fractures," 2nd edit., 1901.

[3] *B. M. J.*, vol. i., 1903, p. 1204.

that he gave to the first local authority when he received the infant.

(5) If the infant dies or is removed from the care of the receiver, that person within 48 hours thereof shall give notice in writing to the local authority of the death or removal, and in the latter case, also the name and address of the person to whom the infant has been transferred.

(6) Any person required to give such a notice who fails to do so within the time specified shall be guilty of an offence against this Act, and shall forfeit in whole or in part, at the discretion of the court, any lump sum which may have been given in consideration of the nursing of the infant.

Section 2. (1) Every local authority shall make provision for the execution of this part of this Act within their district, and shall from time to time make inquiry whether there are persons residing therein who undertake the nursing and maintenance of infants ; and if such persons are found, the local authority shall appoint one or more persons of either sex to be infant protection visitors, whose duty it shall be from time to time to visit any infants referred to in the notices sent, and the premises in which they are kept, to satisfy themselves as to the proper nursing and maintenance of such infants, or to give any necessary advice or directions regarding the same. Where infants have been placed out to nurse in the district of a local authority by any philanthropic society, the local authority, if satisfied that the interests of such infants are properly safeguarded, may authorise such society to exercise the powers of infant protection visitors, subject to the obligation that such society shall furnish periodical reports to the local authority.

One local authority may combine with another local authority to execute the provisions of this part of this Act. A local authority may exempt from being visited, either conditionally or unconditionally, any particular premises within their district which appear to them to be so conducted that it is unnecessary they should be visited.

Any person undertaking the nursing, etc., of any infants who refuses to allow any such visitor to visit or examine the infants or the premises in which they are kept, shall be guilty of an offence. Should any visitor be refused admittance to any such premises, or have reasonable cause to believe that any infants under seven years of age are being kept in any premises in contravention of this Act, he may apply to a justice, who on being satisfied on information in writing on oath may grant a warrant authorising such visitor to enter such premises ; any person obstructing such entrance shall be guilty of an offence.

Section 3. It shall not be lawful for any person, unless with the written sanction of the local authority from whose care any infant has been removed under the Infant Life Protection Act, 1897, or under this part of this Act, or who has been convicted of any offence under the Prevention of Cruelty to Children Act, 1904, or under Part II. of this Act, to keep any infant in respect of which notice is required to be given under this part of this Act, or to keep any infant in any premises from which an infant has been removed under the afore-mentioned Infant Life Protection Act, or under this part of this Act, by reason of the premises being so unfit as to endanger the

health of the infant, or by reason of the premises being dangerous or insanitary.

Section 4. A local authority may fix the number of infants under seven years which may be kept in any dwelling, and any person who keeps any number in excess of that number fixed shall be guilty of an offence.

Section 5. If any notifiable infant be kept in any premises which are overcrowded, dangerous, or insanitary, or by any person who by reason of negligence, ignorance, inebriety, immorality, criminal conduct, or other similar cause, is unfit to have the care of it, or by any person or in any premises in contravention of this part of this Act, any visitor appointed or authorised by the local authority may apply either to a justice or to the local authority for an order directing him to remove the infant to a place of safety until it can be restored to its relatives, or be otherwise lawfully disposed of. Any person refusing to comply with such an order upon its being produced and read over to him, or obstructing the carrying out of the same, shall be guilty of an offence, and the order, if given by a justice, may be enforced by the visitor or by any constable.

Section 6. In the case of the death of any infant respecting which notice is required to be given under this part of this Act, the person under whose care the infant was, shall within 24 hours of the death give notice in writing thereof to the coroner of the district within which the body lies, or to the procurator-fiscal in Scotland, and the coroner shall hold an inquest thereon, or the fiscal an inquiry, unless a certificate by a duly qualified medical practitioner is produced to him certifying that he has personally attended the infant during its last illness and specifying the cause of death and the coroner is satisfied that there is no ground for holding an inquest or the procurator-fiscal for making an inquiry. Failure to give such notice is an offence under this Act.

Section 7. A person by whom an infant is kept within the meaning of this Act shall be deemed to have no interest in the life of the child for the purposes of the Life Assurance Act, 1774, and if any such person, directly or indirectly, insures or attempts to insure the life of such an infant, he shall be guilty of an offence, and if any company, within the meaning of the Life Assurance Companies Acts, 1870 to 1872, or any other company, society, or person in any way issues or procures to be issued knowingly a policy on the life of such infant, the company, etc., shall be guilty of an offence.

Section 8. Any person required to give notice under this part of this Act who knowingly or wilfully makes, or causes or procures any other person to make, any false or misleading statement, in any such notice shall be guilty of an offence under this part of this Act. Any such notice may be sent by post in a registered letter to any person to whom such notice should be given.

Section 9. Deals with penalties, the maximum period of imprisonment being six months, and the maximum fine £25.

Part II. of the Children Act deals with the Prevention of Cruelty to Children and Young Persons, and embraces the following provisions —viz.

Section 12. (1) If any person over the age of sixteen years, who has the custody, charge or care of any child or young person,

wilfully assaults, ill-treats, neglects, abandons, or exposes such child or young person, or causes or procures such child or young person to be assaulted, ill-treated, etc., in a manner likely to cause such child or young person unnecessary suffering or injury to his health (including injury to or loss of sight, or hearing, or limb, or organ of the body and any mental derangement), that person shall be guilty of a misdemeanour, and shall be liable on conviction on indictment to a fine not exceeding £100, or alternatively or in addition thereto, to imprisonment with or without hard labour for any term not exceeding two years and on summary conviction to a fine not exceeding £25, or to imprisonment, with or without hard labour for any term not exceeding six months.

For the purposes of this section a parent or other person legally liable to maintain a child or young person shall be deemed to have neglected him in a manner likely to cause injury to his health if he fails to provide adequate food, clothing, medical aid, or lodging for the child or young person, or if, being unable to provide such food, etc., he fails to take steps to procure the same under the Acts relating to the relief of the poor.

(2) A person may be convicted of an offence under this section either on indictment or by a court of summary jurisdiction, notwithstanding that actual suffering or injury to health, or likelihood of the same, was obviated by the action of another person.

(3) A person may be convicted notwithstanding the death of the child or young person in respect of whom the offence is committed.

(4) Upon the trial of any person over the age of sixteen indicted for the manslaughter or culpable homicide of a child or young person of whom he had the custody, etc., it shall be lawful for the jury, if satisfied that the accused is guilty, to find the accused guilty of such offence.

(5) If it is proved that a person, convicted under this section, was directly or indirectly interested in any sum of money accruable or payable on the death of the child or young person, and had knowledge of the same, the penalties made are more severe.

(6) A person shall be deemed to be directly or indirectly interested if he has any share in or any benefit from the payment of that money, though he be not the person to whom it is legally payable.

(7) Production of a copy of a policy of insurance, certified by an agent of the insurance company granting the policy, shall in any proceedings under this section be *prima facie* evidence of the insurance of such child or young person, and that the person in whose favour the policy had been granted is the person to whom the money thereby insured is legally payable.

Section 13. Deals with the suffocation of infants by overlaying (*vide* p. 171).

Section 14. If any person causes or procures any child or young person, or having the custody, etc., of such, allows that child or young person to be in any street, premises, or place for the purpose of begging or receiving alms, or inducing the giving of alms, whether or not there is pretence of singing, playing, performing, offering anything for sale, or otherwise, such person shall on summary conviction be fined or imprisoned.

Section 15. Deals with the exposure of children to risks of burning (*vide* p. 209).

Section 16. Deals with allowing of children or young persons in brothels. This section does not affect the liability of a person to be indicted under section 6 of the Criminal Law Amendment Act, 1885.

Section 17. Deals with the punishment of any person causing, encouraging or favouring seduction or prostitution of any girl under the age of sixteen by knowingly allowing the girl to consort with or to enter or continue in the employment of any prostitute or person of known immoral character.

Section 18. Gives power to a court of summary jurisdiction to bind over any person having custody of a young girl to exercise proper care.

The remaining sections in Part II. deal with the arrest of offenders, provision for the safety of children in respect of whom offences under the Act have been, or there is reason to believe have been, committed, power as to habitual drunkards (*vide postea*), and evidence and procedure.

The provisions of the Prevention of Cruelty to Children Act, 1904 (4 Edw. VII. c. 15) not repealed, or amended by the Children Act, are mainly as follow :—

Section 2. Enacts that if any person causes or procures any boy under the age of fourteen years, or any girl under the age of sixteen or allows such child to be in any street, or in any premises licensed for the sale of any intoxicating liquor, other than premises legally licensed for public entertainments, for the purpose of singing, playing or performing, or being exhibited for profit, or offering anything for sale, between 9 P.M. and 6 A.M. ; or causes or procures or allows any child under the age of eleven years to be at any time in any street, or in any premises licensed for the sale of any intoxicating liquor, or in premises legally licensed for public entertainments, or in any circus or other place of public amusement to which the public are admitted by payment, for any of the aforesaid purposes ; or causes or procures or allows any child under the age of sixteen years to be in any place for the purpose of being trained as an acrobat, contortionist, or circus performer, or of being trained for any exhibition or performance which in its nature is dangerous—
that person shall be guilty of contravention of the Act, and shall, on summary conviction, be liable to fine or imprisonment, provided that—

(1) This section shall not apply in the case of any occasional sale or entertainment the proceeds of which are wholly applied for the benefit of any school, or to any charitable object, if the same is not held in premises licensed for the sale of intoxicating liquor or for public entertainments, or if held therein, if a special exemption has been granted in writing by two justices of the peace.

Section 3. (1) Gives power to a petty sessional court in England or Ireland, or to a School Board in Scotland, to grant a licence for such time and for such hours of the day and subject to such restrictions and conditions as the court or Board may think fit, for any child exceeding ten years of age,

(*a*) To take part in any entertainment or series of entertainments to take place in premises legally licensed for public

entertainments, or in any circus or other place of public amusement ; or

(*b*) To be trained as aforesaid ; or

(*c*) For both purposes ;

if satisfied of the fitness of the child for the purpose, and if it is shown to their satisfaction that proper provision has been made to secure the health and kind treatment of the children.

(2) Makes it the duty of inspectors and officers charged with the execution of the Employment of Children Act, 1903, to see that the conditions of any licence so granted be duly complied with and gives power to any such inspector or officer to enter, inspect, and examine any place of public entertainment, at which such children are employed, as an inspector appointed under the Factory and Workshop Act, 1901, has to enter, inspect, and examine a factory or workshop under section 119 of that Act.

Wilful Neglect.—It would be in the main true to say that wilful neglect of children is always more or less accompanied by some measure of imperfect nutrition, but it is obvious that the degree of imperfect nutrition may stop short of starvation ; indeed it may be said that wilful starvation of children or young persons to the extent of causing death is comparatively rare. The Children Act, section 12, however, definitely lays down what derelictions of duty on the part of parents or guardians come within the category of neglect or cruelty to children : " A parent or other person legally liable to maintain a child or young person shall be deemed to have neglected him in a manner likely to cause injury to his health if he fails to provide adequate food, clothing, medical aid, or lodging for the child or young person, or if, being unable otherwise to provide such food, clothing, medical aid, or lodging, he fails to take steps to procure the same to be provided under the Acts relating to the relief of the poor."

In looking for the evidences of such neglect, the medical examiner must take cognisance of the following points—viz.

(*a*) The condition of the children with respect to cleanliness of person, and of clothing ;

(*b*) Their condition with respect to bodily nutrition.

Nothing need be said at length with respect to the former. Dirty, unkempt, imperfectly-clad children offer clear indications of the absence of proper motherly care, for, however poor a careful mother may be, she may, at least, be cleanly as regards her home and her family—a filthy condition of skin and clothing, a verminous state of body and hair, with marks of scratching or ulceration, or even diseases, of the skin, assist to complete the picture. These conditions, when found, may be taken as sufficient evidence of general neglect.

But the medical examiner must exercise special care in the consideration of the state of nourishment of the children. Imperfect nutrition as shown by relation of growth to age, and of height to weight, may arise from different conditions, such as inherited or acquired disease, or feeding, insufficient or inappropriate as to quality and kind of food.

The following Tables from the Report of the British Anthropometric Committee (1883) may prove of service, as showing the average weight and height of children up to twelve years of age :—

MALE CHILDREN

Age.	Height.	Weight (lbs.).
At Birth	..	6·8
One Month	..	7·4
Two Months	..	8·4
Three ,,	..	9·6
Four ,,	..	10·8
Five ,,	..	11·8
Six ,,	..	12·4
Seven ,,	..	13·4
Eight ,,	..	14·4
Nine ,,	..	15·8
Ten ,,	..	16·8
Eleven ,,	..	17·8
Twelve ,,	..	18·8

Age.	Height in Inches.		Weight in Lbs.	
	Female.	Male.	Female.	Male.
One Year	27·5	33·50	—	18·8
Two Years	32·33	33·70	25·3	32·5
Three ,,	36·23	36·82	31·6	34·0
Four ,,	38·26	38·46	36·1	37·3
Five ,,	40·55	41·03	39·2	39·9
Six ,,	42·88	44·00	41·7	44·4
Seven ,,	44·45	45·97	47·5	49·7
Eight ,,	46·60	47·05	52·1	54·9
Nine ,,	48·73	49·70	55·5	60·4
Ten ,,	51·05	51·84	62·0	67·5
Eleven ,,	53·10	53·50	68·1	72·0
Twelve ,,	55·66	54·99	76·4	76·7

TABLES OF AGES, HEIGHTS, AND WEIGHTS OF MALES AND FEMALES FROM 13 TO 30-35 YEARS OF AGE.

Years of Age.	Males.		Females.	
	Height in Inches.	Weight in Pounds.	Height in Inches.	Weight in Pounds.
13	56·91	82·6	57·77	87·2
14	59·33	92·0	59·80	96·7
15	62·24	102·7	60·93	106·3
16	64·31	119·0	61·75	113·1
17	66·24	130·9	62·52	115·5
18	66·96	137·4	62·44	121·1
19	67·29	139·6	62·75	123·8
20	67·52	143·3	62·98	123·4
21	67·63	145·2	63·03	121·8
22	67·68	146·9	62·87	123·4
23	67·48	147·8	63·01	124·1
24	67·73	148·0	62·70	120·8
25–30	67·80	152·3	62·02	120·0
30–35	68·00	159·8	61·15	120·8

Careful investigation should be made for the existence of disease, or for evidence of causes of malnutrition in children, whenever serious disproportion is discovered in any case, or group of cases, between the actual and average age, height, and weight. Although the above Table only shows averages, and although in any case, or series of cases, divergences in these relations are likely to present themselves, it may be taken to indicate data sufficiently near the normal with which to compare when serious disproportions emerge. In order, therefore, to establish evidence of imperfect or inappropriate nourishment, as to quantity, quality, or kind of food, it is not only necessary to eliminate diseases or conditions causative of malnutrition, but to review such evidence as there may be of the feeding given to the children. This is especially necessary in cases in which homicidal starvation is charged against accused persons, for the lines of defence most usually adopted are either the existence of disease or causes of mal-assimilation or malnutrition; therefore, in the post-mortem dissection, all evidences of disease, if present, must be noted with relation to their effect upon the production of emaciation, for if no gross lesions be found in the body, no sugar be found in the urine, nor chronic nephritis in the kidney, there would be sound, substantial ground for inferring that death was due to want of sufficient nourishment. In all such cases, and especially those of children, the examiner should make inquiry regarding the mental condition exhibited during life.

But within the term "neglect" of children, the law brings others than those who simply do not provide reasonable nourishment for their children, such as the Peculiar People who would rather trust in prayer and the Word of God than to medical aid in the illness of their children, and the so-called Christian Scientists whose belief is centred in faith-healing. With respect to the former, in cases where it can be reasonably shown that in consequence of the non-intervention of medical aid a child dies, the law is that such parents have "neglected" their child in terms of the Act already quoted.

Signs of Death from Starvation.—There are some good grounds for dividing deaths by starvation into two classes—viz. Acute and Chronic; the former, when it occurs within fourteen days from the withdrawal of food, and the latter, when the death takes place beyond that number of days.

As it is sometimes necessary for a medical witness to make examination of living persons believed to be the subjects of neglect and starvation, it is essential that some note ought to be taken of the phenomena attendant upon the process. These may be considered as follows:—

1. As regards the bodily temperature;
2. As regards the pulse;
3. The loss of body-weight;
4. The peculiar odour exhaled;
5. Other and varying signs.

As regards temperature, the general effect of the non-nourishment of the body is that it becomes subnormal after a shorter or longer period of feverishness, and that prior to death the fall may amount to two or three degrees below normal. As respects the pulse, the

progress of a case shows that, at first, the pulse becomes more rapid and, later, slower, but as inanition advances and death approaches, it again rises in frequency. Dr Fowler observed in the case of Sarah Jacob, the fasting girl, that her pulse increased 14 beats on the second day of the watch by the committee, 26 on the third, 54 on the fifth, and 74 on the third, over the pulse-rate at the beginning of the watch. The most outstanding sign, however, is the loss in body-weight, since the body, deriving no nourishment from without, must feed upon itself. Fraudulent fasting may, indeed, be unhesitatingly declared to exist where the body-weight is maintained after the alleged fasting has been in existence for some time, and especially when upon a strict watch being instituted, it is found to steadily fall; as was seen to happen in the cases of Ann Moore and Sarah Jacob. Generally speaking, it may safely be affirmed that it is not compatible with the maintenance of life that a body should lose more than one-quarter of its original weight. Chossat's famous experiments on pigeons showed that when these birds were totally deprived of food, the surplus fat of the body was first used up, then the fatty envelopes of the internal organs, and last of all the interstitial fat of the muscles, while the muscles themselves became smaller by reason of want of nutriment. In all bodies the subject of death from this cause a peculiar odour is given off. The nurse who watched the Welsh fasting girl, Jacob, called it a "peculiar" smell, "not like the usual smell of death," but she could not definitely describe it. Dr Donovan, who recorded his observations of deaths in the Irish potato famine, called it "an offensive odour"; and other observers have given it like names. It is a fact well known to all who have to attend deathbeds, that before death, odours more or less disagreeable are evolved from the body. Dr Isham[1] is inclined to attribute the phenomenon to the liberation of ammonia and of the peculiar volatile oil (fatty acid) which gives the blood of animals its odour, and to the liberation being caused by the diminishing vitality of the blood. It is very probable that the odour from a starved body may be based upon such facts.

Of the minor signs of starvation, the following may be noted—viz. sunken eyes, with a wild and glistening expression from the dilated pupils; prominent bony projections of facial features; pale and parched lips; red, hard, and dry tongue; weak, whispering, "cholera," voice; undue prominence of bony framework of body; sunken abdomen; wasted extremities; constipated bowels; fæces small, ball-like, hard, and dry; urine scanty, turbid, and dark-coloured.

Post-Mortem Appearances.—These may be considered under three heads—viz.

I. Body generally.
II. Solid Viscera.
III. Hollow Viscera.

I. *General Appearances of Body.*—There is considerable emaciation of the whole body; the skin is in folds, or is wrinkled or shrivelled, dry, and, sometimes, covered with a brownish-like varnish; the muscles are flabby, much wasted, devoid of fat; the abdomen is greatly sunken, so much so at times as to appear as if the abdominal wall

[1] *American Journal of the Medical Sciences*, April 1881.

touched the vertebral column; the eyes are sunken, the temples are hollow, and every bony prominence appears unduly prominent. A peculiar odour from the body is observed.

II. *Appearances of the solid Viscera.*—The lungs, heart, and great vessels are comparatively bloodless and collapsed; the liver, kidneys, spleen, etc., are small, shrunken, and devoid of enveloping or interstitial fat; the omentum and mesentery are either clear and without fat, or have practically disappeared; the gall-bladder is full of dark bile; and the urinary bladder empty, or nearly so.

III. *Appearances of the hollow Viscera.*—The stomach is found contracted, collapsed, thinned, and empty. In Casper's case from ankylosis of jaws it was found so much contracted that its calibre scarcely equalled that of the normal colon. The intestines are found in the like contracted condition. This thinning is sometimes so marked that food can be seen and recognised through the almost transparent walls. Donovan, in the case of one of the victims of the Irish famine, was able to recognise a piece of raw green cabbage through the wall of the duodenum. Not only are the intestinal coats thinned, therefore, but the calibre of the canal is much contracted, even to one half of its original size.

In all cases of suspected death from starvation, every appearance of disease, if and when present, must be carefully noted on dissection, and where absence of disease exists, the fact should be equally noted.

In questions of survivorship, and in certain criminal connections, it may be asked of the medical witness, How long will a person live after *complete* privation of food? This is difficult to answer in a general way, and the answer must have special regard to the age and state of the person. It is an axiom that the young and the aged resist less easily than the adult; but if the answer be confined to adult life, then it may be said that the average period is from 7 to 10 days; if, however, water be obtainable for a portion of the time of compulsory fast, the period may be extended, as in the case of the Ayrshire miner, to 23 days. This is further exemplified by a case recorded by Sir Rudolf Slatin. "The well-known Emir, Leki Tummal, on being seized, was thrown into a small stone building the shape of a coffin, the door of which was built up. He was given no food whatever; but a small amount of water was handed to him through an aperture in the wall. For 23 days he suffered all the horrors of starvation; but no sound or complaint was heard to issue from that living grave. Too proud to beg, and well aware of the futility of doing so, he lingered on till the 24th day, when death carried him out of reach of his tormentors." [1] Tidy,[2] with respect to survivorship is inclined, however, to the view that the young die first, adults next, and the aged last, on the ground that old people need less nourishment than the young or the middle-aged adult; but he takes no reckoning, evidently, of the weakened vital forces of the aged as a factor which would be contributory to feebler resistance. We believe that, by reason of the more vigorous vital forces of the young or the middle-aged adult, he or she would resist starvation better than

[1] "Fire and Sword in the Sudan," p. 574.
[2] *Légal Méd.*, vol. i., p. 392.

the aged person. Where water is freely obtainable, life may be prolonged to the 58th day.[1]

Typical Cases of Starvation.—I. It will not be necessary to give more than one or two typical cases illustrative of each of the foregoing causes of starvation. Starvation from *sheer privation* is the common feature of all famines which occasionally visit some parts of the earth. The Irish famine of 1847, however, and successive famines in India since, are typical.[2] Aitken gives an interesting account of a sad case of privation, as follows[3]:—In February 1862, a man 36 years of age was discovered in a stack near Morpeth, dying from starvation. All attempts to rally him failed, and he died. He had been editor and proprietor of a small newspaper. A diary was found in his possession which contained entries of his condition from the 8th to the 25th of that month. From these it appeared that during seventeen days he had twice only tasted a piece of bread, but for the last thirteen days he had been entirely without food. During the first ten of these thirteen days he was able to go for water, but on the eleventh his legs became useless, and he lost all motor power in his limbs, so that, as he expressed it in his diary, "one-half of my body appeared to be dead." Shipwrecked crews sometimes undergo great privation. In *The Times* for February 6 and 7, 1866, is a graphic account of the sufferings of such a crew which consisted of the captain and seventeen men, who were absolutely without food and fresh water in their boat. The periods during which some of them lived under this total privation were noted—viz. one lived eleven days, one, twelve days, one, fourteen days, two, fifteen days, one, eighteen days and the captain twenty-eight days; the prolongation of the captain's life being apparently due to the fact that by tying his cravat around the mast to catch the falling rain and sucking it when it was soaked, he obtained some water. Neglect on the part of parents and guardians is punishable under statute law, as has been said, and cases are, unfortunately, too common to require detailed consideration. But the following are probably outstanding. First, with reference to adult persons. In such cases, criminal starvation is most likely to be practised only in the case of persons who are ill or weakly, or of half-witted individuals who are kept in secret by their friends. The most notorious case of the last quarter of a century was the Penge case, 1877, one of the persons convicted in which being liberated from prison only in 1898. The facts were, shortly, these: Harriet Staunton was the wife of one of the prisoners, and the allegation was that she had been starved to death by her husband, his mistress, his brother, sister-in-law, and another woman, Rhodes by name. She was seen by a medical man before her death, who gave a certificate that death was due to natural causes. But suspicion as to the manner of her death having been aroused in the neighbourhood, a post-mortem examination of the body was made, and upon the facts found was based the charge against the prisoners. The examination showed the following—viz. that the body was greatly emaciated and in a very dirty, uncared-for state; that although the woman's height was 5 feet 5½ inches, her body only weighed 74 pounds, whereas it was shown in evidence that about a couple of years before, she weighed 119 pounds; that there was an entire absence of fat from the body; that the gastro-intestinal tract had thinned walls; and that the only evidence of disease in the body consisted of some miliary tubercles in the *pia mater*, and a small patch of tubercular deposit in the apex of the left lung. The medical evidence at the trial being in favour of death having been caused by starvation, the prisoners were found guilty, and they were sentenced to death. Thereafter, comments were made freely in the medical press regarding the rôle which the tubercular disease found in the body had played in the production of the signs of starvation. Some affirmed that death was due to, or at least was hastened by, tubercular meningitis; others that the death was purely the result of starvation, in the course of which, and by reason of which, the tubercular deposits had developed. The division of opinion became so acute that the Home Secretary reviewed the facts of the case, and, after deliberation, the woman Rhodes was

[1] Fodéré, vol. ii., p. 276.
[2] *The Lancet*, vol. ii., 1879, p. 774.
[3] *Science and Practice of Med.*, p. 744.

pardoned, and the sentences against the other prisoners were commuted to imprisonment.[1]

II. From **Neglect of Children** many cases might be recorded; but the following are typical.

1. The first case was known at the time as the Chester Case.[2] A child was placed in the hands of a woman to nurse. Some time after, it was found by an inspector of police lying in a basket in front of the fire of the woman's house, in a horribly emaciated condition. Although eighteen months old, it weighed only 8 lbs. 2 oz.—practically a little more than the weight of a newly-born child. It was proved in evidence that the child was given only skim milk twice a day, and, in the interval, the empty nursing-bottle to suck.

2. In the Hastings Case,[3] the servant girl at a boys' school was found by the medical men apparently dying of starvation. There was extreme emaciation, hectic fever, and the peculiar odour of starvation.

For other cases, see the following references :—

B. M. J., vol. i. 1880, p. 175.
,, ,, 1880, p. 984.
,, vol. ii. 1880, p. 861.
,, ,, 1880, p. 949.

Cases such as the preceding led to legislation on the subject, and to the passing of the Infant Life Protection Act, 1872, and the Prevention of Cruelty to Children Act, 1894, the main provisions of which have been incorporated in the Children Act. (*Vide ante.*)

The Prevention of Cruelty to Children Act, 1894, repealed certain parts of the Act of 1868 which dealt with the same subject.

Section I. of the Act of 1868 enacts that if any person "who has the custody, care, or control of any child under the age of 16 years wilfully assaults, ill-treats, neglects, abandons, or exposes such child . . . in a manner likely to cause such child unnecessary suffering or injury to its health . . . that person shall be guilty of a misdemeanour." In a case tried before Mr Justice Wills and a jury, he directed the jury that motive of the parents did not enter into the case, if what they did was expressly forbidden by statute. This direction was appealed against and taken to the Court for Crown Cases Reserved in Dec. 1898, when the Lord Chief-Justice, with five other judges concurring, upheld the direction of Mr Justice Wills. The term "wilfully" he defined as an act done deliberately and intentionally, not done accidentally, or by mistake or inadvertence; and "the term 'neglect' meant the absence of such reasonable care as an ordinary parent would reasonably use for the protection and care of his child; in other words, the failure to take such steps for the protection of infant life and health as the general experience of mankind showed to be right and proper, providing, of course, that the means of rendering such treatment were within the reasonable power and competence of the person on whom the duty rested to render them."[4] The above judgment was given against a man Senior—one of the "Peculiar People"—who was convicted of neglecting to provide medical aid to his child and sentenced to four months' imprisonment with hard labour.

Of recent cases of Cruelty to Children may be cited the following :—

(*a*) *The Penruddocke Case.*—The woman, who was tried at the Old Bailey Sessions, London, in Nov. 1902, before Mr Justice Bigham, was found guilty of cruelty, which was of almost inhuman character.[5]

(*b*) *The Gale Case.*—The woman was charged with abandoning infants in railway trains and at railway stations. She was tried at the Central Criminal Court, was found guilty, and was sentenced to two years' hard labour.

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[1] Central Criminal Court, 1877.
[2] *B. M. J.*, vol. i., 1880, p. 256.
[3] *The Lancet*, vol. i., 1880, p. 693.
[4] *B. M. J.*, vol. ii., Dec. 17, 1898.
[5] *Lancet*, vol. ii., 1902, p. 1471.

(*c*) *The Walters and Sach Case.*—These women were charged with the murder of a male child which had been placed in their care to nurse. They were found guilty, and were sentenced to death.[1]

(*d*) The following cases were brought under the notice of the Procurator-fiscal of Glasgow by the Society for the Prevention of Cruelty to Children.

(1) The body was that of an extremely emaciated male child, aged 18 months. Around the scrotum and anus the skin was raw, and on each hip was a reddened area, as if due to recently healed bed-sores. The weight was approximately 10 lbs. and the length 25½ inches. Internal dissection revealed no evidence of organic disease in any organ of the body. (Jan. 1904.)

(2) This was the body of a female child about 18 months old. The body was greatly emaciated, and weighed between 10 and 11 lbs., the length being 24½ inches. Body surface was plentifully marked with flea-bites, but there were no marks of violence to be seen. Internally, the lower third of right lung and lower half of left lung showed hypostatic congestion. The parents were charged with having cruelly ill-treated and neglected the deceased and other three children by failing to provide for them proper or sufficient food and clothing. They were found guilty, the mother being sentenced to six and the father to three months' imprisonment.

For the laws on the protection of infant life in France and America, the reader is referred to the following reference.[2]

III. From **Accidental Entombment in Mines, Pits, or otherwise.**—One of the most interesting cases falling under this head is that recorded by Dr Sloan of Ayrshire,[3] of a miner, 65 years of age, who was entombed in a pit for twenty-three days, at the end of which he was brought out alive, but died on the third day thereafter. At the beginning of his incarceration, he was able to get water which was strongly impregnated with iron, but, after several days, was unable from weakness to go even a short distance for it. In the Transactions of the Linnean Society,[4] as showing the effect of entombment on animals, a case is recorded of a fat pig which, by reason of a landslip on the Dover Cliff, was embedded thirty feet in the débris, but which at the end of 160 days was dug out alive although its weight had diminished from 160 to 40 lbs., a loss of no less than 75 per cent.

IV. **Wilful Refusal to take food** is a feature of the insane, and of the hysterical girl or woman, but it has been manifested as a mode of effecting suicide. Under this latter category is the case recorded by Casper,[5] in which a male prisoner attempted to starve himself to death. The prisoner, who was 36 years of age and had been sentenced to imprisonment for fraud, at the end of a year of his term determined to starve himself. For practically ten whole days he resolutely refused all food, but at the end of that time natural cravings obtained the mastery over his will, and he was permitted gradually to resume his ordinary diet. Woodman and Tidy[6] record the case of another prisoner who died at the end of the 58th day of his suicidal abstention from food.

Among confirmed lunatics, starvation from total abstinence from food may be said to be comparatively common. Cases are upon record where, when water was taken, the patients lived after they refused all food for 42, 47, and 61 days respectively.[7]

Some notice must be given in regard to fasting girls and fasting women. From time to time attention is attracted to cases, especially in young women, where there is deliberate refusal to take food owing to expressed repugnance

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[1] *B. M. J.*, vol. i., 1903, p. 221.
[2] *Ibid.* vol. ii., 1902, p. 1785.
[3] *Med. Gazette*, vol. xvii., pp. 264-389, 1835.
[4] Vol. xi., p. 411.
[5] *Op. cit.* vol. ii., p. 29.
[6] *Op. cit.* p. 1036.
[7] Willan, "Miscellaneous Works," p. 437.

to it. It would be impossible to enter into such cases in detail. In addition to that of Ann Moore—the fasting woman of Tetbury—whose fraudulent simulation of fasting was only detected by a watch committee who discovered that when watched (her bed and herself being meanwhile placed on a weighing-machine) she lost weight, and to whom she confessed her fraud—there are the cases recorded by Drs Ogle,[1] Fowler,[2] and Dougal.[3] In the case of Sarah Jacob, when a watch committee were appointed to test the *bona fides* of the girl, she gradually lost weight and died; whereupon her parents and the medical men of the committee were brought up on a criminal charge of "killing and slaying her." In the case recorded by the last-named observer, it would appear from the facts narrated that the girl for a period of eighteen weeks, with the exception of a small piece of fruit-cake, absolutely abstained from all food, although she took water and sweets freely. Her bowels did not move for eleven weeks. The last measure proposed to her was that if she did not eat she would be taken to a lunatic asylum. For a short time this had some effect in making her try to eat, but she again declined all food, and ultimately died. For more than a year, therefore, this girl, with the exception of water of which she partook freely, some sweets, and beef-tea at odd intervals, and a bit of biscuit or of orange very rarely, abstained from food. She became morose in disposition before her illness—because it must be deemed such—began, when she was 14 years of age, and this continued throughout until her death.

It is not necessary to discuss those persons who fast in public exhibitions—for a consideration. Their cases make no solid contribution to the literature of the subject.

Starvation obviously may arise also from inability to take food by mechanical impediment or disability in the digestive tract, or by reason of disease in the body.

Ankylosis of the jaws is a rare form of disability, but such a case is recorded by Casper,[4] which was due to the careless use of mercurial inunctions by a surgeon, who was therefor condemned to imprisonment. Stricture of the œsophagus from corrosion and cicatrisation after swallowing burning materials or corrosive substances, or from cancerous or other malignant disease of gullet or stomach, are by no means uncommon causes. Of the diseases which present externally apparent signs of starvation, probably those of tubercular origin are the chief, with the exception of *diabetes mellitus*.

Accidental, Suicidal, and Homicidal Starvation.—We need hardly discuss further the cases of starvation which fall within the two first categories, as the circumstances attendant thereupon are usually sufficiently obvious to be easily proved by lay witnesses. It is not so, however, in the last class; usually, medical evidence is of the greatest importance in such cases. Culpability is of varying grades with respect to the inadequate nutrition of children or helpless persons, and it is in cases involving cruelty to children from neglect and starvation, or in helpless persons being starved to death, that the medical witness may prove helpful to the criminal authorities. Parents are responsible for the nourishment of their children; employers, for their domiciled apprentices or servants; and other persons for those who are by law dependent upon them, and who are unable to provide for themselves by reason of any defect, mental or physical, or both. It is considered to constitute the crime of infanticide by omission when a mother wilfully withholds nourishment from her infant so that it dies.

At the Assizes at Leicester in 1877—R. *v.* Mills—the woman was charged with the manslaughter of her infant (an illegitimate child) by neglecting to

[1] *B. M. J.*, vol. ii., 1870, p. 57.
[2] "History of the Case of Sarah Jacob," p. 307.
[3] *The Lancet*, vol. i., 1881, p. 755.
[4] *Op. cit.* vol. ii., p. 33.

suckle it, and for neglecting to see that it was fed otherwise. In R. *v.* Scott (C. C. C., August 7, 1880) the woman was charged with starving her servant, and was sentenced to two years with hard labour. In starvation of apprentices or servants, it was held in R. *v.* Squire,[1] that it is the husband and not the wife who is responsible, although in certain cases, the wife may be charged as an accessory. As the result of the death of the Welsh fasting girl, Sarah Jacob, the father and mother of the girl were tried at the Carmarthen Summer Assizes, in 1870, on the charge of criminal neglect of their child, and, after evidence, were convicted, the father being sentenced to 12 months', and the mother to 6 months' imprisonment. The medical members of the Watch Committee were charged with " killing and slaying Sarah Jacob," but they were acquitted, on the ground, it is believed, that neither the other members of the committee nor the nurses asked their advice. This case ought to act as a wholesome warning to medical men to set their faces not only against all such cases as fasting people, more especially when it is established that in spite of the fasting the body-weight of the person is being maintained, but also to decline taking any part in their exposure. Of cases in which death was attributed to starvation from wilful withdrawal of food by those responsible for the proper nourishment of the persons whose deaths have been so caused, probably the Penge case, the facts of which have been already recorded, would suffice. Other cases, however, have been recorded—viz. R. *v.* Mitchell tried at the Oxford Lent Assizes, 1861, where Mitchell, a naval surgeon, was tried for the manslaughter of a female servant aged 24, by starvation, but where, although the post-mortem appearances were indicative of this form of death, the medical witnesses admitted that they might be due to mal-assimilation. The prisoner set up the defence that the woman suffered from chronic diarrhœa. He was acquitted.[2]

In a recent case, a lay evangelist and his paramour were tried at the Bristol Assizes on a charge of attempting to murder the son of the male prisoner by starving him.

The following case, tried at the Dorset Assizes in June 1899, has a bearing on the subject of starvation. The charge against the prisoner was one of false imprisonment and assault, and the facts were as follow :—The prisoner had enticed a woman on board a large grain hulk which was moored to the quayside at Weymouth, and threw her down the hatchway. She fell on a cargo of corn, and was shut in by the prisoner, who promised to bring her food next day. This he failed to do, and the woman remained shut up in the hulk in darkness and without food for nine days. He was found guilty, and was sentenced to 18 months' imprisonment.

In June 1908, a man was tried at Glasgow before a Sheriff and jury on the charge that, being the father of a female child, five years of age, an imbecile, and in feeble health, and requiring constant attention and careful nursing, he did, between January 1 and April 3, 1908, wilfully ill-treat and neglect her, leave her for long periods unattended, failed to provide her with proper and sufficient food and nourishment and clothing, and to keep her clean, in consequence of which she was seriously injured in health, and died of starvation on April 5, and was thus killed by him, contrary to the Prevention of Cruelty to Children Act, 1904. He pled not guilty. Witnesses stated that prisoner was a widower, and after his wife's death had a series of housekeepers, all of whom, however, proved to be either of unsteady habits, or would not stay. The keeper of the child was a brother, aged fourteen, to whom the imbecile child was attached, but he went out to play unknown to his father and neglected the child. The child had been treated in one of the hospitals, and from the record of her treatment, it was shown that the child swallowed with difficulty, the food flowing back out of the mouth. She had been further examined medically, and found to be in a condition of idiocy, with paralysis of upper and lower limbs. On post-mortem examination of the body, it was found to weigh 12 lbs. only. For the defence it was shown that unsuccessful application had been made to get the child into an institution under the charge of the Parish Council, notwithstanding that the father was willing to pay for

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[1] Starkie, vol. ii., p. 947.
[2] Taylor, *op. cit.* vol. ii., p. 142.

her maintenance therein, but no provision could be made for a child unless the parents were destitute. The prisoner was found not guilty.

We made a dissection of the body of a woman about middle life which was in a condition of extreme emaciation. The backs of both hands and wrists were more or less covered with encrusted dirt and skin débris, but, otherwise, the body was clean. There was a bed-sore, about two inches in diameter, at the lower part of spine at top of sacrum. There were no marks of violence on the body. The internal examination showed engorgement of vessels of *pia mater*, but no naked-eye appearance of disease of brain. The bases of both lungs showed evidence of passive congestion. The intestines were not diseased, but the walls of the small intestines were thinner and more transparent than usual. This woman had been sent into an asylum two or three days before, having been found in a house in a filthy condition by the poor-law inspectors. We were informed by the medical superintendent of the asylum that on arrival there her whole body was filthy and verminous, and the hair of her head matted and also verminous. It was because of her extreme emaciation and uncared-for condition that the attention of the criminal authorities was drawn to her case. (May 1906.)

In March 1907 we examined the body of an old woman. She lived with a middle-aged son. At her death he disappeared. The police took possession of the body. It was very emaciated and very dirty. She had evidently been dead for some days, as putrefaction was fairly well advanced. The feet and lower limbs were œdematous. On outer aspect of sole of right foot was an area of ulceration measuring 2½ inches by ¾ inch. On the right buttock was a deep bed-sore, measuring 3 inches in diameter, and another of nearly similar size over the sacrum. The hair of the head was unkempt, and the face and body were begrimed with dirt. There were no marks of violence. The police information was that, so far as was known by the neighbours, there had been no medical attendance, and no nursing, except what latter the son could give her at intervals from work. Internal examination showed œdema of bases of lungs, and evidence of bronchitis, as also mitral disease. The kidneys and liver showed evidence of cirrhotic changes. We reported that the cause of death was exhaustion from dropsy and extensive bed-sores, the former being due to heart and kidney disease, but that she had been neglected.

As regards the law respecting the practice of "Christian Science," the only deliverance in this country was that given by Mr Justice Hawkins in the celebrated case of R. *v.* Lyon and Mills, in which the death of Mr Frederic, a journalist, was in question. A coroner's jury had returned a verdict of manslaughter against the accused. The Treasury thereupon took up the case, which was tried before the Croydon justices, but after an inquiry lasting several days, the prosecution withdrew the case against Miss Lyon, and asked for a committal against the second accused. The justices, however, were of opinion that the evidence even against Mrs Mills was not sufficient to justify them in sending her to trial, and she was likewise discharged. But the accused had to be indicted upon the finding of the coroner's inquiry, and so the case came up at the Central Criminal Court, for trial before Mr Justice Hawkins; but counsel for the Treasury, after consultation with the Attorney-General, departed from the case, and therefore, the judge had no other alternative than to direct the jury to return a verdict of not guilty: at the same time, he pointed out that he was in no way responsible for the withdrawal of the case, and he declined to share even the responsibility with the Crown in so acting. It may, therefore, be said that as yet no deliverance has been given by the law on this subject, since the statute only deals with the neglect of those who are under sixteen years of age.[1]

[1] *B. M. J.*, vol. ii., Dec. 24, 1898.

At the October Session of the Central Criminal Court, London, 1906, the Recorder mentioned the case of a Christian scientist, named Chisholm, who was charged with manslaughter for not having called in medical aid for his son who was ill of diphtheria, and who died from that disease.[1] Accused was discharged on his entering into own recognisances in £100 to come up for judgment if called upon.

The case of Shead *v.* Tomlinson, tried in Alaska, U.S.A., presents some points of interest. A patient applied to a Christian Science healer for treatment of appendicitis. She was advised to go about the room as usual, to eat anything she desired, and not to lie down. The healer was sued for negligence. The Court held in favour of the healer, on the ground that "the intelligent and voluntary consent to follow the advice and abide by the result of the prayers of a Christian Science healer precludes the recovery of damages for negligence, based on the ground that public policy is opposed to such treatment." [2]

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[1] *B. M. J.*, vol. ii., 1906, p. 1159.

[2] Digest of Cases in the United States, 1906; *B. M. J.*, vol. ii., 1906, p. 268; *vide* also case of death of Major Whyte; *B. M. J.*, vol. ii., 1906, p. 1195.

CHAPTER IX

MEDICO-LEGAL FORMS OF DEATH (*continued*)

VII. DEATH FROM COLD AND EXPOSURE

This is one of the rarest forms of death in this country, chiefly by reason of its geographical position in the temperate zone, the average number of deaths per annum being between 150 and 175. It may be said to have its physiological cause in the driving of the blood of the peripheral circulation into the vital centres, from the contraction of the blood-vessels of the outer integuments by the influence of the cold, so that fatal hyperæmia of brain, lungs, and heart is produced. The liability to death from this cause is slight comparatively in the case of exposure of the robust person in rude health, but it becomes considerably increased in the case of newly-born infants, young children, the aged, the weak, the half-starved, and the mentally depressed. The factor of intoxication, doubtless, plays an important part in many cases, since in drunkenness the bodily temperature is, or readily becomes, subnormal. From careful thermometric observations *per rectum* in "dead drunks" we make this assertion with confidence; consequently, exposure in inclement weather of such persons is more liable in their case to conduce to the above form of death. Few observers, comparatively speaking, have had opportunities of recording many cases, and, probably, the experience of the late Prof. Ogston of Aberdeen is as large as that of any observer in this country. His attention was first called to the subject in 1837 on account of his having been called upon to make an examination of a body the subject of death from this cause. When he published his Lectures in 1878, he had seen, during the interval, sixteen cases—ten of which were adults and six were children. Casper [1] records four cases in children, and Dr Kellie [2] two cases. Associated, occasionally, with death from Cold and Exposure, is frost-bite. This is common in countries with Arctic climates in winter, but very uncommon in our own. Casper affirms that bodies have been found frozen so hard that the brain had to be chiselled out before the base of the skull could be examined, and food, hard frozen, was found in the stomach. In order that frost-bite may supervene, however, it is not necessary that there should be actual exposure in the open air, as the following facts will show :—

During the severe winter of 1879, we were asked to see an infant, four months old, who lived with its parents in the outskirts of Glasgow in a new, but badly-made tenement flat. The child was well-nourished and healthy. We found the left little toe completely gangrenous, so that it was attached to

[1] *Op. cit.* vol. ii., p. 278.
[2] *Trans. Med. Chir. Soc. of Edinburgh*, vol. i., p. 84.

the foot only by the remains of the tendons. The like toe of the right foot was in a similar condition, but the gangrene was not so severe. The history was as follows :—On the Saturday, the mother bathed the child. There was then nothing unusual about the feet, which were covered with woollen boot-coverings. The next day, the child was not bathed, nor were its feet uncovered, because the water-supply had become frozen during the night, and as any other supply could only be procured at some distance by carrying it in a pitcher, as little water as possible was used. The infant cried bitterly all that day. On the following day, the feet were again uncovered, when, to the astonishment of the mother, the left little toe was found to be black all over, and the right little toe similarly, but not so deeply, coloured. She, of her own device, applied warm poultices of bread and milk, which, doubtless, hastened the gangrenous separation. As indicating the conditions under which the family had to live at that time, it must be stated that in spite of a continuous fire in the grate, a wet cloth or sponge, left lying not far from the fire, quickly froze, owing to the badly-fitting doors and windows, and the consequent free in-draught of cold air.

Sinclair Holden records the case of an able-bodied tramp, who, with the thermometer registering 22° of frost, lay down for the night by the side of a stack of straw in a farmyard. Snow fell during the night, and by the morning he was banked up in a mass of it which fell from the roof of the stack. In the morning he was extricated from his position, and was taken to Sudbury Workhouse. His feet were found to be swollen and dusky in colour, and after a few days gangrene of the toes set in. It was deemed advisable to amputate both feet, but the man would not consent. By next day, the gangrene had spread, and involved half of the feet, while the ankles and calves were darkening from venous thrombosis. The legs were then amputated at the lower third of the thighs, but he died 24 hours after the operation.[1]

The intimate cause of death by cold has been ascribed to the fact, ascertained experimentally on blood, that at zero, oxygen becomes less easily dissociated from the hæmoglobin, and, therefore, death is due to the oxygen-starvation of the brain and nerve-centres. This would account, partly, for the extreme drowsiness which overcomes those who have been exposed for some time to rigorous weather, although, doubtless, the severe muscular efforts to overcome difficulties and in trying to attain shelter are also important causative factors.

Post-Mortem Appearances.—These consist mainly in the following—viz.

Externally.—(1) The presence of irregular-shaped, dusky-red patches or stains on limited areas of the surface of the body. The situation of these is determined by the parts of the skin which are exposed to the air, because they are not formed upon covered portions of the body. They must not be confounded with post-mortem lividity, because they are met with on non-dependent parts, nor with the cherry-red diffused coloration of the skin in CO poisoning which is found equally upon parts exposed to, and covered from, the air. These coloured marks appear cherry-red owing to the more marked contrast caused by the unusual pallor of the rest of the skin of the body. Such coloration of the skin is found to some extent, as has been already pointed out, in deaths by drowning, particularly upon the skin over the malar prominences and in the mucous membrane of the lips. In all the cases in which we have seen this, the deaths have happened in intensely cold weather, the temperature being below freezing-point. There can be little doubt that, in these circumstances, the phenomenon

[1] *Lancet*, vol. i., 1889, p. 782.

is due to oxygenation of the blood by the air through the thin walls of skin and mucous membrane; and the same factor is, in all probability, the cause of the dusky- or cherry-red coloration of the skin of exposed parts in deaths from cold and exposure. Falk [1] has expounded this view. He affirms that at temperatures below zero, the hæmoglobin of the blood of the skin of the dead body is capable of combining with oxygen and of retaining it as a fairly firm combination, but when the surrounding temperature rises the hæmoglobin parts with its oxygen to the adjacent tissues, the skin loses therefore its red colour, and the stains become like ordinary post-mortem stains. But it ought to be remembered in this connection, as possibly throwing some light on the production of such stains, that blood exposed to a temperature of 10° to 15° C. below zero not only solidifies, but the red corpuscles are ruptured. This was described by Pouchet in 1866, and later by Maljean.[2] The effect of freezing upon flesh meat is shown by the simple test of placing a small piece of the meat in a test-tube containing water, or, better, by expressing on a glass-slide some of the meat juice. If the meat be fresh, microscopic examination will show numerous red discs, normal in shape and colour (if the treatment has been by the latter method), floating in a colourless *liquor sanguinis*; but if the meat has been subjected to freezing, or has been "chilled," for purposes of transport, a like treatment of a small piece of it will show red discs more or less distorted in shape and without colour, floating in a *liquor sanguinis* remarkedly red or dark in colour. By the test-tube method, the water, in the case of frozen meat, becomes more rapidly and more notably coloured than in the case of fresh meat, indicating that the colouring-matter of the blood in the former is dissociated from the corpuscles by the action of the cold. It would appear, therefore, as if there was some destructive action on the corpuscles either during the period of freezing or chilling, or during the period of thawing or raising of temperature.

(2) General pallor of the covered surface of the body. This is due to the absence of blood from the skin, the result of its being driven into the interior of the body. In Ogston's series of cases, this general pallor was constantly observed.

Internally.—The principal appearances are as follows:—

(1) An arterial hue of the blood throughout the body. This, obviously, is due to combination of the oxygen of the air with the hæmoglobin. When, however, the blood in the heart is viewed *en masse*, it has a dark colour. Ogston failed to find this general arterial coloration of the blood in two cases. This is to be expected; for the amount of oxygenation must depend upon two factors in any given case—viz. (*a*) the temperature of the air during the period of exposure and (*b*) the length of time of exposure.

(2) An unusual accumulation of blood in the centres of circulation; in other words, the cavities of the heart and the large blood-vessels will be abnormally full of blood, owing to the blood of the peripheral circulation being driven into the centres of circulation. According to certain observers, anæmia of the internal organs has been

[1] *Vierteljahrsschrift für. gericht. Med.*, 1887, *u.* 1880.
[2] *Journ. Pharm. Chim.*, 1892, 25, p. 348.

met with. In Ogston's series, hyperæmia of the brain was found in three, and hyperæmia of the liver in seven of the cases.

(3) Punctiform extravasations of the blood under the epithelium of the gastric mucous membrane. This internal sign was found to be constant by Wichniewski [1] in a series of 44 deaths from cold. From his description, however, it is not quite clear whether these were hæmorrhages or minute collections of blood-colouring matter, the doubt arising from the fact that they could be detached from the epithelium without apparent breach of continuity of surface.

In 9 cases observed by Blosfield of Kasan, the foregoing signs, both external and internal, were found: in 5 bodies examined by Krajewsky, the pallor of, and dusky-red patches upon, the skin were found; and other observers, in smaller series of cases, have also noted these main signs.

In arriving at a conclusion in any given case that death was due to exposure and cold, it is essential that not only the post-mortem signs upon and in the body should be taken into account, but also the concomitant circumstances; and in no case, in view of the likeness of the coloured marks on the skin to those of CO poisoning, should a spectroscopic examination of the blood be omitted.

It sometimes happens in cases in which the body has been exposed to a temperature below zero, that evidence of freezing will be found upon the body. If the freezing be general, the body will be absolutely rigid as in the most marked *rigor mortis*. This condition may be differentiated from *rigor mortis* by the fact that if a joint be forcibly flexed, it is accompanied by audible crackling sounds, which are not found in a similar operation in the case of a joint stiff from *rigor mortis*. Some indication as to the time the body has been exposed may also be afforded by watching the behaviour of the body during and after thawing. It is well known that the carcase of an animal which has been frozen immediately after it has been killed does not undergo *rigor mortis* until it has been thawed, and that although the stiffening does then appear, its duration is much shorter and it is less marked than it would have been had the *rigor motris* appeared in the usual course. In a dead body, therefore, in which the stiffening appeared after thawing, it could be said, at least, that the body had been exposed prior to the usual time of onset of this phenomenon, and, if the foregoing signs were found on and in the body, that in all probability death was caused by the cold and exposure. Besides, it is not inconceivable that a body, having upon it marks of violence, and at the same time signs of death from cold and exposure, might be found in a lonely place. In such a case, the place where the body was found ought to be carefully examined, especially when wounds are found upon the body, before the balance of evidence is finally adjusted in the determination of the cause of death.

Whether is the Death due to Accident, Suicide, or Homicide?—It may be taken as a well-established statistical fact that in the bulk of cases death is due to accident. During the winter of 1881, an old, weak-minded man escaped the vigilance of his friends and wandered into the country in the neighbourhood of Glasgow. Snow fell during

[1] *Archives de l'Anthrop. Crim.*, 1895.

the period he was amissing. He was discovered two days after on a lonely hillside by a shepherd's dog, and on the shepherd coming up, he was found to be still alive, but he died almost immediately after his removal to comfortable quarters. This may be taken as one type of case in which this form of death results; intoxicated persons lying down on a roadside in cold inclement weather, as another; and young children who have wandered during similar weather, as a third. Such a death occasionally happens, however, in the case of strong men, but this is rare; it was more common in the old coaching-days than now. Casper[1] narrates an interesting case of an unmarried woman who gave birth to a male child during very severe cold weather, on the floor of her house. After her delivery, and while the child was still lying on the floor (there being no assistance at hand), she became unconscious, and on her coming to herself, she found her child dead and the body quite cold. Although her narrative of the occurrence was very circumstantial, there is left in the mind of the reader a lingering suspicion that it was, to say the least of it, a curious accident.

In January 1902 we examined the body of a married woman which was found in a park close to a suburb of Glasgow. The night before was cold, stormy, and wet. The marks of violence found on the body consisted of superficial bruises on the brow, on nose, over right eye, and on face generally. The nose was swollen, and bleeding had occurred from both nostrils. The left eye was swollen and deeply bruised, and in the area of bruising was a lacerated wound ¾ of an inch long. There were also wounds of like dimension on lower right eyelid and over right eye. The upper lip was swollen and bruised, and on its mucous surface was a lacerated wound. In the mouth, two blades of grass were found, and in the hair of the head some bits of dock-weed. On the left side of back of head was a contused area, in which was a small lacerated wound. There were four bruises on right thigh above the knee, and several abrasions in front of right shin. There were similar abrasions and bruises on inner and outer aspects of left thigh. Both lower limbs were dirty and more or less covered with mud. Internal examination did not reveal any serious lesion to account for the death. The stomach contained an alcohol-smelling liquid. There was no evidence of violence in the sexual parts. Our opinion was that the injuries found were neither individually nor collectively sufficiently severe to cause death, that certain facts indicated that the deceased had been the victim of sexual intercourse, and that death was greatly accelerrated by, if not, indeed, mainly due to, the effects of cold and exposure while deceased was under the influence of alcohol.

In April 1907 we examined the body of an elderly woman which had been found dead in a field. The trunk of body and upper and lower limbs were more or less covered with mud, as if the body had been lying in a dirty place. On left forearm, left side of abdomen between umbilicus and vulva, on left side of pelvis and buttock, left thigh, and on inner and anterior aspects of left knee, as well as on back of right elbow and right forearm, and in front of right knee, were areas of abrasion and scratches as if the body had been drawn over a rough surface or had been scratched with finger nails. Internally the lungs were found engorged with blood, the air-passages were empty of any foreign substance, the right heart was engorged, and there was disease of the mitral valve with hypertrophy of left ventricle, and extensive atheroma of thoracic and abdominal aorta. Stomach contents gave off a very marked odour of alcohol. The major portion of left lobe of liver was the seat of cancerous growth, and there were many surface cancerous nodules in right lobe, as well as cancerous enlargement of abdominal glands. The vaginal contents were pipetted for further examination. Later, no spermatozoa were found. We reported that the cause of death was shock and exposure to cold, and that the injuries, consisting of abrasions, scratches, and rubbed abrasions, were prob-

[1] *Op. cit.* vol. ii., p. 278.

ably produced, the first and last named by the body being dragged over a rough surface, and the scratches by the finger-nails or other relatively sharp instruments. At the Circuit Court, Glasgow, in July, two young lads were tried for culpable homicide of this woman, the charge being that they pulled the deceased out of bed, carried her down a stair into a court, and there had or attempted to have carnal knowledge of her, she being then in a state of helplessness from intoxication and unable to consent or resist, and did thereafter carry her or convey her along a street for a distance of about 80 yards, and did lay her down and leave her lying on said street in a partly nude state, exposed to the inclemency of the weather, while she was incapable of taking care of herself, in consequence whereof she died, and was thus killed by them. The evidence showed that the events named in the indictment had all taken place, including carnal connection, and that the deceased had been allowed to lie in what, though called in the indictment a street, was really an open field. The prisoners were found guilty and were duly sentenced.

The following case presents some unusual points of interest. A young woman, a farm servant, was tried at the July Circuit Court, Glasgow, 1909, on a charge of murder, in that, on 20th or 21st April at a farm in the parish of Ardrossan, she culpably exposed her illegitimate female child, aged five months or thereby, by placing her in an empty boiler in one of the out-houses of said farm, deserting her, and leaving her without food or sustenance, and unattended for a night, wholly regardless of consequences, whereby her child died. There was no body of a child found, but there were transmitted to us for examination and report the contents of three bottles of different sizes, and of one small cardboard box, all duly sealed and labelled. On examination, the contents of the bottles were found to consist mainly of ashes from a grate or fireplace and numerous small portions of bone, and the contents of the box, of six small pieces of animal tissue. From the contents of the bottles 71 pieces of bone of varying sizes were recovered. These, when arranged, were identified as far as possible: 26 were portions of cranial and facial bones, 9 of arm bones, 4 of pelvic bones, 8 of leg bones, and 2 of spine, the rest being non-identifiable. The contents of the box proved to be portions of cartilaginous tissue with, in one case, a minute portion of muscular tissue; all of which bore evidence of exposure to fire. It appeared later that the accused stated at the time of her apprehension that having found, as she alleged, her child dead in the empty boiler, she kindled a fire in the boiler-grate and placed the body of the child in it. The contents of bottles were recovered by the police from the grate and from the ashpit. After evidence was heard, the jury found her guilty of culpable homicide.

Suicide by Cold may be considered so rare as to be left out of consideration.

But cold and exposure have been used with homicidal intent. A few such cases have been recorded, but two will suffice for illustration. Dr Ozonam of Lyons [1] records one in which a girl, eleven years of age, was forced by her father and stepmother into a barrel of water on a cold night in December, and, although the girl was rescued by a servant, she was again forced back by the parents. She died in consequence of this treatment. After trial, the stepmother was condemned to imprisonment for life. Another case—R. *v.* Lovell—was tried at the Gloucester Lent Assizes, 1853, and the charge against the woman was that she had forced the child, who was sickly, under the spout of a pump in cold weather in January, and pumped the water upon her. The child died shortly after. At the trial, the woman was found guilty by the jury, and Mr Justice Talfourd said, although it was contrary to the evidence of the medical witness, he entirely agreed with their verdict.

[1] *Annales d'Hygiène*, vol. vi., 1831, p. 207.

VIII. DEATH FROM HEAT APOPLEXY

This form of death may arise either from insolation or sunstroke, or from abnormally high temperatures in which men have to work hard. While from the former cause it is not unknown in this country, it is much more frequent in other countries where during summer the climatic conditions approach those of the torrid zone. The annual deaths from this cause in this country may be, on the average, any figure between 100 and 130. Persons who have undergone or are undergoing much fatigue in a humid atmosphere of high temperature are most liable to attack from sunstroke. In such cases, it may present itself in one or other of the following typical forms :—(1) The individual is suddenly stricken down insensible, in a state of collapse, with a pale, cold, moist skin, gasping respiration, and with a feeble, rapid pulse. The bodily temperature may be found approximately normal. (2) In the second form, the mode of onset is more gradual, and premonitory symptoms show themselves, such as weakness, weariness, sickness, heat of skin, restlessness, sleeplessness, or drowsiness ; and there may be temporary delirium or mania. Then follows a comatose condition, during which the person becomes completely insensible, with a weak, rapid, and irregular pulse, a pale face, and a bodily temperature from 104° to 110° F. The pupils, which are at first dilated, become contracted in this stage. Convulsive movements of a limited kind, or general convulsions, may supervene, followed either by death or recovery. Death usually occurs within 48 hours of the seizure ; if the patient live over this period, he may be expected to recover. Death, however, happens in not less than 40 per cent. of cases. From the foregoing appearances, therefore, the two forms which sunstroke assumes may be designated shortly as the cardiac or syncopal and the hyperpyrexial or comatose.

Four different hypotheses have been propounded as to the intimate cause of this affection or seizure—viz.

1. The Caloric theory.
2. The Chemical ,,
3. The Autotoxic ,,
4. The Microbic ,,

Those who argue in favour of the first affirm that the action of great heat upon the body is to derange the action of the vasomotor and heat-regulating centres of the body. The supporters of the second urge that the seizure is due to the ultra-violet and violet rays of solar light acting chemically upon the brain and nerve-centres in the manner that they are capable of producing dermatitis in the process of skiagraphy. The autotoxic theory is based upon the view that high temperatures, acting upon the body from without, produce profound changes in the blood, in respect that the products of imperfect metabolism of tissues are discharged into that fluid, and acting upon the vasomotor centres and cardiac ganglia produce the profound constitutional symptoms. Some force is given to this view by the fact that the blood of a victim of insolation has been found to produce toxic effects upon animals. There are, besides, those who believe that the

affection, like many other tropical diseases, is due to micro-organisms, because heat-stroke or heat apoplexy is endemic in certain tropical low-lying regions, and, occasionally, takes an epidemic form. Time and research are both needed, however, before the true cause or causes of sunstroke are determined. But heat apoplexy takes place quite apart from the direct rays of the sun, as, for instance, in the case of stokers, engineers, and others whose duties compel them to work in hot, confined places. Many such cases have been put on record. The history of such is something like the following:—the person falls down suddenly, either partially or completely insensible, with a temperature of about 104° F.; this gradually rises until it may reach 107° to 110° F.; the pulse becomes rapid, weak, and almost imperceptible; the breathing is stertorous, and the face, more or less cyanosed. After appropriate treatment, the temperature having been reduced by ice-packs, etc., the person may recover. Such cases usually occur under the circumstances described in hot climates, but they are not unknown even in our own country in men working at furnaces during hot, summer weather. The seizure may also occur in the lower animals.[1]

Dr Glaister, R.N., has reported to us the facts of a case in which a stoker of a cruiser was attacked by heat apoplexy while working in the stokehold, the temperature of which at the time was 130° F. The ship was then in sub-tropical waters. The man became suddenly unconscious. His temperature was found to be 108·6° F. when he was brought up from the stokehold. He died in about four hours.

Jardini [2] describes his experiences of sunstroke in Florence in 1905, in which year, owing to sudden access of great heat, high vapour tension of the air and marked electric condition of atmosphere, the number of cases was larger than usual. Most cases occurred in July, the mortality being 10 per cent., and the largest percentage of deaths being among males, probably due to their greater exposure and harder work. As a rule, the attack was sudden, and not infrequently after a hearty meal had been eaten. Cyanosis was not uncommonly present during the attack, and urea was found to be lessened in amount at height of attack. At first sight the coma of sunstroke resembles uræmic coma, but it differs from the latter in being associated with hyperpyrexia. In the Florence attacks the order of frequency of occurrence of types was as follows:—(*a*) mixed forms; (*b*) asphyxial; (*c*) syncopal; (*d*) cerebro-spinal. Jardini is in favour of the view that insolation is due to hyperpyrexia and auto-intoxication. He also notes that when death takes place decomposition of the body sets in quickly.

In September 1906, a stout, red-faced man of about 40 years of age suddenly became unconscious, was somewhat cyanosed, and breathed stertorously. He was a country carrier and had brought a parcel into a shop where he was stung by a wasp, for which soda was applied. The next minute he fell on the floor unconscious. When medically examined he was found to be breathing six or seven times only per minute, was rapidly becoming more cyanosed, and to have no perceptible pulse at wrist, faint heart-beats numbering about 120 per

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[1] For further references, consult:

Lancet, vol. i., 1889, p. 781.
B. M. J., vol. ii., 1900, p. 764.
,, ,, ii., 1900, p. 831.
,, ,, ii., 1896, p. 1568.
,, ,, i., 1897, p. 78.
,, ,, i., 1898, p. 862.
,, ,, ii., 1906, p. 596.

[2] *Clin. Modern*, 22-24, an. xii.

minute being discovered, however, on auscultation. His eyes were closed, conjunctivæ were insensitive, pupils insensitive to light but about normal in size, the eyeballs being turned sharply toward the left. The shade thermometer stood at 90° F. He was first bled from the arm to between five and ten ounces, and his head then packed in ice. About twenty minutes later there were signs of returning consciousness, as exhibited by slight restless movements and rigidity of limbs, which up till then had been flaccid. In ten minutes more his respirations had increased to fifteen per minute and he began to groan. He was then sent to hospital. About an hour after admission he began to shout, and to struggle violently and persistently, but aimlessly. His wrist pulse was still imperceptible. He was again bled at the arm to the amount of about a pint. During the night he was quietly delirious. Next day he was more rational, but dazed. He was able the day after to tell that he had been stung by wasps on five or six occasions previously, and on each occasion had become unconscious for some hours and had been delirious afterwards.[1] The recorder of the foregoing fact heads his communication "Sunstroke or Wasp Sting." We think there can be little doubt that the cause of the illness was the latter, and we refer the reader to p. 755, where we have recorded similar symptoms following the stings of black or Ligurian bees.

Post-Mortem Appearances.—In the first type of cases, the cause of death being syncope, the appearances found on section of the body will be those of death by syncope. In the second type the death is due to interference with the functions of brain and lungs, therefore the appearances will be those of comato-asphyxia. Both of these have already been fully described.

IX. DEATH FROM MORTAL WOUNDS

As in the succeeding chapters the whole question of Wounds and Wounding will be fully considered, it is enough at present to state broadly what kinds of wounds, and wounds of what organs of the body, are incompatible with the continuance of life.

A mortal wound may be defined as one which almost immediately after its causation, or within a short period thereafter, causes death; therefore, it usually so interferes with the function of a vital organ of the body, or with the integrity of the general functions of the body, that death is produced.

Generally speaking, wounds of the following organs may be deemed as mortal—viz.

1. Of the heart and great blood-vessels—arterial or venous—in which, by penetration of their walls, the course of the circulation is diverted, and their function embarrassed;
2. Of the brain, spinal cord, and medulla oblongata, especially of that part of the cord close to its exit from the brain; owing to injury to important nerve-centres;
3. Severe wounding of the respiratory apparatus;
4. Wounds of the abdominal viscera; of stomach, liver, spleen, kidneys, urinary bladder, intestines; either from primary shock, or hæmorrhage, or from subsequent peritonitis.

But persons may outlive, for days or for longer periods, wounds of the heart. Cases are on record of this kind:

[1] *B. M. J.*, vol. ii., 1906, p. 608.

1. Penetrating wound of the left ventricle, after which the person lived till the fourth day ; [1]
2. Wounding of the right ventricle, where person lived for ten years after ; [2]
3. Wounding of the left coronary artery and vein and of the muscular substance of heart, where person lived for four and a half months after ; [3]
4. Penetrating wound of left auricle which was sutured, where person lived for seventeen days after.[4]

For further reference to this subject, consult Langenbeck's *Archiv.* for 1868 — article by Fischer of Hanover, where are recorded 452 cases of wounds of the heart, of which 72 recovered, 104 died immediately, and 270 lived for periods afterwards varying from one hour to nine months ; and Watten, *Deut. med. Wochen.*, Sept. 12, 1901.

In the Phœnix Park assassinations, 1882, the death of Mr Burke was due to penetration of the left cardiac ventricle, and of Lord Frederick Cavendish to hæmorrhage from severance of the right axillary blood-vessels. In the Finchley tragedy, the right ventricle of the victim was penetrated. We have seen several homicidal deaths which were caused either by penetration of one of the cavities of the heart, the aorta, the pulmonary artery, or the common carotid. In all of these last-mentioned cases death followed almost immediately.

With respect to wounds of the internal abdominal viscera from applied violence, the fact cannot be too strongly impressed upon the mind that serious wounding may be present without any mark of violence whatever being visible on the abdominal wall externally.

[1] *The Lancet*, vol. ii., Oct. 8, 1881.
[2] *Med. Times and Gazette*, Aug. 3, 1861.
[3] *B. M. J.*, vol. ii., 1896, p. 1440.
[4] *Giordani, Rif. Med.*, Sept. 9, 1898 ; and *B. M. J.*, vol. ii., 1898, *Sup.*, p. 77.

CHAPTER X

WOUNDS IN THEIR MEDICO-LEGAL RELATIONS

It may be said generally, that all lesions of the body, internal or external, which are caused by the application of mechanical violence may be designated as wounds. Certain kinds of lesions, however, are neither medically nor legally so designated; for example, the lesion produced by a red-hot poker is, legally and otherwise, more properly called a burn. It will be well, therefore, at the very outset to have a clear conception of what, legally, constitutes a wound. In law, a wound is a breach of continuity of the true skin, or mucous membrane, or other internal structure of the body; therefore, a mere abrasion of the epidermis or cuticle which does not include the *cutis vera* is not a wound in law. The above definition is not obtained from any Act of Parliament which deals with crimes in which wounding is a prominent feature, but is derived from various decisions of judges given from time to time in cases of wounding. Wounds may be said to include all local alterations of tissues of the body which are caused by violence, whether the cause has been violently applied to the body, or the body to the cause. Notwithstanding the many definitions which have been proffered by various writers, none is better for inclusiveness and comprehensiveness than that given by Wiseman, who was serjeant-surgeon to Charles II.[1] It runs as follows:—"A solution of continuity in any part of the body suddenly made by anything that cuts or tears, with a division of the skin. By the word skin, I understand not only the external cutis, but also the inward membranes of the gullet, ventricle, guts, bladder, urethra, and womb, all of which are capable of wounds from sharp instruments, either swallowed or thrust into them." With respect to any external lesion of the skin of the body, it may be said that the presence of bleeding, however slight, may be held to be evidence of wounding, since it is indicative of implication of the true skin. Mere separation of the epidermis is unaccompanied by bleeding.

In a case tried before the Court of Crown Cases Reserved in August 1838, where, in an assault by a stone bottle, the epidermis only was separated, and although the assaulted person lost the sight of an eye and the hearing of one ear from the effects of the assault, the judges held that to constitute a wound in law, it was necessary that the whole skin should be divided, and therefore, the charge of wounding against the prisoner could not be sustained. The prisoner, consequently, was convicted of common assault only.

The Acts of Parliament which deal with the crime of wounding are the following:—

[1] "Chirurgical Treatise," book v. chap. i.

1 Vict. c. 85.
14 & 15 Vict. c. 100.
24 & 25 Vict. c. 100; sects. 11, 15, and 20.

With respect to lesions producible by violence other than external or internal breaches of continuity of the surface, it was formerly held of simple fractures that such were not wounds, but within the last half-a-century or thereby, Chief-Justice Denman, Justice Parke, and other judges have ruled that these fall within the legal definition of a wound. In the case, R. *v.* Smith (8 C. and P., p. 173), where the lower jaw had sustained two simple fractures from a hammer, and where it was argued by counsel that these injuries were not wounds in law, Justice Parke said, " there must be a wounding; but if there be a wound (whether there be effusion of blood or not), it is within the statute whether the wound be external or internal." On the same ruling, a dislocation which is accompanied by wounding of ligaments would be legally considered to be a wound; in fact, it has been so decided. Moreover, bruises in which there is internal breach of continuity of tissues, although there be no external breach of continuity, are reckoned legally as wounds. Consequently, to Wiseman's definition must be added breaches of internal tissues.

WOUNDS IN THEIR RELATION TO DANGER TO LIFE

In order to convey some meaning to the minds of others with respect to the relative gravity of wounds, certain qualifying terms have been applied; as, for example, *slight*, *dangerous*, *mortal*. It is very necessary that medical witnesses, especially, ought to have clear and definite conceptions of what ought to be meant by these terms.

A *slight* wound ought to mean one in which the lesion is neither extensive nor serious, which heals rapidly, and which leaves no deformity behind it; a *dangerous* wound, one that is either extensive or serious with relation to the organ or part wounded, which presents surgical difficulty in its cure, but which is not attended usually by fatal consequences; and a *mortal* wound, one which almost immediately after its causation, or within a short time thereafter, causes death. A wound ought to be deemed *dangerous to life* only when the danger is imminent; as, for example, where a large artery is wounded, since in the absence of skilled assistance death from hæmorrhage would ensue. The term ought not to designate a wound which, originally simple in character, becomes dangerous from superinduced disease, as tetanus, erysipelas, or septicæmia, even although from such secondary complication the wounded person may die. " Whosoever shall, by any means whatsoever wound or cause any grievous bodily harm to a person " shall be guilty of crime. So run the words of the statute. What then is meant, or ought to be meant, by the words " *grievous bodily harm* " ? It is difficult to put in terms what is meant in law by these words; but it may be said that grievous bodily harm is inflicted when the injury causes some measure of pain or inconvenience, or both, to the assaulted or injured person, and so prejudices, for the time being at least, the bodily health.

At the Leeds Assizes, February 1883, before Mr Justice Day, the Corporation of Sheffield prosecuted a midwife for having recklessly spread syphilis among certain women whom she had delivered, and from them to their husbands. The charge against her was that on a certain date she "unlawfully and maliciously did inflict grievous bodily harm on" the persons named "against the form of the statute in such case made and provided, and against the peace of our Lady the Queen, her Crown, and dignity." The prosecution brought forward three groups of persons infected by the defendant,—two married women, one infant, and the husbands of the women. It appeared that forty-five persons in all were infected either directly or indirectly by the defendant. She was found guilty on all the counts, and was sentenced to twelve months' hard labour.[1] Burning by the throwing of corrosives is another example of causing "grievous bodily harm" (*cf.* p. 207).

WOUNDS WITH RELATION TO CULPABILITY

If a wound be inflicted to remedy which surgical operative procedure is required, and from which surgical procedure, *skilfully applied*, the assaulted or injured person dies, the person who caused the wound is chargeable either with the crime of murder, or culpable homicide or manslaughter, these last being the terms employed in Scots and English criminal law respectively to designate the same crime. In such circumstances, however, it would be competent for counsel for the prisoner to lead evidence, if he thought fit, to show that the treatment was not skilfully applied. The law is very liberal in its interpretation of the meaning of skilful treatment. If the person who applied the treatment is a registered medical practitioner, if it has been applied for the purpose of cure and in good faith, even if the treatment in itself was improper, the assaulted person would be considered to have been skilfully treated, and the assailant chargeable with the major crime; provided that it was not proved in evidence that the original injury was not in itself dangerous to life, or that the improper treatment *per se* was not the cause of death. The law demands only reasonably skilled treatment, such as ought to be able to be given by any ordinary registered practitioner, for the simple reason that the standard and means of treatment of a rural practitioner ought not to be gauged by those of an expert hospital surgeon. It is because of the alleged absence of reasonable skill, or the non-exercise of it, that actions of mala-praxis are not infrequently laid against medical men.

It is not expected that medical men should be familiar with the circumstances which constitute wounding in one case to be justifiable, and in another, criminal. If, for example, two persons agree to commit suicide together by the same agency, and one die and the other survive, the survivor is chargeable with the crime of murder.

At the Manchester Assizes, Nov. 1906, John Chapman, aged 18 years, was convicted of murder, with a strong recommendation to mercy by the jury, and was sentenced to death, under the following circumstances. The prisoner

[1] *B. M. J.*, vol. i., 1883, p. 335.

and his sweetheart drank some poison with the intention of dying together. He recovered, but the girl died the next day.

On the other hand, if a fatal wound be inflicted in self-defence when the inflicter was under just bodily fear of death from an assailant, provided it was not inflicted in a duel, the deed would be held in law to be justifiable homicide or manslaughter.

1. *Fatal Revolver Wound in Chest of a Burglar. Justifiable Homicide.*—In March 1908, we were present at the post-mortem examination of the body of a man who had been shot while burglariously entering a private residence in the West End of Glasgow. The body was that of a young, powerfully-developed man. On the middle of the chest in front was a rounded opening situated four inches directly downwards from the suprasternal notch in a line joining the nipples. It measured three-eighths of an inch in diameter. Its edge appeared as a ring of hard blackened tissue, but there was no evidence of surrounding scorching or tattooing Just within the posterior fold of left axilla was another wound, ragged and lacerated in character, which measured approximately half-an-inch in diameter. For a distance of several inches round this wound there was considerable swelling and bruising of tissues, and much liquid blood was present around the part. Internal examination of the chest showed that the wound in the sternum was like an accurately drilled hole, that a missile had passed in a very oblique direction inwards and to the left into the pericardium. The pericardium was found to contain twelve ounces by volume of firm blood-clot and a few ounces by measure of clear serum. The wound had penetrated the right ventricle immediately below the lower border of the tricuspid valve, severing in its course some of the attachments of the valve, passed through the interventricular septum, traversed the left ventricle, ploughed a deep furrow one and a half inches long on inner wall of said ventricle, and emerged therefrom about eleven inches from its upper border. It then penetrated the posterior wall of pericardium on the left side, traversed the lung, passed partly through and partly between the sixth and fifth ribs, and from this point the missile had been deflected upwards through the soft tissues to its point of exit in left axilla. No missile, or portion of it, was found in the body.

An inquiry into the circumstances attending the death under the Fatal Accidents Inquiry (Scotland) Act, 1895, and the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act, 1906, was held on March 25. Among the productions in the case were two revolvers, one of which, loaded in three chambers, was found in possession of the deceased at the time he was shot. Found on deceased, and also produced, were a sheath knife with a blade seven inches long, several burglar's tools, a crape mask, and a tiny electric lamp. The evidence of the young man who fired the fatal shot was that he sat in the smoke-room till shortly after 1 A.M., and then went into the dining-room. On going into the room he heard a noise outside, and listening at the window he heard shuffling, as if someone were moving in the grounds outside. He then went upstairs to the morning-room. Looking from a window there, which overlooks the grounds close to the dining-room window, he saw a man, who was wearing a grey cap, leap up to the window-sill and walk along towards the drawing-room window. He then went to his bedroom and obtained his revolver and cartridges, and then went to the telephone and informed the police of the presence of a housebreaker in the grounds. Shortly after, he proceeded on his way upstairs to the morning-room, and at the top of the stairs he heard a noise as if someone were in the morning-room. The door of this room was about half-way open. He waited a few moments, then quietly crept into the room, switching on the electric light as he entered. In the centre of the room he saw standing the man in the grey cap. He asked the man what he wanted, and added that he had telephoned for the police, saying also that the intruder might go downstairs without any fuss, and await the arrival of the police. Witness then saw the man drop his hand to his pocket, and, fearing mischief, he ducked behind a screen and skipped to its opposite end. A shot passed through the right of the screen. Witness fired in return. By this time the deceased had moved towards the fireplace. The intruder then fired a second

shot, which also passed through the screen, and witness fired two shots in rapid succession. The intruder then tottered and fell, and witness went to him and took the revolver from him. He never said a word during the whole time. Then the police arrived. The Sheriff, in reviewing the case, directed the jury to find a verdict narrating the facts, and to add the words "that witness was

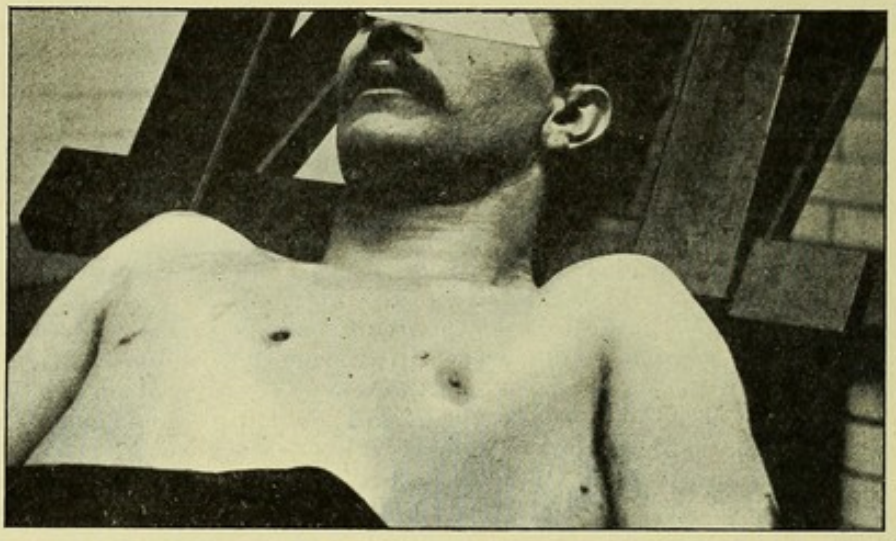

FIG. 47.—Entrance wound of bullet as seen over sternum midway between nipples as a circular punched-out opening. The tumefaction of left axilla surrounding wound of exit is just visible.

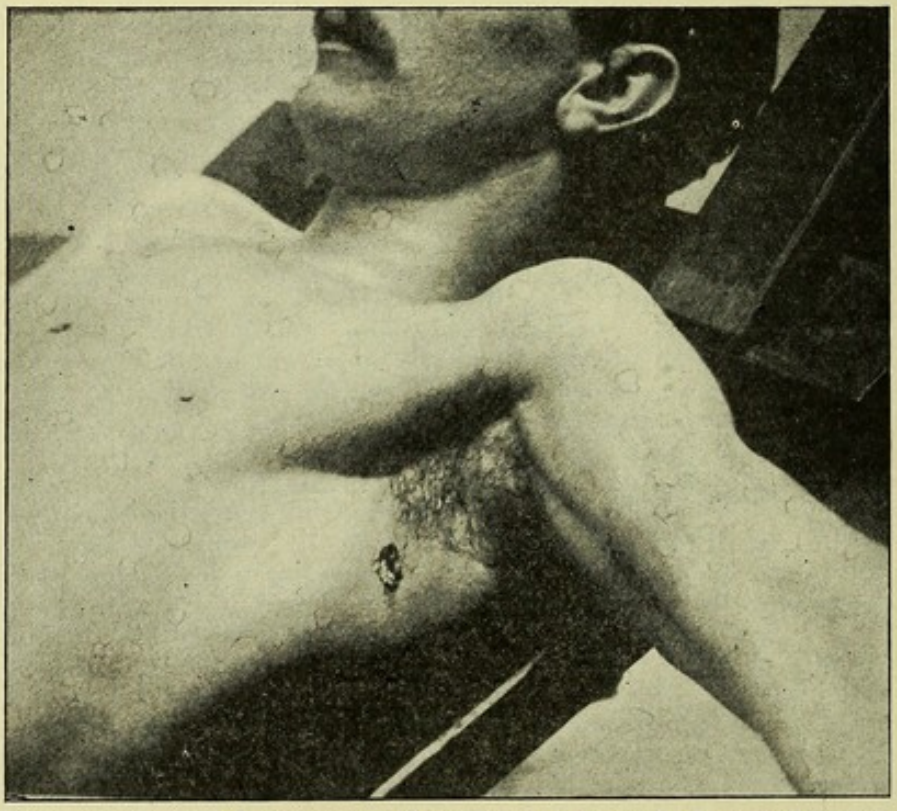

FIG. 48 shows wound of exit in left axilla as an irregular lacerated wound, surrounded by a large area of tumefaction. The entrance wound is seen as a line mid-sternum.

entirely justified in acting as he did in the defence of his own life." The jury after consultation, found accordingly.

2. *Fatal Shooting by Mistake.*—At a Fatal Accidents Inquiry held in Glasgow on Oct. 14, 1908, a Sheriff and jury heard the facts relating to the death of a woman who had been accidentally shot by her husband, who had

mistaken her for a burglar. The husband and wife were caretakers of a Home for Working Boys. The evidence of the husband, who had served as a soldier at home and abroad for 21 years, was that on the occasion in question (Aug. 9), he and his wife were sitting together a little later than usual, waiting for one of the inmates who had not returned. They heard an unusual noise on the stair below. He went out and listened, but came to the conclusion that the noise was due to rain pattering on the glass roof above the stair. They both returned to their room and sat for a little longer, when the noise was repeated, which his wife declared was not due to rain. After listening again, he agreed with her. Knowing that the premises had once before been burgled, he got his revolver out of a bag and filled its six chambers with cartridges. Taking off his slippers at his wife's suggestion, he examined the premises. Coming out of the cellar (the stairs leading up to his house being quite dark except for the reflection coming through the partly open door of the sitting-room) at a sharp turn of the stair he noticed all at once in front of him and above him what he took to be a revolver and a man behind it. He expected to see the flash of the revolver, and getting excited, he thought he had better fire as quickly as possible, which he did. While waiting for the smoke of his revolver shot to clear away, he heard his wife's voice come from the direction in which he had fired. He then rushed forward and lighted the stair-gas. He then discovered that it was the candle in his wife's hand which he had mistaken for the revolver. He saw a wound on her wrist, and thinking that his mistake was not to have a serious issue he felt somewhat relieved. He then carried her to her bedroom, and laid her on the bed, but on further examination found that she had also been wounded in the stomach. A constable, who happened to be near by, hearing a shot in the direction of the Home, went there and looked through the gate. He saw the husband standing with a revolver in his hand, and, asking what was wrong, was told by the excited husband that he had shot his wife. The wife told witness that her husband did not mean to shoot her. He helped to convey the wife to her bedroom. The jury found that the wife had been accidentally shot by her husband under the impression that she was a burglar, and expressed sympathy with the husband and the wife's relatives.

It is a crime to attempt to commit suicide by wounding or in any other way, unless the person be proved to be of unsound mind at the time. Suicides who recover after attempts to destroy themselves, if sane, are chargeable with the crime of attempted *felo de se* or self-destruction.

If a wound be the cause of death within a year and a day after the date of its infliction, the person who maliciously inflicted it may be charged with the crime of culpable homicide. In civil suits also, within a like period, an action would lie. Under the Workmen's Compensation Act of 1906, due notice must be given to the employer of the occurrence of an accident, and if an action be raised, that must be done within six months after the date of the accident. In cases where the employer requires it, the injured workman shall, from time to time, submit himself for examination by a registered medical practitioner appointed and paid by the employer. If the workman objects to or is dissatisfied with such examination, he may elect to be examined by one of the medical men in his locality appointed for the purpose by the Secretary of State. The report of that practitioner shall be deemed conclusive.

Mala-praxis or Malpractice is, as the name implies, failure in the exercise of reasonable skill or care on the part of a medical practitioner. As it is of the highest importance that the lives of the citizens should be conserved, if possible, when menaced by disease or by the infliction of injury, most civilised States enact that those who are to pursue the profession of medicine and surgery

should be duly educated and examined before being adjudged fit to have their names placed upon a register as being considered duly qualified by the State. The public who entrust themselves to the skill and care of such registered practitioners are, therefore, entitled to demand and to expect from them the exercise of reasonable skill and care. There is no let or hindrance in British law to any person, however unfit, professing the treatment and cure of disease, so long as such person does not falsely pretend by the illegitimate use of titles commonly used in this country by those who are legally registered, or in other way, that he is so qualified and registered. But the law will more narrowly scan the actions of such persons, since, obviously, death may arise in the course of their practice attributable to their lack of knowledge, or to improper treatment. Further, illegitimate practitioners are not entitled by law to sue in law-courts for fees for services rendered, since they are not upon the legal register of those who are recognised as qualified to render medical or surgical services.

What is meant by the terms "reasonable skill" and "reasonable care" with reference to the practice of medicine and surgery? These are difficult to define. Obviously there must be in theory a minimum in respect of both, failure to satisfy which would inculpate the practitioner. The question whether or not mala-praxis has existed must depend upon the facts of each case; but from a purview of many cases, it is clear that gross ignorance of treatment, or gross carelessness in the conduct of a case, is necessary for a conviction of malpractice. It is obvious that the term "reasonable" must be applied relatively. It cannot be expected that a rural practitioner should possess the surgical resources of a hospital surgeon; therefore, all that the law demands is the exercise of such an amount of skill as ought to be possessed by everyone who has received the statutory education and who has passed the statutory examinations. It is laid down by the law that a medical practitioner is not responsible where, for example, in the *bona fide* treatment of a case a drug has been administered to expedite a cure or to convey relief, but which, contrary to ordinary experience, has acted disastrously. Sir Matthew Hale [1] declares that "if a physician gives a person a potion, without any intent of doing him bodily hurt, but with an intent to cure or prevent disease, and, contrary to the expectation of the physician it kills him, this is no homicide; and the like of a chirurgeon." Chief Baron Pollock (R. *v.* Crick, 1 F. and F., p. 519), said: "It would be most fatal to the efficiency of the medical profession if no one could administer medicine without a halter round his neck" and in the case of R. *v.* St John Long, Mr Justice Parke said to the jury, "It would be a dreadful thing if a man were to be called in question criminally whenever he happened to miscarry in his practice." Whether or not reasonable skill or reasonable care has been exercised must be determined by the evidence in each individual case. Cases on the border-line might be cited in large numbers. It would be a question for a jury to determine whether, for example, in a case of delivery of a child, the perinœum of the mother being torn some inches into the rectum, and where no surgical remedial procedure was adopted, nor, indeed, any intimation of the occurrence was made, with the result that the woman thereafter suffered from incontinence of fæces, the medical practitioner was guilty or not of malpractice. It would, doubtless, be probably argued that rupture of the perinœum is not an uncommon accident in such cases, but there would be difficulty in explaining why the lesion produced was not surgically treated by the practitioner, and why he had not called for assistance if he himself were unable to cope with the lesion. The *culpa* in such a case would not lie in the production of the lesion but in the gross negligence exhibited in its treatment. In criminal cases, great carelessness or gross ignorance must be proved. At the Calcutta Criminal Sessions, April 1884, a medical practitioner was tried and found guilty of having caused the death of a child by administering an enema of carbolic acid in water for worms. The enema was proved to contain 200 drops of Calvert's No. 2 acid. The reprehensible ignorance displayed in this case merited the punishment which was awarded. It has been our duty to advise the Crown regarding cases of alleged malpractice. In one case in which the information was laid by one practitioner against another, it was alleged that owing to the culpable carelessness

[1] "Pleas of Crown," i. p. 429.

of the accused, enormous bed-sores had formed on the body of the patient. Examination of the patient and other inquiries revealed that the sufferer was a paraplegic and that the nursing had not been carried out according to instructions. The charge, therefore, broke down. In another, a practitioner was accused of the death of a woman after her delivery, in respect that he had failed to give her the usual and necessary care and attention. Post-mortem examination of the body of the woman showed that death resulted from septicæmia, due in all probability to absorption of septic matter by a small breach in the perinœum—a condition which, occasionally, arises even with the exercise of the greatest care. The charge, therefore, was never formulated. In 1893, at the Central Criminal Court, London, certain "Indian" oculists were charged with alleged conspiracy to obtain money by false pretences with intent to defraud. It was shown in evidence by eminent oculists that the operations performed by these persons were not only antiquated and barbarous, but were also useless and unnecessary for the purpose of cure. On the questions being put to the jury whether they thought the operations performed were as above described, and whether there was intent to defraud, a verdict of not guilty was returned. In the case of R. *v.* Wight, tried at the same Court in November 1895, the accused, being a qualified practitioner, was charged with having caused the death of a woman while delivering her with forceps, he being at the time under the influence of alcohol. It was shown in evidence, however, that the cause of his condition was not alcohol, but chloral hydrate. He was found guilty and sentenced to three months' imprisonment. In delivering sentence, Mr Justice Wright stated that had alcohol been proved to be the cause of the prisoner's condition, a much more severe sentence would have been passed. The comments of the Judge indicated very properly that no medical man was entitled to practise his profession while under the influence of any drug or other narcotic substance. Charges of malpractice are common against practitioners in civil actions. They are usually founded upon badly-mended fractures, or injuries with division of nerves followed by loss of power. But some of the charges are unusual. In June 1899, in the case of Smith *v.* Burns, the defendant was sued for damages in respect that through negligence or ignorance he had opened an aneurysm of the leg in mistake for an abscess. After trial, the jury returned a verdict for the defendant. The judge in his charge to the jury said that a medical man was not responsible for an error of judgment, and that the question they had to decide was, whether the error was one which any reasonably instructed surgeon, using due care and skill, would have made.[1] The law relative to the responsibility of a medical practitioner may, in short, be summed up in the words of the Lord Chief-Justice in the action of Anderson and Another *v.* Moeller which was tried in May 1900 —viz. "A medical man was bound to bring to the discharge of his duty only reasonable care, skill, and knowledge."

Probably one of the most outstanding cases of recent years was that of Southern *v.* Dr Skryne and Mr Lynn Thomas, the facts of which are briefly as follow:—The plaintiff, while riding a bicycle, came into collision with a cart, and was thrown, bruising his face, wrist, hand, knee, and ankle on the right side, and sustaining a fracture of the surgical neck of the humerus, complicated by sub-glenoid dislocation of the head of the bone and by much bruising of tissue about the shoulder-joint. Defenders reduced the dislocation, but the head of the humerus remained rotated with the articular surface inwards, and the fracture surface outwards, the fractured end of the shaft being drawn upwards and inwards into the axilla, and the fractured surfaces not brought into apposition. The bones were brought into lateral apposition and united in that position. When plaintiff recovered, the movements of the arm were, in consequence, much limited. Skiagrams showing the displacement and form of adjustment of the broken bones were taken. Plaintiff claimed damages of £2000 against defendants. At the first trial, held in Cardiff, the jury disagreed. At the second trial, held in London, in which a large number of eminent surgeons gave evidence, the jury awarded damages to the plaintiff of £100 with expenses, the latter carrying the costs of both trials, which amounted to over £4000.[2]

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[1] *B. M. J.*, vol. ii., 1899, p. 60.

[2] *Ibid.* vol. ii., 1905, p. 1620; *ibid.* vol. ii., 1906, pp. 1607, 1658, 1673.

Among other cases may be cited Pughan *v.* Darnell,[1] in which damages were recovered against a medical practitioner in prescribing belladonna liniment without warning those who nursed the patient of the dangerous character of the drug and the need for caution in its use. The evidence showed that the practitioner acted according to the ordinary usage of the profession in such circumstances. The judge ruled, however, that this was not sufficient, and that the law requires that a physician should use the highest degree of care, prudence, and foresight known to the law, or, as described by another judge on a previous occasion, "consummate care, prudence, and foresight." In Lanphier *v.* Phipos,[2] in which the defendant, a surgeon, called to treat the plaintiff for injury to wrist and hand, mistook the nature of the injury so that plaintiff lost the use of her hand, Chief-Justice Tindal said to the jury that "every person who enters into a learned profession undertakes to bring to the exercise of it a reasonable degree of care and skill. He does not undertake, if he is a surgeon, that he will perform a cure, nor does he undertake to use the highest possible degree of skill. There may be persons who have higher education and greater advantages than he has, but he undertakes to bring a fair, reasonable, and competent degree of skill, and the question is, whether the injury must be referred to the want of a proper degree of skill and care in the defendant or not." A verdict was given for plaintiff with damages of £100.

In Rich *v.* Pierpont,[3] Chief-Justice Erle said "that a medical man was certainly not answerable merely because some other practitioner might possibly have shown greater skill and knowledge, but he was bound to have that degree of skill which could not be defined, but which in the opinion of the jury was a competent degree of skill and knowledge."

The Characters of Wounds.—In cases of wounding it is important that the character of the wound, in relation to the class of weapon by which it was produced, should be properly designated. For that purpose wounds have been classified as follows—viz.

(*a*) Incised wounds;
(*b*) Lacerated and Contused Wounds;
(*c*) Punctured Wounds;
(*d*) Contusions;
(*e*) Gunshot Wounds.

I. Incised Wounds.—In surgical language, an incised wound is defined as "a solution of continuity without loss of substance." Such wounds are produced by sharp-edged instruments, as knives, scissors, glass, sharp edges of metal vessels, or earthenware. The instrument may be used either:

(*a*) As a wedge; as in stabbing, where the sharp point of the weapon is driven into the tissues, thus separating them as a wedge does a piece of wood (Fig. 49); or,

(*b*) After the manner of a saw, where the tissues are divided by the microscopically fine serrated edge of the cutting instrument held in the fashion of a pen, which serrations are the more apparent the blunter the edge of the weapon. To observe this serration of edge, it is only necessary to examine the edge with a good hand-lens against a black background.

The *Form* of an incised wound depends, in some measure, upon the mode of use of the sharp instrument. When it is used as a wedge, the form of the wound is fusiform or spindle-shape, due to the greater

[1] *B. M. J.*, vol. i., 1906, p. 815.
[2] 8 C. and P., 475.
[3] 3 F. and F., 35.

retraction of the tissues in the middle of the breach of continuity; but when it is used as a saw, the spindle-shape character may be more or less lost in the linear. This gaping or retraction depends, also, as to its amount upon the elasticity of the particular tissues severed, and upon the direction of the wound; for example, a wound made in the plane of the muscular fibre gapes less than one made at right angles to the plane; and the same is true when a limb is extended than when flexed. (Fig. 50.)

The *Edges* of an incised wound are clean-cut, regular, and well-

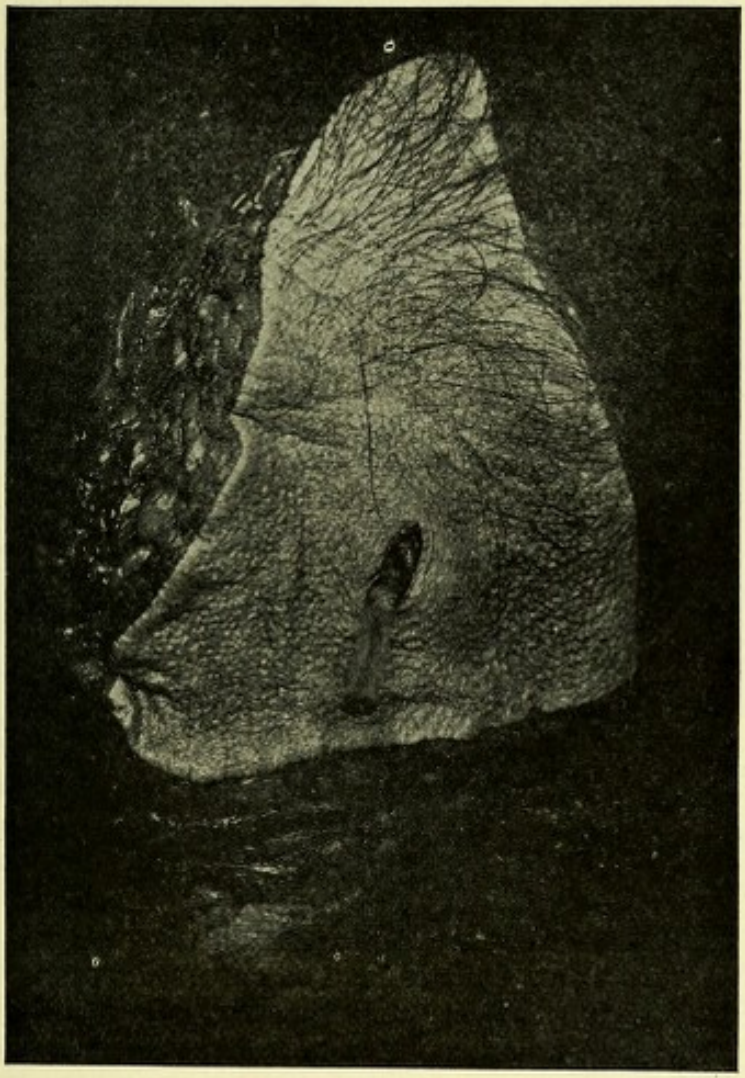

FIG. 49.—Photograph of Incised Wound in Wall of Chest produced by Stabbing. The weapon entered the Aorta. (Author.)

defined, begin abruptly, bulge in the centre, and terminate gradually. An incised wound usually bleeds much more, things being equal, than do other kinds of wounds. With relation to the class of weapons which produces them, incised wounds are broader than the edge of the cutting instrument (in other words, broader than the thickness of the blade), and their length is usually somewhat less than the breadth of the instrument. This rule, however, applies more to wounds produced by stabbing—where the instrument is used as a wedge—than to those where it is used after the manner of a saw. Stabs which partake of the

character of an incised-punctured wound are of distinct fusiform shape, and are generally less in length than the breadth of the instrument, because of the contractility of the tissues. Where a penetrating incised wound has passed through a limb, the wound of exit is likely to be smaller than that of entrance, because of the common tapering character of instruments capable of producing wounds of such depth. It may



FIG. 50.—Case of Homicidal Cut-throat. (*Vide* also Fig. 64.) The above illustration is taken from the left side of body. The upper wound, as shown, was serrated at its termination on the right. The main wound on the neck ran from nearly the extremity of one clavicle to the extremity of the other, and at its endings was only half-an-inch higher than the level of clavicles. It severed the main blood-vessels, muscles of neck, and trachea.

happen, however, that by reason of uniformity of breadth of blade, exit and entrance wounds may be indistinguishable.

But in certain circumstances, and in certain situations on the body, wounds may be produced by a blunt instrument which may simulate very closely the appearances of an incised wound produced by a sharp instrument. Such wounds are usually found over bony prominences, as the shin, external process of the frontal bone, superciliary ridge, orbital ridge, zygomatic process, line of lower jaw, occipital eminence, etc., but they may even be found on a flat bony surface, as the forehead. Where such a wound exposes hair-bulbs in its lips, it is ordinarily possible by examining these carefully with a good hand-lens to say whether they have been crushed or cut, or are entire, and thus to establish whether the wound was caused by a sharp or blunt instrument.

II. Lacerated Wounds.—These are caused by forcible contact with blunt instruments. They are usually ragged, or torn, or irregular as to their edges, and do not, generally, correspond in shape or in size to the

instrument which has produced them. If the violence has not entirely severed the skin tissues, on gentle separation of the edges of the wound, little bridges of connective tissue, or nerve fibrils, will probably be discovered stretching across the gap and binding the edges. These will be absent, however, where the skin and subjacent tissues are wholly divided. As a rule, lacerated wounds are accompanied by more or less contusion of their edges; hence the edges are generally swollen. The amount of contusion found will depend entirely upon the amount and incidence of the concussive force, and the resistance of the tissues; for example, where there is a bony background, as on the scalp and elsewhere on the body, contusion is likely to be more marked than where the subjacent tissues are softer, and, therefore, less resistant. Lacerated wounds may or may not bleed much. This depends upon whether the blood-vessels are wholly, or only partially, severed; in the latter case, because of the inability of the coats of the vessels to retract within their sheaths, there is usually much bleeding, but in the former the crushed coats at the severed ends seal up the vessels, and, consequently, there is but little hæmorrhage. In their production, there is usually loss of substance, and, therefore, they heal by granulation, suppuration accompanying the healing process; thus they leave a permanent scar in their train.

III. Punctured Wounds.—These are sometimes termed penetrating wounds, because in their course the deeper tissues, or a natural cavity of the body, are penetrated. They may be produced by pointed weapons, the point being either sharp, or comparatively blunt, in which latter case more force is necessary to effect the same degree of penetration than where the point is sharp. In the case where the instrument is sharp-pointed, they ought to be designated punctured-incised, and where blunt-pointed, punctured-lacerated wounds; because of the physical characters of the edges. A punctured wound differs from an incised or lacerated wound in that its depth is greater than its length or breadth, characters which indicate the use of a pointed instrument. The use of the word "penetrating" ought strictly to designate a wound which, passing through the tissues, enters a cavity of the body, such as thorax or abdomen. (Fig. 51.)

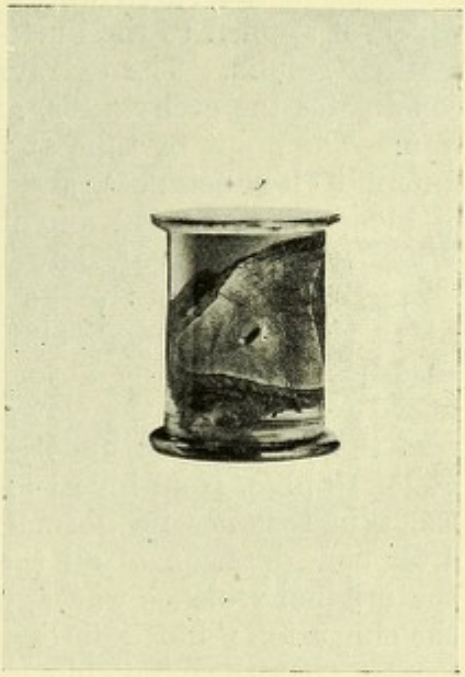

FIG. 51.—Photograph of Incised Wound in Wall of Chest produced by Stabbing.

IV. Contusions.—Some degree of contusion is often found in or around the edges of lacerated wounds, and, in rarer instances, around the edges of incised wounds. This is due to the use of a blunt instrument in the former, and, in the latter, to the use of a short-bladed weapon which is driven violently up to the hilt. The term *contused wound* ought to be abolished from medico-legal nomenclature, since wounds

are either caused by sharp or by blunt instruments. If the edges of an incised or a lacerated wound be accompanied by contusion, the fact ought to be noted, but the nature of the wound itself ought to determine the class to which it belongs, and to indicate the class of weapon which has produced it; in short, the term "incised" ought to be used only to signify a wound caused by a cutting instrument, and the term "lacerated," to a wound caused by a blunt instrument, while the element of contusion, when found, ought to be treated as merely an incidental fact, indicative of the amount of violence used with relation to the part struck. There would, therefore, be left the general term *contusions* which should be used to denominate bruises, in which the wounding is not on the surface of the skin but in the substance of the true skin and the subcutaneous cellular tissue, in which the blood is effused and lodged, and which causes the condition called ecchymosis. Contusions may vary in size from those accompanying a "black eye" to extensive swellings accompanied by much subcutaneous extravasation of blood. A contusion, therefore, may be defined as a breach of continuity of the structure of the true skin or subjacent tissues without loss of external continuity, caused by the application of a blunt instrument. The extent of rupture of subcutaneous vessels depends, in normal circumstances, upon two factors, mainly—viz. (*a*) the severity of the concussive force; and (*b*) the vascularity of the part struck. The first factor is obvious; the second may be illustrated by the enormous swellings in the vulva which usually result from a degree of violence, which, if applied to the buttock or the head, would have produced less marked results. The extravasated blood in the subcutaneous tissues constitutes the ecchymosis, and is the cause of the resulting discoloration. The point of time at which the discoloration appears varies in different circumstances, and its colour-tone depends upon the amount of blood extravasated and its distance from the surface of the skin. When it does appear, however, it tends to deepen until the extravasated blood ceases to be effused; then the part appears swollen. Later, the blood separates into serum and coagulum, the serum becomes absorbed, and as the absorption proceeds, the swelling becomes reduced; gradually, the clot also becomes absorbed, during which process the colour-tone undergoes change in gradation of colour—from violet to blue, from blue to green, from green to yellow, until, at last, the skin assumes its normal hue. Only in a very general way, and after consideration of all the circumstances, can the period at which the original violence was applied be inferred from the colour-tone of the contusion; but, approximately, it may be said of an average-sized bruise, that the blue colour appears about the 3rd day, the greenish from the 5th to the 7th day, the yellowish, from the 8th to the 10th, while the normal colour will probably be restored to the part between the 13th and 18th day. While it is generally true that the change of colour is first apparent at the periphery of the bruise, since there the layer of extravasated blood is usually thinnest and the effects of absorption are, therefore, most quickly perceptible, it ought to be noted that in certain bruises, on the other hand, the change is first noticeable in the centre; this is specially true of extravasations in the neighbourhood of varicose veins. The foregoing is, however, only true of

comparatively superficial bruises; when ecchymoses are more deeply seated, the colour takes some time to appear externally. Further, the part where the external discoloration appears does not necessarily, in the case of deep-seated extravasations, indicate the seat of the application of the violence, because, owing to the disposition of planes of areolar tissue in limbs and other parts of the body, the discoloration may show itself either above or below the part struck. Velpeau has shown, for example, that in the armpit the discoloration appears below the part injured, whereas in the iliac and hypogastric regions it extends above the part struck; and so, also, in respect of bruises in the vicinity of the knee and shoulder joints.

But the quantity of extravasated blood is sometimes determined by abnormal conditions of the body; in other words, the amount of discoloration present may be out of all proportion to the amount of violence used. In scrofulous, scorbutic, purpuric, and hæmophilic conditions, this is particularly true; and if attention be not given to the presence or absence of these factors in estimating from the extent of discoloration the amount of violence offered, very serious mistakes of judgment will be made, and very erroneous opinions offered. In hæmophilia, hyperæsthesia of the whole nervous system, and of some centres in particular, differences from normal in the elasticity and contractility of blood-vessels, and in the firmness and density of their walls, are commonly found; moreover, it is usually a hereditary condition. Retardation in the coagulation of the blood has also been assigned as the condition present in hæmophilia. Groves has dealt with the hereditary aspect of the subject from the surgical point of view.[1] In all cases, therefore, in which extensive bruises are found, the presence or absence of the foregoing predisposing factors ought to be considered, before opinion is finally offered.

While it is probably true in the large bulk of cases that ecchymoses are the result of applied violence, it ought not to be forgotten that they may present themselves without the application of any external violence whatever—in the legal sense. This fact has been known for many years, as it has been noticed in books on whooping-cough, in which affection, by reason of the explosive cough, ecchymosis is by no means infrequently seen in the conjunctivæ, and, less frequently, in the face and neck. But the phenomenon received special attention from the pen of Lediard of Carlisle[2] in a paper on "Ecchymoses from Natural Causes." There cannot be any doubt whatever that in cases where from any cause embarrassment of breathing and tension of the circulatory system are united, these spontaneous extravasations of blood are likely to result, as, for example, in asphyxia from any cause. Their importance arises from the fact that they might be mistaken for extravasations due to violence, and thus, under certain circumstances, an innocent person might be convicted of assault where no violence has been offered.

The following cases illustrate the extent of such ecchymoses arising spontaneously:—

[1] *B. M. J.*, vol. i., 1907, p. 611.

[2] *Med. Chirurg. Trans.*, vol. lxxix.; Reg *v.* Kerr, Carlisle Assizes, *Lancet*, vol. ii., 1889.

1. Cabadé [1] reported at a French Congress the case of a carpenter, aged 40, free from cardiac and vascular lesions, who, after an attack of epilepsy which occurred while he lay in bed, developed in the course of the day subcutaneous extravasations of blood which involved the chest from the sub-clavicular region to the base of the thorax on the right side, and to the crest of the ilium on the left side, the arms and shoulders being also enormously swollen and discoloured. At the ecchymotic places, the skin was hard, raised, and dense, and great pain was complained of in arms and shoulders, due, it was believed by the reporter, to compression of the brachial plexus by the extravasated blood. The ecchymoses underwent the usual changes of colour, and they took fully two months before finally disappearing.

2. A young woman, aged 21, while standing speaking to some friends, suddenly fell, striking her head against a wall as she fell. Upon being examined by a medical man there were subcutaneous extravasations of blood over the head and neck, subconjunctival extravasation in both eyes, and there was slight bleeding from the right nostril and left ear. The subcutaneous extravasation ended abruptly about the level of the upper border of the thyroid cartilage. It was believed that the onset of the extravasation was caused by an increased tightness, during the fit, of an already tight collar, because the line of extravasation corresponded with the upper level of the collar. The ecchymosis disappeared after a few weeks.[2]

3. Etienne communicated two cases to the Société de Neurologie of Paris [3]: In the first, there suddenly appeared on each arm of a girl who was 13 years of age, a long strip of ecchymosis, which disappeared, only, however, to be succeeded by other ecchymoses during a period of six weeks. She also suffered from epistaxis. In the second, a woman aged 32, on awaking from sleep, found a strip of ecchymosis measuring three inches long by one-third of an inch wide on the right shoulder, with a few smaller parallel strips over the clavicle. This woman had a purpuric disposition.

While the condition known as "masque ecchymotique" is for the most part associated with trauma of the nature of sudden and violent compression of the trunk of the body, a sufficient number of cases have been put on record to establish the fact that it may be caused altogether apart from injury. Colle and Arquembourg, in contributing to the literature of this subject two cases which came under their personal observation, have also noted other cases recorded by other observers. The first case narrated by them was of a woman, aged 26, who, while taking chloroform preparatory to a uterine operation, stopped breathing after having struggled for a few moments. After respiration was re-established, it was observed that her face and neck as low as the cricoid cartilage were violet-coloured and dotted over with punctiform ecchymoses, a condition which only completely disappeared after a fortnight. The other case was that of an epileptic.[4]

In view of the foregoing, therefore, it is not difficult to conceive that, if these appearances had been found upon dead bodies, very different conclusions as to their causation might, probably, have been arrived at.

V. Gunshot Wounds.—Wounds produced by projectiles which penetrate are likely to be more or less contused and lacerated in character. Where the missile, however, penetrates at high velocity, is of a long, pointed shape, and is composed at its point of hard metal, the wound may only appear as a slit, straight or curved, without much or any evidence of contusion or laceration, and it may heal by first intention. Where the missile strikes the body but does not penetrate the tissues, the lesion will be of the nature of a contusion. Usually, unless important vessels are severed in the course of the traject of the missile, such wounds bleed but little. (Fig. 52.) Much has been

[1] *The Lancet*, vol. ii., 1892, October 8.
[2] *B. M. J.*, vol. i., 1901, p. 338.
[3] *Ibid.*, 1900, *Sup.*, p. 65.
[4] *L'Echo Médical du Nord*, Jan. 13, 1907; *B. M. J.*, vol. i., 1907, s. p. 93.

written regarding the appearances of the wounds of entrance and exit respectively, where the bullet traverses the trunk or a limb of the body; but too much reliance must not be placed upon the statement that the wound of entrance is usually smaller than that of exit, or that the wound of entrance has depressed or inverted, and that of exit, everted edges. It is obvious that these appearances must depend upon the exact conditions of the individual case. Some of the conditions with respect to the person which may affect these appearances are: (1) the part of the body struck by the missile, and (2) the distance into or

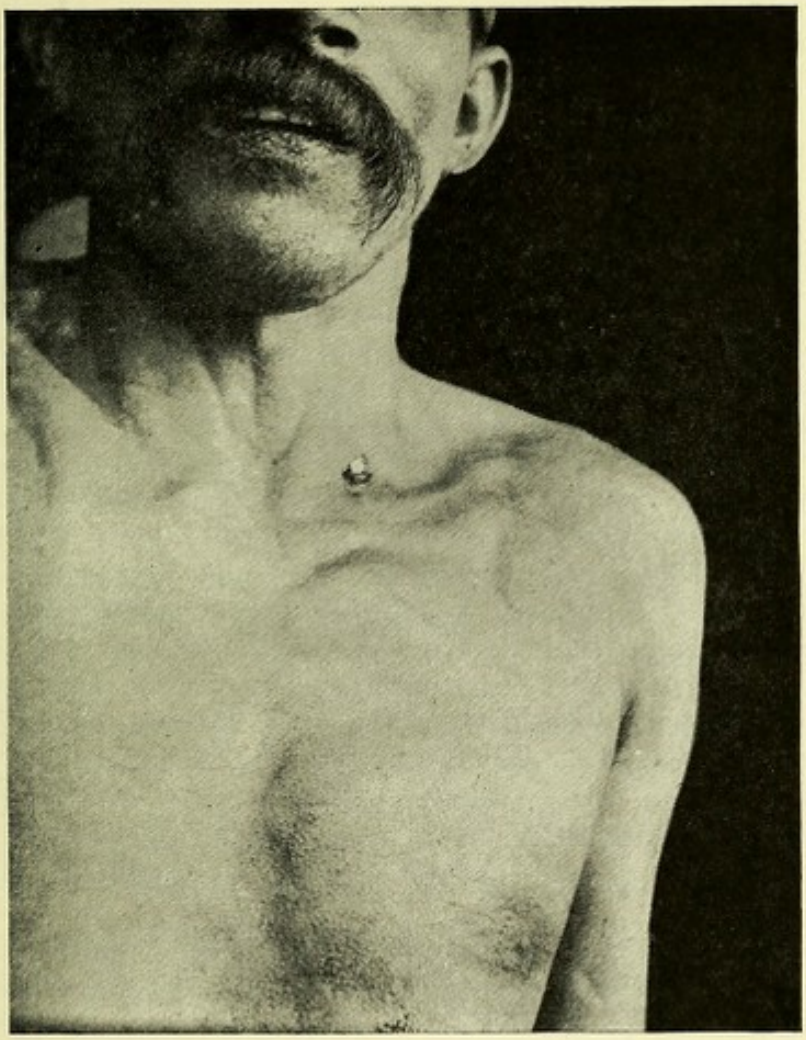

FIG. 52.—Fatal Revolver Bullet Wound of Neck. The missile passed through the tissues of the neck without wounding any important blood-vessel or nerve-trunk, but penetrated the apex of the left lung. The left pleural cavity contained about 36 ounces of fluid and clotted blood and bloody liquid. The bullet was found between second and third ribs, which were not fractured, close to vertebral column. (Author.)

through the body which the missile has traversed; and the conditions with respect to the missile itself, are: (1) the shape and composition of the missile; (2) its velocity at the moment of impact; and (3) the amount of obstruction experienced by the missile in its traject through the tissues. The experiences of the South African and other recent wars clearly indicate, with respect to modern projectiles at least, that our views on gunshot wounds must be recast. The correspondent of

one of the medical journals[1] states of the wounds produced by the Mauser bullet, that " the aperture of entrance seldom shows any bruising of surrounding tissue ; frequently it has been difficult to locate it, for where the skin is dense and elastic there is seldom any bleeding. There is never any inversion of the edges, which are sometimes circular in form, and sometimes triangular, like a leech-bite. The aperture of exit, where the bullet has not been distorted, is seldom any larger than that of entrance ; there is no bruising of surrounding tissue, and no eversion of the edges ; bleeding varies, of course, in accordance with the proximity of large, medium, or small blood-vessels in the track, but in the vast majority of cases it is slight." The late Sir William MacCormac, quoted by Sir William Stokes,[2] says, " I saw a large number of injuries inflicted by the Mauser bullet, which is remarkable for the small external wound it produces. In three-fourths, if not a larger proportion, it was impossible to tell the exit from the entrance wound, they were so similar in appearance." This is less to be wondered at when the size of missile is considered. The calibre of the Mauser rifle is only 7 mm., or 0·275 of an inch, and that of the Lee-Metford, 7·7 mm., or 0·303 of an inch, while the diameter of the bullet of the former is 0·284 inch, and of the latter, 0·311 inch ; in other words, the bullet is rather larger than the rifle-calibre. Such bullets, when the impact with the body is at high velocity, perforates bones just as if a gimlet had been passed through them. Sir F. Treves,[3] by reason of his South African observations, traverses three statements of the books respecting gunshot wounds : (1) that the entrance and exit wounds decrease in size as the range increases ; (2) that a circular and small wound of exit is rare when a bone is hit, as he has seen the very smallest hole after the bullet has actually passed through a bone ; (3) that shock is commonly present. From multiple observations by various surgeons in the war, recovery was marvellously rapid even in cases where the missile, from the line of its traject, must have traversed the most important organs of the body, and even the heart itself. It is very apparent, then, from the foregoing, that the small missiles must have passed through the body without any alteration in shape.

The following figures of cases which have come under our observation indicate that the wound of exit may be distinguished in certain cases from the wound of entrance.

Figs. 87, 88 show a suicidally-inflicted wound by a revolver bullet. The suicide was in the act of being apprehended on a charge of murder by shooting when he shot himself.

Figs. 47, 48 illustrate the same point. The person was shot by another in self-defence. It will be observed that the entrance wound was a clean, circular, punched-out wound, situated mid-sternum, and that the exit wound was somewhat ragged in external appearance and was associated with considerable swelling of surrounding axillary tissues, due to extravasated blood. The bullet in its traject passed through both ventricles and the intervening septum of the heart.

[1] *The Physician and Surgeon*, 1900, p. 49.
[2] *B. M. J.*, vol. i., 1900, p. 1453.
[3] *Ibid.* vol. i., 1900, p. 1156.

Where expanding, grooved, soft-nosed, Dum-dum, rounded, or ground-nosed bullets are used, the wounds produced are of a more extensive, more ragged, and more destructive character.[1] The wounds from fragments of shell are, also, of this extensive and destructive nature. (Fig. 53.)

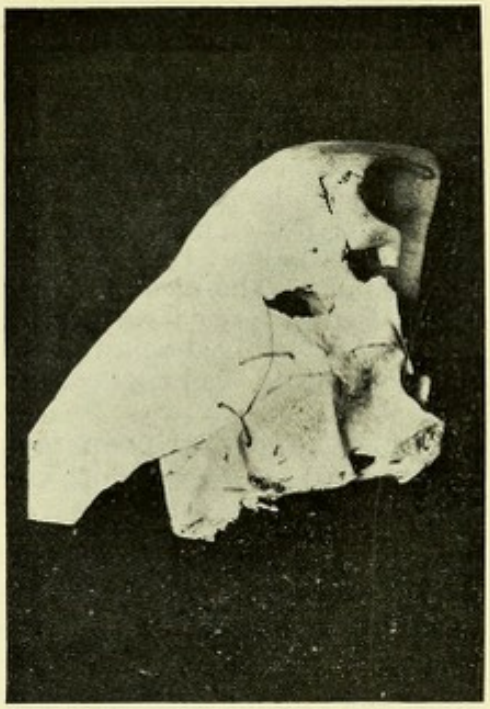

Fig. 53.—Fatal Gunshot Wound of Brain. The missile—a soft, round, lead bullet—entered the malar bone at its junction with the zygomatic process and produced much fracturing of bone. (Author.)

Regarding the healing of wounds produced by missiles from small-bore rifles, Mr Makins states that in the South African war they "heal in a few days with no surrounding induration or œdema."[2]

In projectile wounds of the cranium, where the bullet has entered from without inwards, the wound of entrance may usually be distinguished by the bevelling of the inner table of the bone—that is, there is more bone driven off the inner table than the outer—and the exit wound, when the bullet has passed from within outwards, as in a shot fired into the roof of the mouth, by the bevelling of the outer table. This is due to the fact that the cranial bones are composed of two plates with a layer of more cancellous bone—the diploë—intervening. But even here, too hard and fast a line cannot be drawn.

But charges of small-shot may, under certain circumstances, produce wounds which simulate more or less closely those produced by a single missile; as when the charge enters the body at short range. Such, however, will be more fully considered when the question of accident, suicide, or homicide is discussed.

It may here be mentioned, however, that death may follow from the wound inflicted by a single pellet of a discharge of small shot. In one case, a gamekeeper was found lying behind a tree unconscious and bleeding profusely from mouth and nose. He died shortly after. External inspection of the body revealed nothing but a black eye and a very small abrasion of upper eyelid. Post-mortem examination showed, on everting this eyelid, an ecchymosed patch in conjunctiva to nasal side of eyeball. An effusion of blood was found both extra-durally and sub-durally on opening the skull, and a small puncture wound discovered in *dura mater*, which was found to be in line with the eye and the sphenoid bone in which was also a punctured wound. Further examination of the track of this missile showed that the orbital plate of the ethmoid was splintered, that it then passed through the left cavernous sinus and the internal carotid artery, then through the pons, and was found lying between the lobes of the cerebellum. The missile was a single pellet.[3]

In dealing with gunshot wounds, when the question arises whether, in the case of two wounds being found on the body not corresponding

[1] *B. M. J.*, vol. i., 1900, p. 665; Johnston, *Edin. Med. Jour.*, Oct. 1901.
[2] *Vide* Dent, *B. M. J.*, vol. i., April 21, 1900; *ibid.* vol. ii., 1899, p. 1809.
[3] *B. M. J.*, vol. ii., 1907, p. 1826.

to the likely line of traject, we are dealing with wounds produced by one or by two missiles, it is important to remember that the course of a projectile in the body may be very erratic. Such unusual courses have been often recorded, but the following recent case will exemplify this point.[1]

"The bullet first produced a comminuted fracture of the left thumb, which was in contact with the chest wall at the time, then entered the chest 2 inches above and the like distance to the inner side of the left nipple, passed upwards and outwards along the rib, was deflected downwards by the anterior edge of the left scapula, and continued on this course until it reached the crest of the left ilium; it then passed nearly vertically upwards to the wound of exit which was situated about 1½ inches below and in a line with the inferior angle of the left scapula. The pleura was wounded *en route*. After leaving the body of this patient it tore a large piece from the pectoral muscles of a child aged five, who was probably clinging to the old man from behind. There were no signs of any injury to the lung itself, and the cases did well."

Cases have also been recorded where, in attempted suicide by a revolver, the muzzle of the weapon being applied tightly against the skin of the body, no further mischief than slight contusion has resulted. It would appear as if the only explanation of this is, that the column of air in the barrel between the pistol-charge and the skin acts as a cushion or buffer by reason of its inexpansibility, and thus the explosive force of the charge being expended in overcoming this resistance, the missile falls harmlessly to the ground.

In view, therefore, of all the foregoing circumstances, it is only wise that no opinion should be offered regarding the nature and course of the missile, unless and until the whole facts of the case have been carefully weighed.

The following cases, most of them from our case-book, together with those described on p. 249 *et seq.*, will illustrate many of the points under discussion.

1. At the Circuit Court, Glasgow, September 1902, Malcolm Peters was indicted on a charge of murder, he having shot Alexander Whyte in the throat with a revolver loaded with ball cartridge, and murdered him. We examined the body of the deceased on July 12. The only wound found on the body was one situated in the middle line of the neck in front, the upper extremity of which was 2¼ inches below the point of the chin. The wound, as we found it, measured 2¼ inches in length and 1 inch in breadth at its point of greatest breadth. It was evidently in part a surgical wound. It opened into the voice-box in its lower part. Extending on each side of the wound as far as the shoulders outwards, and as far as the upper part of the chest downwards, the tissues were markedly emphysematous and crackled on palpation. Closer examination of the neck wound, and further dissection, showed a fracture of the *pomum Adami* of the larynx, which had ragged and blackened edges. On opening the larynx both vocal cords were found bruised and discoloured. Lower down in the larynx, and on the right side of the cricoid cartilage, was a bruised area, in the centre of which was a wound irregularly circular in shape. Further dissection revealed behind the fracture of the cricoid cartilage, a wound through the gullet on its right side, and behind that a ragged, circular opening in the front of the body of the first dorsal vertebra, in which, lying loose, were several small fragments of bone. From this point the course of the missile was tracked through the body of the first dorsal vertebra into the body of the second, where it was found embedded. The bullet was cylindro-conoidal in shape, was irregularly flattened at its apex, and measured five-eighths of an inch at its point of greatest length, and three-eighths of an inch

[1] *B. M. J.*, vol. i., 1897, p. 1219.

in breadth at its base. The course of the bullet was as follows :—it entered the skin over the *pomum Adami*, passed downwards between the vocal cords, through the right side of the cricoid cartilage, and the right side of the gullet, penetrated the body of the first dorsal vertebra, and became embedded in the body of the second. From this, we gave it as our opinion that the deceased at the moment the bullet entered his body was in a sitting posture and probably leaning forward, and that his assailant was standing in front of the deceased when he fired the shot.

From the evidence at the trial, it appeared that the accused was the tenant of the deceased, that some difference of opinion had arisen between them regarding the deceased having rented to another man for a smithy a piece of land close to that occupied by accused, who was of the same trade, and that the accused went into Glasgow, bought a revolver, returned, and walked into the shop of deceased, and shot deceased across the counter. After receiving the shot, deceased was taken to the Infirmary, where his wound was temporarily treated, but he died about twelve hours later. The defence, as stated, in answer to the judge, Lord Young, by prisoner's counsel, was that it was an accident. Lest a plea of insanity should be put forward, the Crown had caused the accused to be examined by two medical witnesses, whose names were in the indictment and who were in attendance to give evidence. Since, however, prisoner's counsel had declared that they did not found on insanity, the evidence of these witnesses was not called. Notwithstanding this, Lord Young in his charge to the jury suggested that the man was insane at the time, and after an absence of twenty-five minutes the jury returned the verdict that the accused had committed the act charged, but that he was insane at the time. The judge thereupon ordered the accused to be confined during his Majesty's pleasure.

2. In January 1903 we made a post-mortem examination of the body of a man who had been homicidally shot with a revolver. The following marks of violence were found on the body :—On the right temple was an area of discoloured swelling in the centre of which was a small circular wound, which measured one-quarter of an inch in diameter. The wound was situated $1\frac{3}{4}$ inches to the right of the outer angle of the right eye on a level with the arch of right eyebrow, 2 inches in front of right ear, and $1\frac{1}{2}$ inches above the level of the middle line of the ear. The skin around the wound was dotted or tattooed with small black dots due to engraining with particles of unconsumed gunpowder, the area of skin so marked covering an area round the wound the radius of which was 2 inches, the centre of the circle being the wound itself. Above the wound was a broad linear marking due to burning, probably from a part of the wad of the cartridge. On dissecting the scalp, much clotted blood was found in the deep tissues of the right temple, and in a line with the scalp wound was a circular wound in the temporal bone. On removal of calvarium, clotted blood in some quantity was found on surface of brain beneath *dura mater*, and after reflection of *dura mater*, clotted and fluid blood was seen to cover the entire surface of the left hemisphere, more especially in the region opposite to that of the external wound. On removing the brain, a little clotted blood was found on the brain close to the wound in the temporal bone, much effused blood was found in the base, and some blood had extended into the upper part of the spinal cavity. In the neighbourhood of the wound of temporal bone internally were found small pieces of bone. In the *dura mater* at this point was a circular wound measuring three lines in diameter. On the right side of the brain, and in a line with wounds in scalp, temporal bone and *dura mater*, was a wound with laceration of margins, in which, and in brain substance in its neighbourhood, were found several small pieces of bone and a small piece of bullet of irregular shape. On the opposite side of inside of skull was found a circular wound of the *dura mater*, punched-out in character, and beneath it the bone was bruised over a small area. On dissecting the brain, the bullet was found in the superficial parts of the brain substance at a point a little posterior to the bruised area of bone mentioned. It measured one-quarter of an inch in diameter at its base, and five-sixteenths of an inch in length as found. It was somewhat mushroom-like in shape, with a rounded nose, due to flattening, and a thick stem. The line of traject of the bullet was from the wound on right temple through brain tissue to point of bruising of bone on inside of skull on left side, practically straight across

the skull but slightly upwards, and was then deflected backwards and upwards to the point where it was found. We gave as our opinion that the weapon had been fired at a comparatively short distance from the head of deceased, from the fact of the gunpowder tattooing formed on the scalp. (Fig. 54.)

The accused, a man named John M'Ghee, was indicted on a charge of murder at the Circuit Court, Glasgow, in February of same year. After

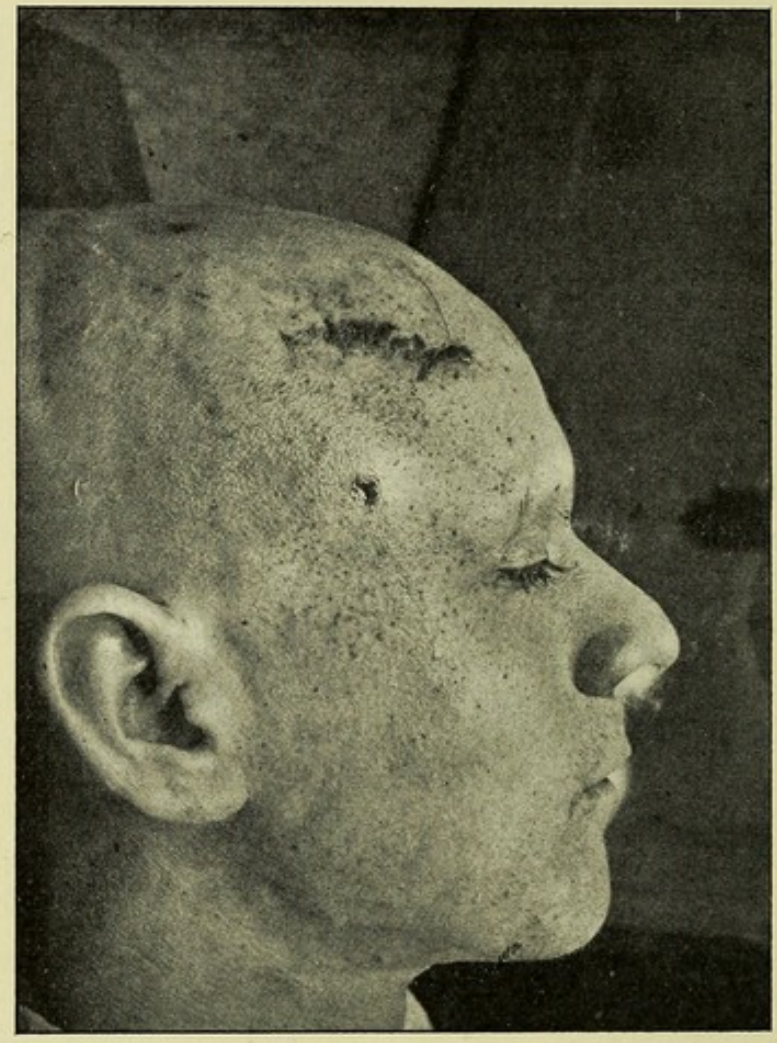

Fig. 54.—Entrance Wound of revolver bullet which was found in brain. Tattooing by particles is seen around the wound. The linear dark mark above the bullet wound was caused by scorching. (Author.)

hearing the evidence, the Advocate-Depute deserted the diet on a charge of murder, and asked the jury to return a verdict of culpable homicide. He was found guilty on that charge, and was sentenced to 5 years' penal servitude.

3. *Homicidally-inflicted Gunshot Wounds.*—At the Circuit Court, Glasgow, September 1905, Lewis Klink was indicted on a charge of murder, he having assaulted Leah Goldberg by shooting her and murdering her, and also, with assaulting the girl's father, with intent to murder him by shooting him to the danger of his life. He was found guilty.

4. In April 1904 we made a post-mortem examination of the body of a young girl. The only external marks of violence found were situated on the left zygomatic region, in front of the ear. In that position was a bruised and discoloured area of skin measuring $1\frac{1}{2}$ in. by $1\frac{1}{4}$ in. in the centre of which were two smaller areas, darker in colour, each of which measured three-eighths of an inch in diameter. In the centre of each of the smaller darker areas was a circular wound which measured three-sixteenths of an inch in diameter in each case. Around the larger area the tissues were swollen. On opening the brain

cavity, there was found much blood lying between the *dura mater* and the brain, especially at the upper and back part of the head, and when the brain was removed the base of the organ was also found covered with effused blood. Further examination and dissection of the brain showed that a missile had entered the base of the left temporal lobe in a line with the external wound on the left side of head, had passed backwards through the cerebrum and cerebellum, ploughing up the substance of both in its traject, and had then passed through the under surface of the right occipital lobe to the surface of the brain behind. A bullet was found at this part. It was conical in shape but somewhat distorted by contact with the skull bones, and measured seven-sixteenths of an inch in its longest part. Examination of the skull, after stripping the membranes, showed an opening in the floor of the left middle fossa, which had irregular and ragged edges, round which small pieces of bone were found. The opening measured three-eighths of an inch in diameter. The course of the missile seemed, therefore, to be as follows: —entering the side of head, close in front of left ear, the bullet passed inwards slightly upwards and backwards, struck the occipital bone and rebounded forwards up through the right occipital lobe to the point where it was found. Careful dissection was made to discover if a second bullet had entered the skull, but although two wounds, apparently produced by similar missiles, were to be seen externally, only one bullet seemed to have entered the cranial cavity.

The father, who had shot his daughter, was indicted on a charge of murder at the Circuit Court in Glasgow, but a plea of insanity in bar of trial, having been tendered on behalf of the accused, and after medical evidence had been given by us and others, the accused was found to be insane and was ordered to be detained during his Majesty's pleasure.

5. *Death from Gunshot Wound of Abdomen. Accident or Homicide?*—In December 1904, we made an examination of the body of a farmer in the farm occupied by him in the vicinity of the town of Airdrie. The body had been found on one of the farm roads with a large wound in the abdomen, and his gun lying by his side. On removing the clothing from the body, which consisted only of the following:—(*a*) trousers, (*b*) under-pants, (*c*) shirt, (*d*) semmit, and (*e*) shoes, there was exposed on the front of abdominal wall a wound from which protruded a small mass of intestine. The wound was oval, nearly circular in shape, measured $1\frac{5}{8}$ inches from above downwards and $1\frac{3}{8}$ths inches transversely, and was situated a little to the right of the middle line of the body, $1\frac{1}{2}$ inches above and to right side of umbilicus, and the same distance from the lower margin of right ribs, the top end of the wound being 4 inches below the lowest point of sternum. There were no marks of tattooing by gunpowder grains around the wound, but the edges bore evidence of scorching. Blood covered more or less the entire surface of the abdomen, but the main direction of flow from the wound was towards the genital organs and fork of thighs. Internal examination of abdominal cavity showed that it contained over twenty ounces of fluid and partly-clotted blood, the intestines being bathed in it. On the inner surface of abdominal wall in the course of the external wound, the rent of tissue was found to be more extensive than on skin surface, as it measured $3\frac{1}{2}$ in. $\times 2\frac{3}{4}$ in. in area, the direction of greatest injury being downwards and to left side, in a line from external wound to umbilicus. In the substance of the intestines and in their interior in some instances were many pellets of small shot. In the lower part of the lumbar spine, just above point of junction with the sacrum, the bodies of the vertebræ were peppered with small shot; and the tissues around and the main abdominal vessels in front of the spine at this part were much torn for a distance downwards of three inches. Lying loosely in some fluid blood in the left side of the pelvis were found the entire wad of a cartridge along with a small mass of matted material—fragments of clothing—enveloping several pellets of shot. We reported (1) that death was due to the effects of a gunshot wound of abdomen, the immediate cause being shock and hæmorrhage, (2) that the direction of the charge of shot was acutely from above downwards and from right to left side of the body, and (3) that from the position of the abdominal wound and other circumstances which we found on investigation, the wound was not produced suicidally.

The circumstances alluded to were these: the deceased, his sister, his wife and an infant of a few days old were the sole occupants of the farm on the night in question. His wife had been delivered of her child a few days before, and was then confined to bed. After the family had retired to rest, some person

or persons, believed to be after the female domestic servants, began to create a noise about the farm. There were no female servants then in the house, as they had just left, and new maids were to enter service the next day. Deceased, annoyed at his wife being thus disturbed, rose from bed, and partly dressing, took down his fowling-piece, went to the door, and there fired, with the intention of frightening the disturbers. But the disturbance increasing a few minutes later, he again went out gun in hand. Shortly afterwards, the inmates heard a shot at some distance from the house, but deceased did not return. Toward morning, as soon as daylight began to break, a messenger was sent to his mother's farm some distance off, as it was thought he might have gone there. He was not there, however, and his mother returned with the messenger. Search was then made about the farm, and his mother found his dead body lying on a field road about 70 yards from the house, the body lying across the roadway, face downwards, and the gun about a yard from the body. When the gun was examined when found *there were no empty or other cartridge*

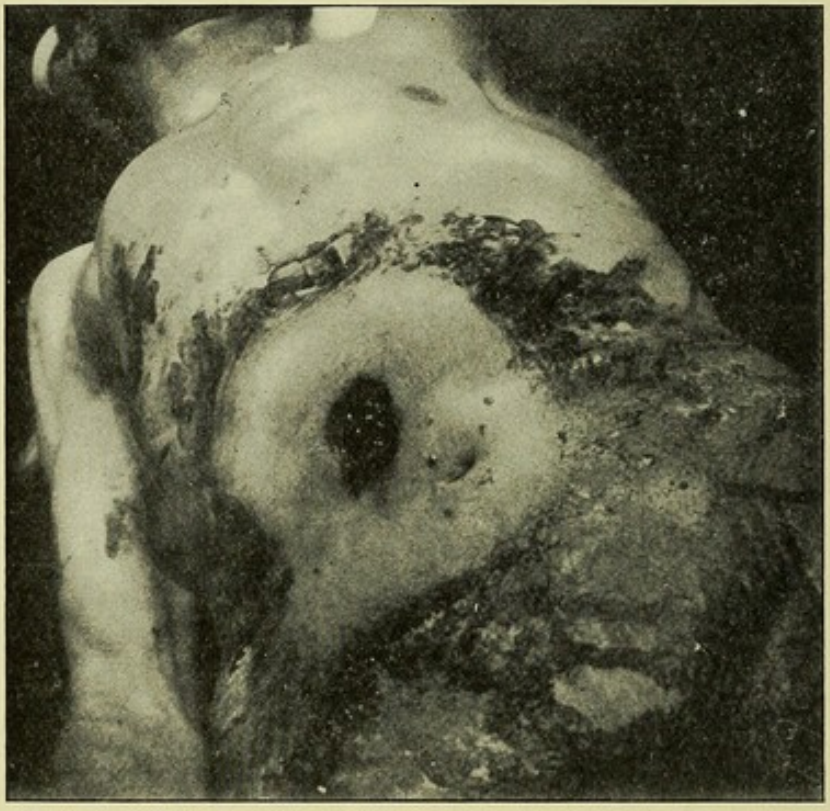

FIG. 55.—Abdominal wound produced by charge of small shot from a fowling-piece. (Author.)

cases in the breech. From the very serious character of the abdominal wound it is impossible to believe that the deceased himself removed the empty case or cases, and the inference, therefore, was that they had been removed by some other person. What was the precise manner in which the wound was produced? From the length of the fowling-piece and the position and direction of the wound, it could not possibly have been of suicidal infliction. Nor was it likely to be a homicidal wound from a weapon fired by another person, because of its unusual direction. Could it be due to accident? It could not have been caused by the deceased going through the low hedge bordering the road on which his body was found, because there were no blood-stains on the grass or ground except close to the body. Besides, such accidents commonly happen by the loaded weapon being pulled muzzle first after the person, and that could not have been the case here, because the direction of the wound was from above downwards and to the left, whereas in the case supposed a wound would have been in an upward direction. So far as we were able to judge, there remained but one possible explanation of an accidental causation, and that was that deceased had come across an intruder, that they got into grips for possession of the gun, and that while the gun was high up, and muzzle downwards, in the

struggle for possession it had gone off, burying the contents of the charge in the abdomen of deceased, who would immediately fall, and that the other person, alarmed at the unexpectedly serious issue of the struggle, had emptied the breech of the cartridge case or cases in the belief that suspicion as to the cause of the production of the wound might be diverted. (Fig. 55.)

6. At the High Court, Glasgow, July 1907, a man was tried for having on April 16 discharged three chambers of a revolver loaded with ball cartridges at a medical practitioner, whereby he was wounded in the body, contrary to the Act. 10, Geo. IV. cap. 38, section 2. After accused had pled not guilty and evidence was led, the jury returned a verdict of guilty as libelled, but without intent to do grievous bodily harm. Accused was sentenced to 7 years' penal servitude. (*Vide post.*)

7. In April 1909 we examined the body of an Italian who had died from the effects of a bullet wound in the abdomen. After receiving the shot, deceased had been conveyed to the hospital, where he died. On the left side of the abdomen was a sutured surgical wound which measured 6¾ inches in length. The top of the wound, which was in the plane of the body, commenced 4¾ inches below the level of the left nipple, and the line of the wound was 4½ inches to left of umbilicus. At right angles to this wound was another surgical wound, the central part of which was unsutured, into which passed surgical dressings. In this wound were the marks of a wound with ragged blackened edges, probably the point of entrance of a missile. This was situated on left side of abdomen close to lower margin of the lowest rib and seven inches to the left of the line of the umbilicus. There was no exit wound on opposite side of body. Internal examination showed peritonitis and that a missile had entered the abdominal cavity. It had passed through the small intestine in two places, and the large intestine in one place, in addition to the omentum and mesentery. These woundings had been surgically sutured. There was no injury to kidneys. Further examination revealed a wound in the substance of the left psoas muscle, and on being followed, a bullet was found embedded partly in the soft tissues and partly in the bone at the left sacro-iliac synchondrosis. Fluid blood amounting to eight ounces was found in the pelvis. The course of the bullet was inwards, backwards, and slightly downwards. The bullet was cylindro-conoidal in shape, measured eleven-sixteenths of an inch in length and five-sixteenths of an inch in diameter at its base, and was comparatively little deformed in shape.

The accused, the son of deceased, who was tried at the July sitting of the Circuit Court, Glasgow, pled not guilty, and put forward the plea of self-defence. After hearing the evidence the jury returned a verdict of " not guilty."

8. *Fatal Suicidal Gunshot Wound with Blank Cartridge.*—A man, who had misappropriated money, committed suicide with a rifle (1905). He did the deed in an attic apartment, which had a sloping roof and cross rafters. From the position of the body when found, it was fairly evident that he had placed the butt of the rifle against one of the rafters, rested the muzzle against his chest and pressed the trigger with a stick which was found lying on the floor beside the rifle. On examination of the body, a clean punched-out wound was found between the third and fourth left ribs, two inches from edge of sternum. The wound was slightly larger than the bore of the ·303 rifle which was used. There was no wound of exit, and it was believed that a blank cordite cartridge had been used. On the blood-stained shirt there was an irregularly-oval burned area which measured 2 in. by 2½ in. The wound on the chest was simply enlarged by the knife, when it was seen to penetrate the left pleural cavity; but no further dissection of body was made. We are indebted for particulars of the case to Dr Adamson.

9. In the Moat Farm Case in 1903, Dr Pepper stated that the body of deceased, which had been found buried in an old ditch, was much decomposed and must have been in contact with the earth for a very long time. Nearly all the soft structures of the body had been converted into adipocere owing to lying in wet soil. The remains measured 5 ft. 1 in. in length and were those of an adult woman. On the right side of the skull above and behind the ear was a circular aperture a quarter of an inch in diameter. A fragment of the inner table of the skull of same diameter was lying just within the aperture, as was also a small piece of lead. On the left side of skull, there was a more or less circular aperture which measured ⅜ths of an inch by half-an-inch. The outer table of skull was splintered off more than the inner. He found a bullet within the skull, which

was elongated in shape, and which weighed 85 grains. From the relative positions of the wounds in the skull, he was of opinion that the shot had been fired from behind, and that the direction of the bullet was from above, down, forwards and to the left. The bullet found in the skull measured the same at its base as did the bullets found in Moat House. He was of opinion that the body of the woman had lain in the ditch from three to five years.

Injuries without External Marks of Violence.—In addition to the wounds which are caused by different classes of instruments, it is necessary to be forewarned of the fact that violence may be applied to the abdomen whereby serious lesions of internal organs are produced, without leaving any external trace of its application upon the abdominal wall. This fact was forced upon our attention by a case which occurred in 1879, and which we then recorded.[1] The facts, shortly stated, were these: A young blacksmith, while engaged in shoeing a horse, was violently kicked in the abdomen by the unshod hoof of the animal. He suffered at the time from severe abdominal pain, took to his bed, and died two days after No trace of injury was seen on the abdominal wall at any time between receipt of the kick and the post-mortem examination which we made on the day after the death. The dissection revealed general peritonitis, and in the small intestine, corresponding in position to the region of the kick, was found a knuckle of intestine, much inflamed, in the centre of which was a lacerated wound one inch in length, and opening into the lumen of the bowel. The record of this case called forth other cases; one in which there was "fatal rupture of colon, without external bruising," by Dr Haining of Chester; a second, in which the jejunum was ruptured from a blow, with no trace of external or internal bruising of abdominal wall; and a third, "rupture of the jejunum, without abdominal contusion." Since that time, we have found like lesions in several cases, the subject of medico-legal inquiry, in all of which fatal intestinal injuries had been produced without any external or internal mark of injury upon the abdominal wall; and in others in which rupture of the liver at the junction of right and left lobes or of other organs was produced Dr Davies,[2] and Mr Bryant,[3] have also recorded similar observations.

Data from which the Kind of Instrument used may be inferred from the Nature of the Wound.—The forms of wounds are very variable, and, frequently, their shape bears no relationship to the kind of weapon which has caused them. At the same time, there are certain well-established data which, if found, are of great assistance in arriving at a conclusion.

I. Wounds with sharply-defined edges—clean cut—are, in the great bulk of cases, the result of forcible contact with a sharp instrument. The rare exceptions are those which are produced over bony ridges or prominences by forcible contact with a blunt instrument. Differential diagnosis in these can be established by careful examination of the condition of the hair-bulbs of the cut edges with a hand-lens.

(*a*) When a sharp-pointed, edged instrument is applied perpen-

[1] *B. M. J.*, vol. ii., 1879, p. 652.
[2] *Ibid.* vol. i., 1899, p. 469.
[3] *The Lancet*, vol. i., 1896, p. 87.

dicularly to the body, the wound is less in length than the breadth of the instrument, and broader than the thickness of the blade.

(*b*) When the same instrument enters the body obliquely, the edges of the wound appear unequal, one edge appearing to be straight and the other curved, and, not infrequently, owing to the bevelled shape of the wound, beads of subcutaneous fat appear between the lips.

(*c*) Lesions produced by glass and earthenware present different appearances. Some closely simulate wounds by an instrument of the dagger type, others wounds by instruments used after the manner of a saw. One very interesting case of the former type, in our experience, was as follows :—

Two men were fighting late at night. One was a railway servant on his way home from work, the other a barber who left his shop to engage in the fight. The former fell, shouting out that he had been stabbed by scissors. He was bleeding profusely from a wound over the hip, which measured 1½ inches in length and 2½ inches in depth. From careful examination of the wound, we concluded that the wound was not caused by scissors, but, probably, by glass or earthenware. On further inquiry, it appeared that the wounded man, before he began to fight, had been carrying a small, empty, earthenware jar in which he conveyed his liquid food to his work, and had set it down beside where he stood. A careful search of the scene of the fight was then made by a criminal officer, and a broken jar was found, of which the remains could be fitted together, except a triangular piece still amissing, and which, moreover, corresponded in size to that of the wound. When daylight came, further search was made, and, some yards from where the man fell wounded, the missing piece, covered with blood, was found. This helped to solve the problem.

In cases of wounds of the scalp from glass or crockery, small shivers of these substances may be found either in the tissues, or even embedded in the bone itself, from which the nature of the offending weapon can be diagnosed. We have found this on many occasions.

There is one especial peculiarity of glass wounds which we believe to be characteristic solely of glass—viz. a parallelism of the edges of the wound, with a sudden inequality or tapering, sometimes to the form of a mere scratch, at one or other extremity. This we believe to be due to the unequal fracture-surface so often seen in broken glass.

(*d*) Upon occasion, wounds consisting of a series of small punctures, situated at equidistant points from one another, may be seen. These are the result of violence from the strong teeth of a comb which is worn by a certain low class of women of the town, for keeping up the hair at the back of the head, and which is a favourite weapon of offence and defence.

II. Wounds with ill-defined, irregular, or ragged edges, which may be connected by bridges of connective tissue or nerve-filaments, are always caused by forcible contact with a blunt instrument. When found on the scalp, whole or crushed hair-bulbs may be picked out of the edges of the wound

(*a*) Wounds may be found upon the body—most commonly, however, on the head—some of which are contusions, some incised, and some lacerated, which at first sight look as if they had been produced by two different classes of weapons. This is not

so, however, in the bulk of cases; they are caused by the same weapon, and in this way: the assailant seizes a bottle by the neck and hits his opponent, from which contusions or lacerated wounds may result. But as the result of the repeated concussions, or of greater force, the bottle breaks while he is yet pounding his victim, and thus incised wounds are produced. The same remarks apply to an article composed of earthenware, such as a jug.

III. Contusions found upon the body, in the great majority of cases, are the result of forcible application of a blunt instrument. In most cases they do not afford any further clue to the character of the instrument used, but occasionally from their defined character and from the presence of more than one mark of like shape upon the body, some opinion may be offered; for example, a series of contusions in the form of stripes, the breadths of which closely correspond to each other, would be indicative of the application of a stick, or a leather strap, or other like weapon. Again, the amount of extravasated blood is sometimes no index to the severity of the violence offered, as in injuries to the vulva or penis, because of their peculiar vascular structure, and to persons of scorbutic, purpuric, or hæmophilic tendency, on account of their extreme susceptibility to bruising and bleeding from small degrees of violence. It must also be noted, as already pointed out, that ecchymoses may appear and develop spontaneously. So that in offering an opinion as to the amount of violence used from the extent of the ecchymosis, the preceding factors must be previously considered by the examiner.

IV. Wounds which are circular, slit-like, or triangular in shape, and to which on other parts of the body in a more or less direct line other similar wounds correspond, may usually be reckoned as having been produced by traversing missiles. Single wounds of this character may either be due to a missile which has entered the body and is retained therein, or to such an instrument as a pointed piece of stick or a butcher's steel. Usually the history of the case will determine the difference, and in dead bodies, dissection will probably clear up the difficulty. The diagnosis of gunshot wounds is obvious, when around the wound are found scorching or engraining of the skin with particles of carbon, or incrustation with the products of smokeless powder.

Wounds: The Significance of their Situation, their Dimensions, Direction, etc.—In dealing with wounds which form the subject of medico-legal inquiry, the greatest accuracy in their description must be observed. In estimating their dimensions, it is not enough that approximate measurements be made, but such must be exact in every particular. The following points with reference to wounds require to be carefully noted:—(1) the *situation*; (2) the *shape*; (3) the *direction* and *dimensions*.

1. The *situation* of the wound. Sometimes from the position of the wound on the body, some light may be thrown upon the mode in which it has been produced. Certain parts of the body are the elect seats of suicidal wounds, as, for example, the throat, chest, forearm, groin, and thigh; while wounds on other parts of the body oppose, if they do not, indeed, absolutely negative, the idea of suicide, by reason of

their inaccessibility, as, for example, on the vertex of the head, or on the back. Not only do wounds on the vertex most usually negative suicidal production, but also accidental production, because it is rarely possible to injure the vertex by a fall from the standing position. While multiplicity of wounds upon a body most commonly indicates homicidal violence, this is also found in cases of accident or suicide, although more rarely. In cases where wounds are found upon the throat of a dead body, it is advisable always to carefully examine also the hands. In this way it may be possible to distinguish, although not always, between homicidal and suicidal cut-throat wounds, for in the former

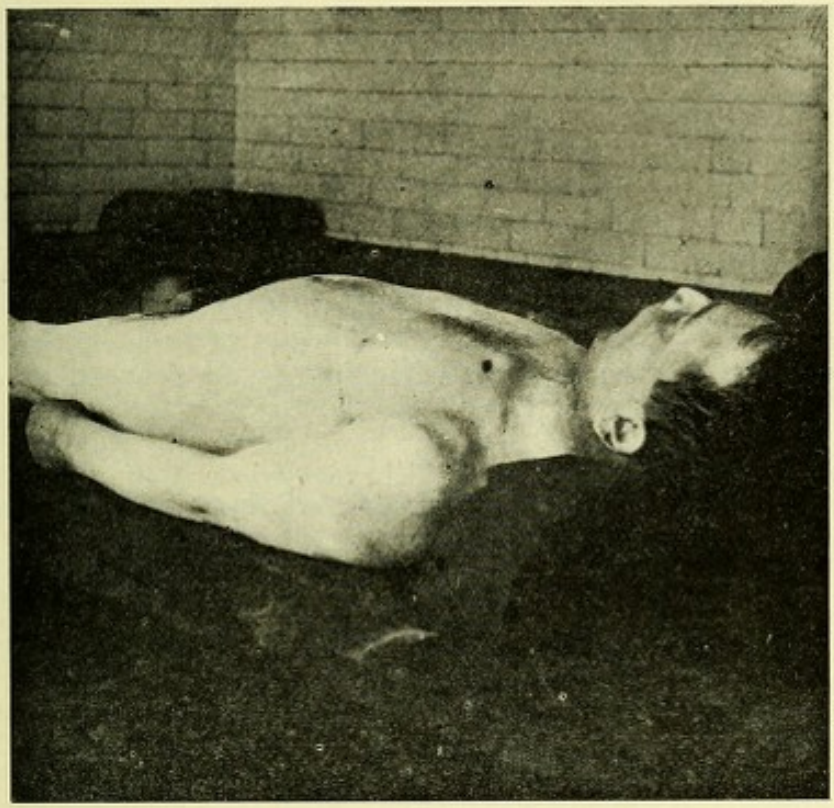

FIG. 56.—Mortal Wound of the Heart caused by Stabbing. The wound was situated 1½ inches below the level of left clavicle and 2¼ inches to the left of middle line of sternum. It measured $\frac{11}{16}$ of an inch in length, $\frac{5}{16}$ of an inch at point of greatest breadth, and was fusiform in shape. The direction of the wound was from above downwards and from left to right, passed into the thorax between the first and second ribs, severing part of the cartilage of the second rib, then through the mediastinal tissues and pericardium, and entered the aorta at a point 1¼ inches above the point where that vessel leaves the left ventricle. The pericardial wound measured $\frac{10}{32}$ of an inch in length, and the wound in aorta $\frac{9}{32}$ of an inch: thus showing that the weapon was tapered towards the point.

class of cases, unless the person be taken unawares from behind, or in a state of sleep or other form of partial unconsciousness, the hands when used in defence are liable to be injured. Homicidal wounds are usually inflicted over some vital region of the body, either on the front of the thorax near the region of the heart, on the neck, on the head, or on the back between the shoulders. (Figs. 56, 71.)

2. The *shape* of the wound may afford information of an important kind. From the business-like way in which a throat has been cut, or from the unsurgical mode in which a body has been divided, suspicion

would, in the former case, fall upon a person whose work lay in that direction upon animals, as a butcher, and in the latter, upon a person who was unacquainted with the anatomical conformation of the body.

In the Glasgow Pollokshields tragedy which was tried at the December Circuit Court, 1892, it was shown in the medical evidence that the body of the victim had been cut up into several parts, that the neck had been severed from the body with a saw, that the bones of the thigh had been divided by the same tool, and that the cause of death was a wound in the throat which severed the carotid arteries. The like rough manner of dividing the body was observed in the Wainwright tragedy. In the Rainhill tragedy, 1892, four of the five victims were murdered by cut-throat wounds, and in at least one of the four, the wound in the throat had divided all the tissues of the neck, and severed the connection between two of the cervical vertibræ, while in the fifth, the cause of death was strangulation, produced in the manner already described.

3. The *direction* and *dimensions* of the wound have often an important bearing as indicating the relative positions of the assailant and assaulted at the time the wound was inflicted, especially in the absence of eye-witness of the commission of the crime. This is, perhaps, more true of gunshot than of other forms of wounds, particularly when the missile penetrates the body. In such cases the particular direction from which the shot has been fired sometimes becomes of the greatest importance in establishing connection with any given accused or suspected person.

In the famous Ardlamont case which was tried at the High Court of Justiciary in 1893, before the Lord Justice-Clerk and a jury, this question was of supreme importance, since upon it vital issues depended. The charge in the indictment against the prisoner Monson was that "on the 10th August 1893, at a part of a wood situated about 360 yards or thereby in an easterly or north-easterly direction from Ardlamont House," he "did shoot Windsor Dudley Cecil Hambrough, and kill him, and thus did murder him." The prisoner pled not guilty. It was shown in evidence that the prisoner, along with another man named Scott or Sweeney, who was also charged in the indictment with the same crime, but who did not appear to answer to the charge, went with the deceased to shoot in the wood in which the body of deceased was afterwards found. The body was first examined by a local practitioner, who, in his report, certified that he found on the body a scalp wound extending from the right side of the occipital protuberance to near the right ear, part of which had been carried away. This wound, a large and ragged one, measured about 3½ inches by 1½ inches. About the centre of the scalp wound there was an irregular opening, about 1 inch in diameter, right through the occipital bone into the brain. The bone had been carried into the substance of the brain. The brain substance was protruding from the wound, and blood had escaped rather freely. The wound was exactly what one would expect to find from a charge of small shot, fired from a distance of perhaps twelve inches. The shot had not time to spread, as there were no separate pellet marks. There was no blackening of the parts in or near the wound, due, as the witness believed on information supplied him by the prisoner, to the use of "amberite," a nitro-powder. The skin or hair was not burned. The cartridge-cases, including the empty one by which the supposed accident had been caused, had been removed by the prisoner, and the doctor did not see them. From these facts, the doctor reported that,in his opinion, the death was probably due to accident, the gun having gone off while in the hands of deceased, during his attempts, it was believed, to save himself from stumbling when walking along a turf-topped wall. It appeared, however, on further inquiry by the Fiscal, that "amberite" cartridges were not manufactured for the bore of gun used by the deceased, and, further, that a previous attempt on the life of the deceased by drowning had been made by removing the plug in the bottom of a boat under the foot-boards, so as to swamp it; and, in addition, that the prisoner, who was

said to be in financial difficulties, had made efforts, successful and unsuccessful, to effect insurances for large sums upon the life of the deceased. The theory of the prosecution, therefore, came to be that the prisoner wilfully shot the deceased from a little distance; that of the defence, that the deceased in attempting either to scale, or walk along the top of, a wall, stumbled, whereupon his gun had gone off lodging the charge of shot in his head. Before the trial, a second examination of the exhumed body was made by Sir Henry Littlejohn and by Dr M'Millan the local medical man who had formerly reported on the case, in Ventnor Churchyard, where the body had been interred. In their joint report they gave a detailed description of the wounds in the scalp and cranium. The former in his evidence at the trial further stated as his opinion from that examination, that the injuries had been caused by a charge of shot which had entered the parts from behind forwards, but that the injuries were only due to a portion of the charge, and not to the entire charge. He was further of opinion that the charge had been fired from a distance of from 3 to 9 feet, probably nearer 9 feet than 3 feet. These views were corroborated generally by other medical witnesses for the prosecution, as well as by gun-experts, the latter of whom testified that, from certain markings on trees and shrubs in a given line, the shot must have come from that direction. For the defence, however, evidence was adduced by other medical and gun-expert witnesses to the effect that the injuries could be accounted for by the discharge of the deceased's own weapon, and that the distance of the mouth of the gun-barrel from the head of the deceased might be any distance between a few inches and about 3 feet, but not exceeding 4 feet, and that the charge struck the head at a very acute angle. The jury returned a verdict of "not proven." This case is remarkable in respect of the amount of experimental evidence which was given by the witnesses, based upon the effects produced upon objects by charges of small shot fired at varying short distances.

We have seen two cases in which a charge of small shot has accidentally produced a wound which might have been caused by a single old-fashioned round bullet.

1. Two gamekeepers were out shooting grouse. They were lying on their backs behind a low wall waiting for the birds which were being driven towards them. One of them, resting uncomfortably, clumsily shifted his position, and in doing so, the trigger of his gun caught in his shot-belt, and the discharge from the gun went into the foot of his companion under and behind the ball of the great toe. On examination of the foot, one irregularly-circular opening with blackened edges was found in that position, and on the dorsum of the foot, a large irregular opening in which all the tarso-phalangeal joints were exposed. The gun was charged with No. 5 shot; the distance from the muzzle of the gun to the part of the foot struck was about 2½ feet. The foot was amputated, and the man did well.

2. The facts of the second case are these: a party was out grouse-shooting. Two of the party were defiling through a gap in a ditch in a crouching attitude, when the charges of both barrels of the gun of the second man went off accidentally and struck the man in advance between the shoulders, ploughing a way for themselves in the tissues over the spines of the upper dorsal vertebræ, and producing one long, ragged wound which exposed in its base two of these spines, but without fracturing them. From the attitude of the man in advance, the discharge then passed over the back of his bent head. The distance between the gun-mouth and the part struck was estimated to be between 3 and 4 feet.

The following cases illustrate accidental wounds from loaded revolvers:—

1. Two young boys, tired of playing indoors on a very wet day, thought they would clean their father's revolvers. The elder taking one out of the case, pointed it at his brother, making the playful remark, How would he like to be shot? To his consternation, the pistol, which unknown to him had been lying in the case loaded, went off, and the bullet struck his little brother in the face,

and he instantly fell. On examination of the boy a few minutes thereafter, we found a small bullet wound, somewhat irregular in shape, situated between the inner angle of the right eye and the base of the nose, which had evidently penetrated the brain through the orbital plate, because brain substance appeared in the wound. Surrounding the wound were engrained particles of unconsumed powder in the skin. The bullet was a conical one $\frac{3}{8}$ths of an inch in diameter, and the distance of face from the revolver-barrel mouth was about 2 feet. The boy died. On post-mortem examination the bullet was found in the brain.

2. This case was also the result of a revolver accident, and presents several points of interest. It was recorded by Dr Ward Cousins.[1] The facts, shortly, are these: a girl, aged 16, was holding in her hands a revolver, and at the moment of discharge, the muzzle was pointing toward the stomach. The bullet entered the abdominal wall 2 inches to the left of the umbilicus at a point about midway between it and the ninth costal cartilage, and passed out behind on the right side of the spinal process of the twelfth dorsal vertebra, but without perforating the clothes behind. The missile was a "cylindro-conoidal bullet, half-an-inch in length, five-eighths of an inch in thickness, and it weighed 120 grains." After passing through the abdomen, it was flattened on one side near the point. The edges of the wound of entrance were black and discoloured. In its passage, it had perforated the stomach, which was sutured by operation, and the girl recovered.

3. It would be difficult to say whether the wounding in the following case was accidental or intentional, but the facts of it are somewhat unique. A boy, aged 6, was playing with his companions in the public street, and suddenly stopped his game complaining loudly of a sudden pain in his stomach. He was able to walk home. He was seen by a doctor who found a wound on the right side of the pit of the stomach which he thought might be due to a missile from a pistol. No pistol-shot had been heard at the time by any of the boys, although, by reason of the noise of the busy thoroughfare in which they were playing, that might have happened without having been heard by them. The boy becoming gradually worse, was sent to the Infirmary, where he died. On post-mortem examination of his body, we found a wound, covered by a crust or scab, measuring $\frac{7}{16}$ths by $\frac{3}{8}$ths of an inch, which was situated on the right side of the pit of the stomach about $\frac{5}{8}$ths of an inch from the middle line of the body and at the lower border of the cartilage of the tenth rib on the right side. In the right chest were twenty-four ounces of pus, the right lung being collapsed and functionless. In its lowest lobe, an irregularly-conical bullet or slug was found which measured a quarter of an inch in length and $\frac{3}{16}$ths of an inch in diameter, and which, from its appearance, looked like a missile commonly used in an air-gun. No clue was found to the perpetrator.

The following case is uncommon in respect of its details:—

In June 1909 we examined the body of a man who was alleged to have been accidentally shot within the premises of a private shooting club. A companion of the deceased had been taken into custody pending further inquiry into the circumstances. The body was that of a healthy young man. The only external mark of injury visible on the body was an oval-shaped wound, measuring $\frac{5}{8}$ths of an inch by $\frac{3}{8}$ths of an inch, which was situated on the upper front of the left temporal region of the head. The eyelids and tissues around both eyes were discoloured of a blackish-red colour from extravasated blood, but there was no ecchymosis of the eyeballs. On dissecting the scalp, the deep scalp tissues over an area of 6 inches in diameter from the wound were found to contain extravasated blood. In the skull was an oval penetrating wound which was situated in the left temporal bone close to its suture with the left frontal bone, and which was of like dimensions to the wound on the scalp. On removing the calvarium, a similar wound was found in the *dura mater* in a line with the wounds in scalp and skull. The whole area of the brain surface was covered more or less with a thin layer of fluid blood. On the left aspect of left frontal lobe of brain was an area of lacerated brain tissue, corresponding in line with the wounds already described. Dissection of brain showed that a missile had traversed the substance of both frontal lobes. Examination also showed that

[1] *B. M. J.*, vol. ii., 1898, p. 145.

it had then been deflected backwards through the right hemisphere, and had lodged in the right occipital lobe where it was found. Examination of base of skull revealed that the missile in its traject from left to right side of brain

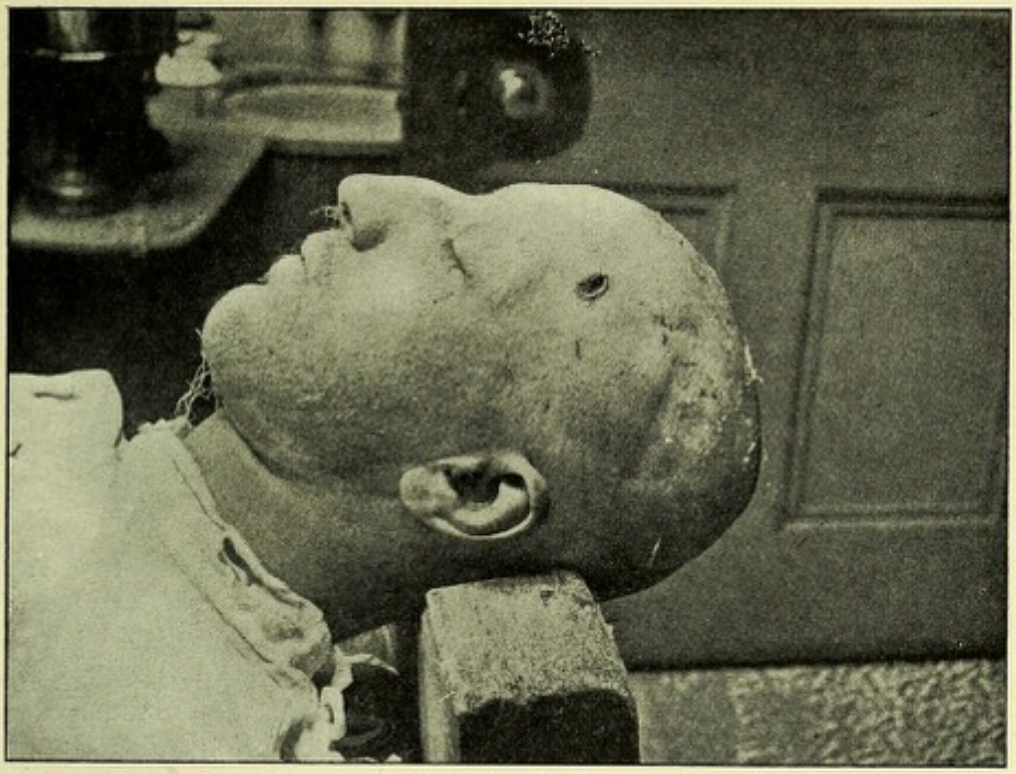

FIG. 57.—Shows the entrance wound of a bullet from a Morris tube rifle. Bullet was found in the brain. The bullet entered the head broadwise instead of by the point.

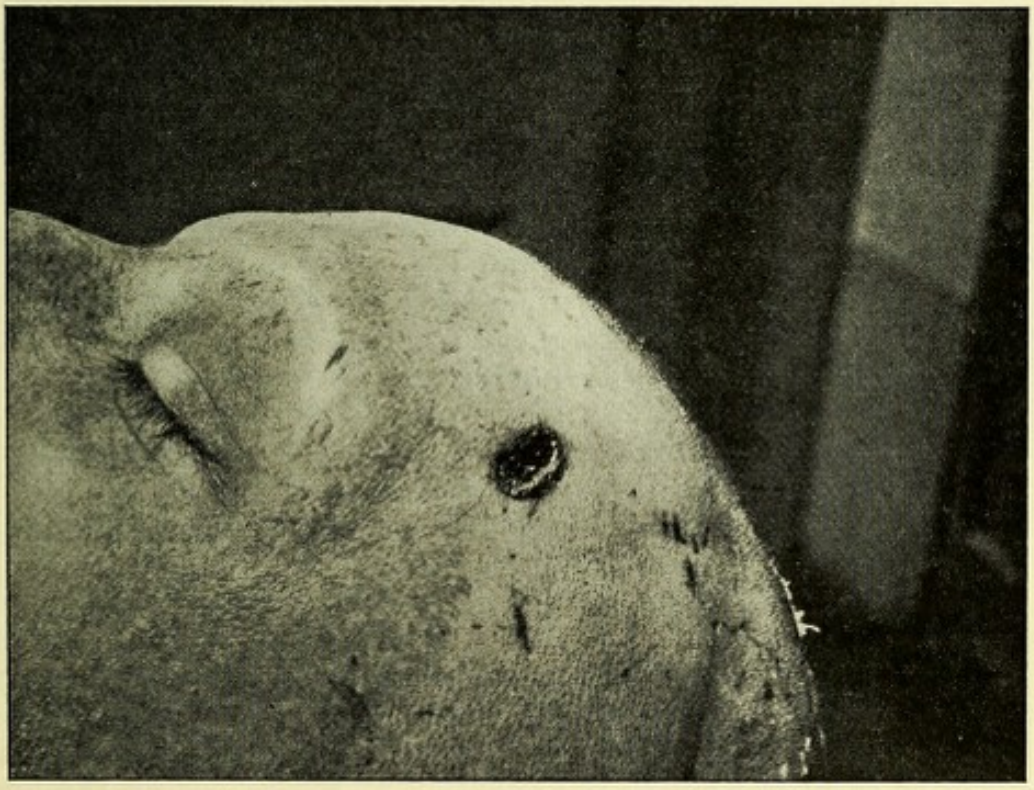

FIG. 58.—Is a photograph of Fig. 57, but nearer the object. (Author.)

cavity had produced fractures of the roof of each orbital cavity, that of the left being linear in character, whereas that of the right was composed of a series

of fractures radiating from a common point, where the missile had struck the bone ; thus accounting for the extravasation of blood around both eyes which was seen externally. The bullet was much distorted in shape, It measured $\frac{8}{16}$ths of an inch in length and $\frac{5}{16}$ths of an inch in breadth at the point of greatest breadth, and, therefore, corresponded to a bullet fired from a tube-rifle.

The prisoner was tried before a sheriff and jury on July 27, on the charge that he did discharge a rifle loaded with ball cartridge at or towards the deceased, and did shoot him and kill him. From the evidence it appeared that both accused and deceased were members of this club, and that both were expert shots. On the occasion in question they had been shooting at small targets in friendly rivalry, and both had made excellent scores. They then shot at pennies suspended by a string, and both had hit the pennies. The deceased then challenged the accused to hit a clay pipe which he was to hold in his mouth, and it was during the act of being shot at with the pipe in his mouth that the deceased met his death. From the relative sizes of the wound in the skull and of the breadth of the bullet, we had arrived at the conclusion that, for some reason unknown to us at the time (the foregoing history not being then in our possession), the bullet had entered the skull broadwise and not pointwise. Examination of the fragments of broken pipe showed small spots of blood. We concluded from these facts that the bullet had struck the pipe and had been deflected at an angle and entered broadwise the head of deceased. The jury found the prisoner " not guilty." (Figs. 57, 58.)

But the direction of the wound may also be of importance in cases of incised wounds by stabbing or otherwise. When the relative position of assailant and assaulted is a question of moment by reason of absence of direct evidence as to the manner of the infliction of the wound, the medical examiners are expected to offer some opinion on the point from the wound itself. In three cases in our experience where death was caused by stabbing, the direction of the wounds, which in each case penetrated the chest and the aorta or pulmonary artery at their points of origin from the heart, or the left ventricle, showed that the assailant—in each case a right-handed person—had attacked his victim in front and from the right side ; and in a fourth case, where the victim was first struck on the forehead by a hammer, and then stabbed in the root of the neck with an ordinary breakfast table-knife, it was evident that the head blow had been administered from behind, and the neck wounds produced while the assailant stood behind the head of the fallen victim.

The points to be attended to by the medical examiner in any case of wounding may be summarised as follows :—

1. The dimensions of the wound, accurately measured ;
2. The relation of the wound to anatomical landmarks on the body, and in the case of more than one wound, the relation of each to the others in measured distances ;
3. The character of the wound or wounds, with respect to the class of weapon by which it, or they have been produced ;
4. The direction of the wound, where it penetrates the tissues.

It is also of prime importance, where wounds are found upon a part of the body usually clothed, to examine the different superposed garments together and separately. All evidences of the passage of instruments through the fabrics must be carefully noted and measured, as well as their relation to the situation of the lesions on the body ; for it sometimes happens that a clue is thereby afforded to the exact position of the assaulted person at the moment of the assault, a point which is of much importance, especially in penetrating wounds of

the chest. It occasionally happens, also, on examining an under-garment not tight-fitting, that more marks of perforation are discovered than there are wounds on the part of the body corresponding to the position of the garment, or in the superjacent garments. This, at first sight, is somewhat puzzling; but it is simply due to a wrinkling or folding of a voluminous under-semmit, which upon being spread out for examination will reveal three perforations instead of one. This may be easily demonstrated by doubling a piece of paper on itself and perforating it with a knife, and thereafter spreading it out flat.

In the examination of a dead body upon which there is a wound or wounds, the following questions are bound to arise for answer :—

Is the Injury or Wound mortal ? and, where there are more wounds than one : Which of the Wounds was likely to prove mortal or dangerous to life ? Such questions must be answered in the light of what has already been said regarding mortal wounds. But it must be borne in mind that death may result, in certain circumstances, from a comparatively small wound which, under other circumstances, would not prove fatal. This point is exemplified by the following cases which fell within our experience :—

1. The dead body of a woman, aged 44, was found in bed. The mattress was soaked with blood. The body was pallid, as from the effects of hæmorrhage. On the inner side of the calf of the right leg a small circular wound was found, which, on examination, was discovered to open into a large varicose vein.

2. The dead body of another woman, aged 65, was found in bed, under nearly parallel circumstances, the bedclothing under the body being saturated with blood. A small circular wound was discovered on the inner side of left ankle, which opened into a dilated varicose vein.

In both of these cases, the women lived alone. From the position of the bodies it was apparent that the rupture of the vessels had occurred during sleep, and that they had bled to death.

The next question which arises is, Was the wound or wounds inflicted during life, or after death ?

The following points must engage the attention of the medical examiner before answer—viz.

1. Do the edges of the wound, or wounds, show evidence of vital retraction ?
2. Has there been more or less copious bleeding, and, if so, are there spirts or jets or sprays of blood in or near the vicinity of the body ?
3. Are clots of blood present in the wound itself, and clotted blood in the neighbourhood of the body ?
4. Is there staining of the tissues of the wound by blood ?
5. Are there any signs of vital reaction present ?

The signs of vital reaction can never, obviously, be observed in the case of mortal wounds, but they may be found in cases of wounding in which, but for the mere accident of individual circumstances, the wounds would have proved quickly mortal, as in wounds of the heart or large blood-vessels, but in which the person lives for a day or two afterwards. In contusions, the signs of ante-mortem production are the following—viz. (1) swelling of tissues; (2) discoloration of skin; (3) presence of blood in subcutaneous cellular tissues, as revealed on incision, the amount of which will depend upon (*a*) degree of original

violence, (*b*) nature of tissue injured, and (*c*) condition of bodily or constitutional health of person at the time.

The absence of the foregoing appearances would point to post-mortem production, except in bodies taken from the water, in which, by reason of the water washing away all evidence of hæmorrhage, the answer to the question becomes exceedingly difficult. But it ought to be borne in mind that so long as molecular life remains in the tissues not only is retraction of edges possible in wounds then produced, but a certain amount of bleeding will occur by gravity, if the operation of this force can prevail, by reason of fluidity of the blood remaining so long as the body is warm. For the same reason, limited contusions may be produced on a body just after death ; but even in this case the amount of subcutaneous extravasation and the consequent superjacent swelling of tissue will be less.

Data from which to infer the Age of a Wound, or Wounds.—It becomes of some importance to the criminal authorities where it is tried to establish connection with a certain crime of a given suspected person upon whose body there is a wound, and where the fact is known that the actual perpetrator was wounded at the time of its commission, to know whether or not the wound found on the body of the apprehended person corresponds to the conditions of a wound inflicted at the given time. If, in such a case, from the appearance of the wound, the medical witness can reasonably show that the said wound was probably produced within a time covered by the interval between the commission of the crime and the date of apprehension, that and other facts may lead to the proper conviction of the culprit. In this connection, the following data may assist in answering approximately the foregoing question :—

1. A wound which shows vascular congestion and accompanying œdematous swelling but absence of connective tissue elements, may be deemed to be of less than 48 hours' duration.
2. A wound which begins to show evidence of tissue-regeneration, may be reckoned to be from 5 to 8 days old.
3. Pus usually appears in a wound from the 3rd to the 4th day after production.
4. In wounds which heal by first intention, especially if limited in length, the edges may be temporarily glued together by serum within 48 hours of their production, but not permanently until 4 to 7 days.
5. When a wound heals by granulation, as it always does where there is loss of substance and where the edges cannot be brought into surgical continuity, the stage of granulation exists for so variable a period, depending upon so many factors, that an answer, when ventured upon, can only be given from the experience of the individual observer, and even then, should be given with great caution.
6. A recently-healed wound exhibits a cicatricial cuticle which, at first, forms a thin, bluish, transparent membrane ; when older, a rosy or brown coloration ; and when still older, a white and dense appearance.

Whether is the Wound, or Wounds, of Accidental, Suicidal, or Homicidal Origin?—This question is bound to arise in every case where a dead body is found upon which there are marks of violence. While in the bulk of cases, probably, it is capable of answer from the moral circumstances of the case, there is a series in which the medical examiner, from observation of the wounds and of the *locus* of the deed, may be able to offer testimony of the most valuable nature.

The criminal authorities expect that when a medical examiner is called upon to examine such a body *in situ*, he shall note every point on and around the body which might throw light upon this question. Among these points, the following ought, certainly, to be noted :—

1. The position of the body, if in a room, with relation to prominent objects of furniture, and to weapons, if such be present ;
2. The presence or absence, and if present, the incidence, of blood-stains on or near the body, and upon such objects or weapons ;
3. The applicability of such objects or weapons to the production of the injuries found ;
4. The general appearances of the surroundings of the body, as evidences of marks of a struggle ;
5. The condition of the hands of the deceased with respect to blood-stains, or the clutching of weapons, hair, or bits of clothing, etc. ;
6. The physical appearances of the effused blood,—in pools, or splashes, or streaks, or trails, or jets,—and if in the form of jets or sprays, the direction of the flow, and their position with relation to the position of the body when found, as throwing some possible light upon the position of the deceased at the moment of infliction of the wound.

The following case which was tried at the Glasgow Circuit Court, March 1899, illustrates several of the foregoing points. The facts of the case were, shortly, these : In a house in Dunoon, in which for the time being lived a young man, the prisoner, and an old woman of 82 years of age, it was alleged the prisoner had inflicted the injuries of which the latter died. From the evidence it appeared that on Monday, December 5, a doctor was called to see the old woman. He found her lying in bed in an unconscious condition. Her pulse was hardly perceptible, and her breathing feeble. On the right side of the face over the eyebrow was a lacerated wound about an inch long, there was ecchymosis of left eye, and certain other marks of supposed violence on the side of head and neck of a " maroon " colour. He further testified that erysipelas was present round the wound over the eye. The woman died. A post-mortem examination of the body was made by the medical attendant and another medical man who reported as follows :—That the following marks of violence were found on the body—viz. (1) a contusion of a deep " maroon " colour on the right side of the face and neck extending from the scalp down to an inch from the collar bone ; (2) a lacerated wound about an inch long over the right eyebrow ; (3) ecchymosis and swelling of left eye ; (4) an abrasion over left cheek-bone ; (5) a contusion on and under the chin ; (6) various bruises on the scalp ; (7) a bruise on the right shoulder ; (8) various other small bruises on the body ; (9) fracture of the 3rd, 4th, 5th, and 6th ribs on left side, with a double fracture of the last two ribs. In giving their evidence, the reporters stated that they did not dissect the bruises ; that they examined the bedroom in which the alleged assault took place, and that they found on the woodwork of the window of the room blood-stains with grey hair adhering to them, which resembled the hair of the deceased. They gave the opinion that death was due to shock, the result of the combined injuries, that the injuries could not have been produced by an accidental fall, but were the result of assault by kicking

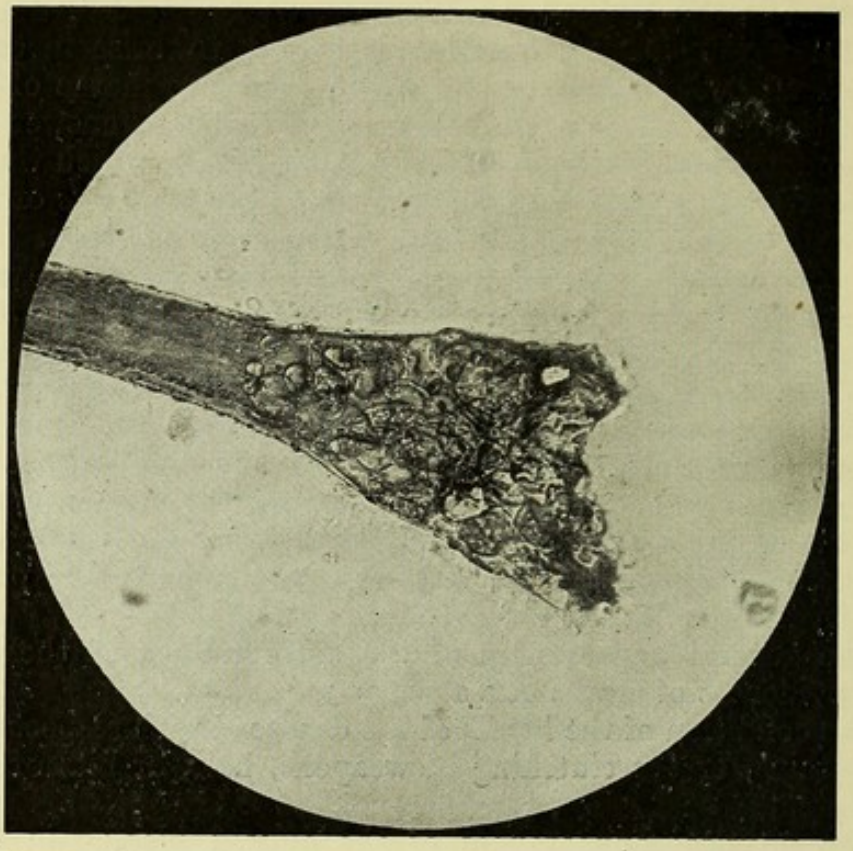

FIG. 59.—Showing Hair-bulb in a state of Fatty Degeneration. The above is a photo-micrograph of one of the hairs of the deceased in the Dunoon Case tried in Glasgow March 1899. × 500 diameters. (Author.)

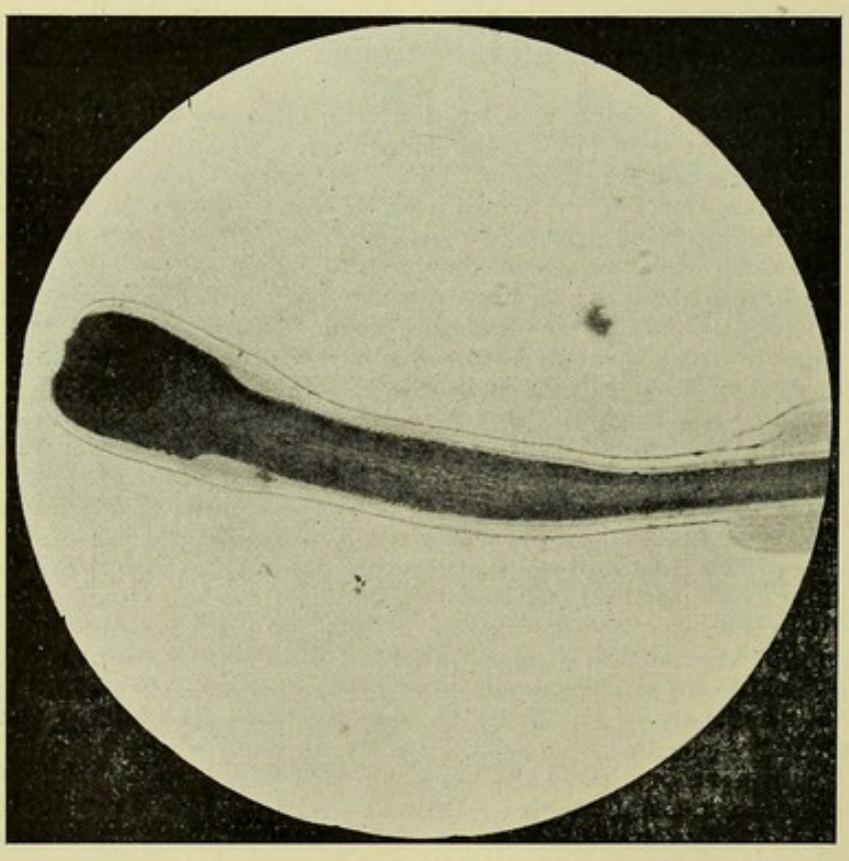

FIG. 60.—Photo-micrograph of Human Hair pulled forcibly from Scalp. The ruptured sheath is seen at the right of the figure. × 500 diameters. (Author.)

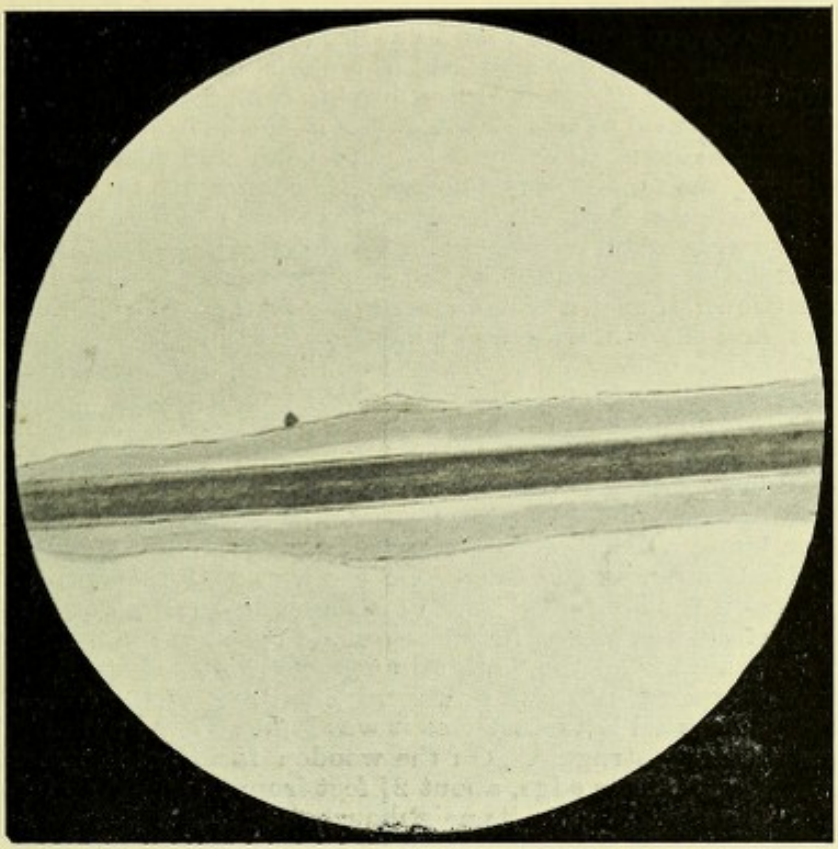

FIG. 61.—Photo-micrograpl. of Human Hair plucked forcibly from the Scalp, showing ruptured sheath; a continuation of Fig 60' × 500 diameters. (Author.)

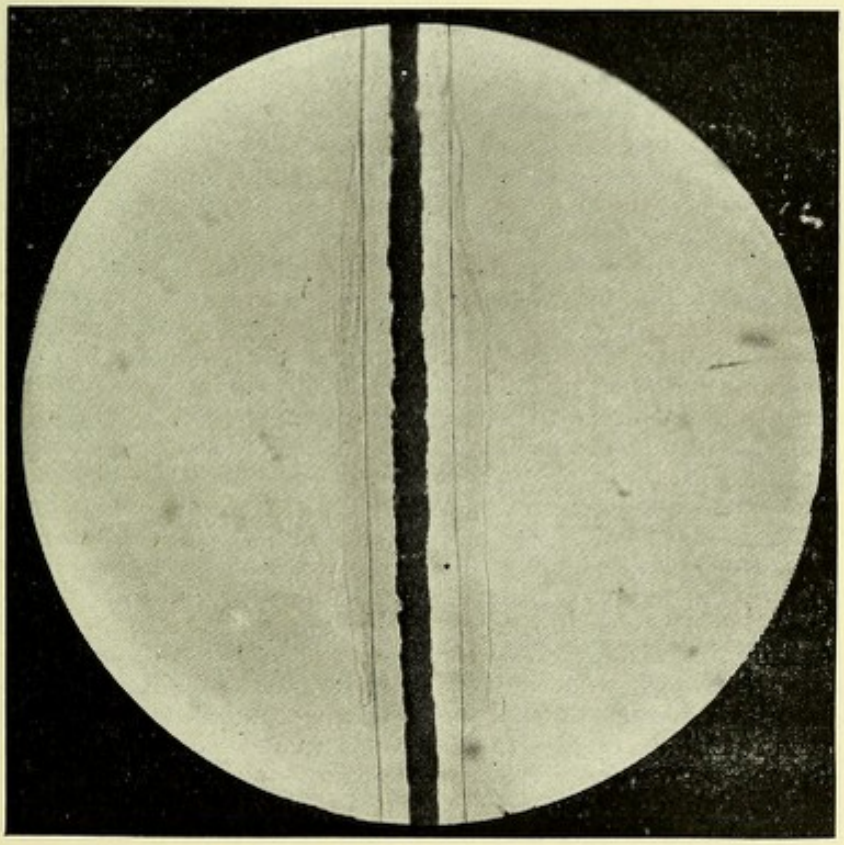

FIG. 62.—Hair pulled forcibly from the Scalp. The torn sheath will be seen at the lower end of hair, which corresponds to the bulb end. × 300 diameters. (Author.)

with a booted foot, or by a person kneeling upon the chest, that the injuries on the head and face were produced by a flat broad weapon laid on with considerable violence, such as the flat back rail of a chair, and, further, that the scalp bruises were caused by handfuls of hair having been forcibly pulled out by the roots. Such a detached chair-rail was found in the bedroom, but they testified that, having examined it, they found it quite clean and with no marks upon it. Another witness, the tenant of the house, who chanced to be from home at the time of the occurrence, testified, however, that said rail had been detached for some time. We were asked by counsel for the defence to examine the said report, and also to make an examination of the premises and of the productions in the hands of the Crown, if such was considered necessary. We carefully examined the premises, and the following was what was found :—the room in which the body lay at the time of death was situated on the right of the hall on the ground floor, and the room in which the alleged assault took place, in the flat above. From the hall leading to the upper flat was a wooden stairway, about the middle of which was a comparatively acute bend, and from the top landing, for about a third of the length of the stair on the left side, was a heavy corniced balustrade with comparatively sharp corners. On the stairway, and on its lowermost step, we found a blood-stain measuring one and a half inches in diameter. This was the only stain on the stair. On the wall of the stairway, at a height of 3 ft. 8 in. from the step-level and in a direct line downward from the top landing of the stair, was a fresh indentation and break in the wall-paper, which was partly separated from the wall, of a nearly circular shape, beneath which the plaster was bruised into fine powder. The room of the assault was next examined. It had been left exactly as it was found by the police. There was no appearance of any struggle. On the wooden facing of the window, which had a comparatively sharp edge, about $2\frac{3}{4}$ feet from the floor we found a slight indentation in the wood, and in its neighbourhood certain marks of blood—viz. running floorwards from the indentation was a tiny stream of blood which had dried, and around the indentation were circular and inverted soda-water-bottle-shaped marks of blood, the latter of which, especially, pointed to the fact that the blood had been forcibly projected against the woodwork from a point close to the woodwork. In addition, on the window facing were irregular, thin smears of blood, in two of which were found hairs which were detached and taken for microscopic examination. Close to the wooden facing on which the blood-spots were found stood a wickerwork arm-chair covered with a light-coloured chintz, on the extremities of the arms of which, at a point where the hands of a person seated in a chair would naturally rest on attempting to rise, were bloody finger-marks and smears. Close to the right of the chair stood a low chest of drawers, its top being about $1\frac{1}{2}$ feet higher than the arm of the chair, on the right edge of the covering of which were more bloody finger-marks. On the other side of the narrow room stood a bed, on a pillow cover of which was a small stain of blood; between that and the fireplace stood a wash-hand basin, and adhering to the soap in the soap-box were three hairs which were taken for examination ; and in the grate, in which there had been no fire for a long time, was a small ball of loosely rolled hair, which was also taken away. There were no blood-stains on the carpet, but there were many small pieces of broken plate-glass and a small oblong piece of metallic mirror which looked like the reflector of an oil-lamp. We afterwards examined the productions in the hands of the Crown authorities in Glasgow, which consisted of body-clothing and bedclothing—all of which were blood-stained—the flat back rail of a chair on which there were no marks of blood or anything else, and some loosely rolled coils of hair, constituting, to all appearance, what a lady would call "combings."

From these facts, therefore, the following points stood out clear—viz (1) there was only one wound of the skin on the body of deceased ; (2) there was a place in her bedroom—the wooden window-facing—which bore the marks not only of forcible contact, but by reason of the blood and its characters, of contact with a living human body ; (3) there was no other *evidence* which indicated the source of the wounding. We were consequently forced to the conclusion, judging from the height of the marks on the facing from the floor, (1) that the wound on the right eyebrow had been caused at that point, and by a fall, because the point of impact was lower than her head when standing erect, and (2) that she had either been partly stunned by the fall or was unable to rise, because of the presence of the tiny stream of blood on the wood which ran down to the floor. It came out in the evidence later that the deceased was very lame,

in fact was partly palsied and was liable to falls. Our view was that after she picked herself up and got up into the adjacent arm-chair, feeling her face damp but not being able to see why, because the room was said to be dark by reason of the lamp having fallen and having been broken, she put up her hands to adjust her hair which had evidently become dishevelled to some extent by the fall, as shown by the presence of the hair sticking in the dried blood at the point of impact, soiled her hands with the blood from the wound over her right eye, tried to rise with the aid of the arms of the chair, thus soiling the chintz, and likewise the white covering of the drawers with her bloody fingers, then tottered across the room to her bed, where she evidently lay for only a very short time, judging by the small stain on the pillow. Being all this time in the dark, she rose to go downstairs for assistance, and on reaching the landing, which like the room and stairs was dark, she missed her footing, banged her body in the fall against the sharp-edged banisters, broke her ribs, and fell to the bottom of the stair, on which we found the blood-stains, which indicated that she had lain there for a little time. This was the opinion we arrived at of the cause of the injuries, as could be drawn from the facts as narrated. Several of the points, such as the breaking of the lamp and the want of light in the room, were corroborated, apart from the prisoner's own statement. The hairs which were found in the blood smears, and those adherent to the soap in the bedroom of the deceased, were examined and compared with the loose coils of hair in the possession of the Crown, and the microscopic examination showed that they all evidently belonged to an aged person, and that the bulbs were in a condition of atrophy and fatty degeneration, thus likely to be shed naturally, and none showed the appearance of having been forcibly pulled from the scalp. (Figs. 59, 60, 61, and 62.) The jury returned a verdict of not proven.

In another case of undoubted murder, in which, however, the murderer was not got, the nature of the assault was written on the walls and furniture of the room in which the deed was committed. The body was that of a woman of known loose habits, and it was because of this that the neighbours did not interfere on cries being heard coming from her dwelling. The body was covered with dirt mixed with blood, particularly over the chest, arms, and legs, although there were also blood marks on the hands, wrists, face, and head. The marks of violence, which were very numerous, consisted of bruises, lacerated wounds, and compound fractures. There were 29 separate bruises, proved on dissection, most of which were situated on hands, forearms, head, face, and shoulders. There were 20 lacerated wounds, some of them 4½ inches in length, which were situated chiefly on head and face. There were two compound fractures ; one on the left cheek, in which the malar bone and the left side of the upper maxilla were broken in pieces, the other, over the left eyebrow, in which a triangular piece of bone nearly an inch in length was driven in on the brain. In the apartment two large pieces of brick were found, one piece measuring 9 inches in length, and weighing 8¼ lbs., the other 5 inches long, and weighing about 3¾ lbs. Both bricks were covered with blood, in which was a quantity of adherent hair which corresponded to that of the deceased. A third piece of brick, wedge-shaped, and ending at one extremity in a comparatively sharp, serrated edge, was also found, which, although also stained by blood, had no adherent hairs. Further examination of the apartment, which was absolutely without movable furniture, showed that it contained a fixed wooden press and a large coal-box, both of which projected into the apartment-space. There was no grate in the fireplace, but, instead, a considerable amount of soot, lime, and broken bricks. It might have been supposed that the cause of the various injuries was falls by this heavy woman, while intoxicated, upon these bricks and upon the wooden fixtures described ; but any such view was at once dispelled when the distribution of blood over the apartment was noted. While here and there on the floor, large pools and smears of blood were seen, there were also plentiful marks of blood on the walls of the room and on the window-panes as high up as the upper sash, which consisted of circular and inverted soda-water-bottle-shaped spots indicative of forcible effusion, or spattering, of blood ; further, on the edge of the coal-box there were marks of bloody fingers, as if someone with bloody hands had rested the hands thereon. It was only too clear from the foregoing appearances that her assailant had picked up the pieces of brick which were lying handy, and that he battered the head and face of the woman while he chased her round the room,

she, meanwhile, putting up her hands to her head to protect herself, thus accounting for the large number of bruises on the hands and forearms. We reported that death was due to fracture of the skull with extravasation of blood upon, and injury to, the brain.

At the High Court of Justiciary, held at Inverary in August 1908, a man was charged with having assaulted a medical practitioner of Ardrishaig, by throwing him to the ground, compressing his throat, and kicking him on the head, face, and other parts of his body with his booted feet, and did thus murder him. The body of deceased was found on the highway between Ardrishaig and Lochgilphead, and the accused was seen standing near by. The report of the post-mortem examination of the body bore that the clothing was much soiled with mud and blood-stains, and the face covered with dried blood, the following marks of violence being found :—the left ear was swollen and of a purple colour, and at the margin of the lobe was a lacerated wound ¼ of an inch long, which divided the cartilage ; the scalp on left side was swollen, and above that ear an area of scalp 2½ in. × 1¾ in. was practically denuded of hair ; there was a similar area, but smaller, on right side ; on left side of neck at angle of lower jaw was an area of abrasion of skin measuring 2 in. × ¼ in. ; in the region of forehead and on both sides of head extensive bruising was found in deep tissues, both temporal muscles being infiltrated with clotted blood ; within the skull a thin layer of effused blood was found between *dura mater* and *pia mater* on upper and basal surfaces of posterior half of brain ; there was no visible injury to brain itself, and its vessels were healthy, nor was there any fracture of skull ; the injuries on right side of face were comparatively superficial and unimportant ; on left side of face, the skin of cheek, forehead, and temple, as also around left eye, was of a deep purple colour, the subjacent tissues being much infiltrated with blood, and in a state of pulp ; above left eyebrow was a triangular-shaped laceration of skin, 1¼ inches long ; on left cheek, below left eye, were two lacerations of skin, the upper measuring 1 inch long, and the lower, ½ an inch ; on upper part of bridge of nose was a lacerated wound, ½ an inch long, which passed down to nasal bones, these being broken in several pieces ; the upper portion of left upper maxilla, forming part of orbital cavity, was fractured and driven inwards, and was lying loose in the tissues ; both upper and lower lips were swollen, and on their mucous surfaces were four deep lacerations varying from ½ an inch to 1 inch in length. The right upper incisor was amissing, the alveolar cavity being full of blood ; there was a fracture of left wing of thyroid cartilage close to its anterior border, and two bruises on internal surface of larynx ; both upper and lower limbs were free from marks of violence. It is noteworthy that the main injuries were situated on left side of head and neck.

On the night in question both accused and deceased were intoxicated, and both were obstreperous in their conduct. The one was going from Ardrishaig to Lochgilphead, the other from Lochgilphead to Ardrishaig, and they met on the way. The body of deceased was found on the public road close to a high retaining wall, and with the exception of his hat, which was amissing, but which was found later at some considerable distance away, the deceased was fully clothed. At the right side of head of deceased lay a pool of blood ; 10 inches from the wall and about 6 feet from the body was a round indented mark on the grass margin at foot of wall, around which the grass had been pressed down ; and beside this mark, on the grass and on side of road near the indented mark, were stains of blood. The wall was about 6 feet high, and had been recently lime-washed. On the wall, and at a height of 58 inches from the level of the road, and 14 inches below the top of the cope of the wall, as well as at various points near this and between it and the wall foot, were several spots of blood in the form of spatters. At the point on the wall 58 inches up from wall foot was a projecting portion of one of the wall stones, and on this projection was a mark of blood, irregular in form. According to one of the Crown medical witnesses, who examined the wall at the time, "the blood on this stone projection was on the side next the indented mark on the grass, and this projection was about 1 foot north of the feet of the body." The same witness found a great deal of blood spattered all over the grass, at base of wall for a few feet north of the body, but none south of it, and none to the north of the grass-indented mark. Only one witness for the Crown stated in his precognition that he had positively seen accused kick deceased, and

that he challenged accused with kicking deceased, which accused then denied. A second witness, companion of former witness, said he did not see accused kick deceased, but that he heard a thud, as if of a kick, and saw accused pull his leg back from deceased. This happened about 11.40 P.M. on June 11.

Assuming that the theory of the Crown was sound, we thought naturally that corroborative evidence of kicking would have been found by the discovery of blood on the prisoner's boots ; but these had not been examined. One of the constables stated in precognition—one who arrested accused—that there was one spot of blood on the outside of the heel of one of the boots, but that there was nothing else, so far as he could see, except mud. There had not been any medico-legal examination of the boots. We examined the boots, as did also another medical witness. We found the boots to be well worn, comparatively thin-soled, light-made boots, without nails in soles or other iron parts. The stain spoken of by the policeman on the heel, was a small stain of blood, but it was the only evidence of blood to be found on the boots, so far as we could find.

Such being the facts found in the reports and precognitions sent us for critical perusal by counsel for the prisoner, it appeared to us that the theory as to kicking could not certainly account for all the facts ; for example, it could not account for the marks of blood on the wall at a height of 58 inches from the ground, since that presupposes the possibility of blood to rise at an angle of nearly 80° from a body being kicked on the ground, a supposition which we have never seen verified in experience ; besides, there were no stains of blood to be found on the kicking part of either boot. The projecting piece of stone on the wall at the height of 58 inches from its base bore a stain of blood. It was not inconsistent with possibility that the face of deceased came forcibly into contact with the wall, either by the deceased while wrestling with another being forcibly flung against it, or by being forcibly driven against it. The projection could well account for the nasal wound and fracture of nasal bones, and the adjacent parts of the wall for the wounds over and under left eye, for the nasal wound was only ½ an inch long and of a punctured character, and none of the lacerated wounds of the face was larger than 1 inch. It would not, however, account for the fractured thyroid cartilage. But that some part of a human body came in forcible contact with the stone projection admits of no doubt, because there was the irregular blood-stain on it, and spatters of blood in its neighbourhood and below it. From what source could that blood have come ? There were, so far as known, only three possible sources or persons from which it could have come—viz. (*a*) the accused, (*b*) a companion who was with him on the road, but who alleged that he left accused before the quarrel with deceased, and (*c*) deceased himself. Examination of accused after apprehension showed the existence of two trifling abrasions on left side of head, no wound on accused's companion, and several wounds on the face of deceased, especially the nasal wound and fracture and wounds around left eye, all of which were on left side. We were forced to the conclusion, therefore, that it was the face of deceased which had come into contact with the wall projection.

In giving evidence for the defence, it was no part of our contention that necessarily any or all of the deceased's injuries were due to accident, although some of them may have been, seeing he was intoxicated on the night in question, and, moreover, since he had been seen, by a reputable witness, a short time before the fatal occurrence, lying face downwards on the road ; but it was our opinion that some of the injuries must have been produced by violent contact with the wall, it might be during a quarrel between accused and deceased. The theory of kicking could not be sustained, in our view, because of the absence of blood-stains on the kicking parts of the boots, and the height of the blood-stains on the wall. At the conclusion of the evidence, counsel for accused tendered a plea of culpable homicide, which was accepted by the Crown.

Fatal Stab Wound of Neck.—In December 1907, a woman was found sitting dead on a chair with a wound on her neck from which blood had freely flowed. In our examination of the body, which was that of a spare, poorly-nourished woman of late middle life, we found the lips and tongue to be bloodless, and the post-mortem lividity of the body to be much paler than usual. Around the mouth and nostrils and over chin was a crusted eruption of the skin, which might have been due either to a skin disease or to the effects of burning. On

front of the neck, 3 inches downwards from the point of the chin and 2 inches upwards from the suprasternal notch, was a wound, the lips of which were glued together by dried blood, which measured seven-eighths of an inch in length. The direction of the lips of wound was almost at right angles to plane of body. It had been produced by a broadish-pointed weapon which was not very sharp, as the lips of wound were not clean-cut but somewhat uneven. The left extremity of the wound exactly touched the middle line of body (Fig. 63). The right eye was blackened from bruising, the discoloration becoming yellowish at the periphery ; there were abrasions of right eyebrow, brow, and right temple ; a bruised area, 2½ inches by 1½ inches, of some days' duration, on outer aspect of right forearm ; marks of recent bruising and burning on left forearm and wrist, and on left thigh and leg bruises and abrasions. There was a medicated plaster over left breast and below it, 7 inches by 5 inches. Both hands were more or less blood-stained.

Dissection of scalp revealed much extravasated blood in left temporal tissues, but no injury to skull at any part. The wound on the front of neck was dissected to track its extent and direction. It was found to pass into the tissues of the neck at first toward the right, and then downwards through the

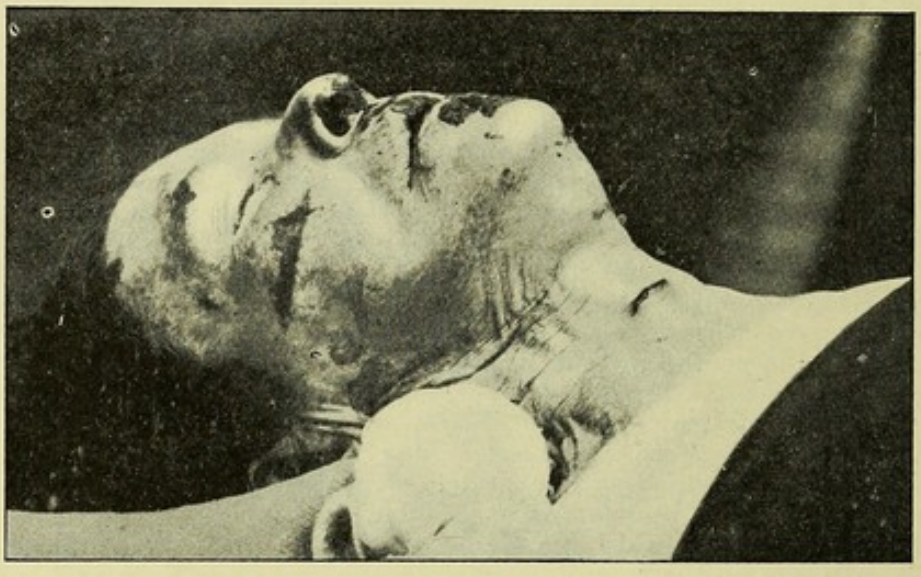

FIG. 63.—Stab wound of Neck which passed into apex of right pleural cavity, severing in its course several deep vessels in neck tissues. (Author.)

tissues into the apex of the right pleural cavity. Further dissection showed that it had penetrated the right internal jugular vein in its passage downwards behind the right clavicle and first rib to the apex of right lung cavity. The total length of wound from surface to top of chest cavity measured a little over 2½ inches. There was no injury to larynx. On opening the chest cavity, the right lung was found to bulge forward in an unusual manner, and on seeking the cause, it was discovered that the right pleural cavity contained clotted blood and blood-coloured fluid, both combined making a total amount of 36 ounces. The pleural surface of the apex of right lung was more or less covered with clotted blood, but on careful inspection after its removal from the body, no wound was found in the top or any other part of the lung.

In the muscular tissues beneath the site of the plaster was found an area of extravasated blood, and beneath that a fracture of the seventh rib. We reported (1) that the cause of death was hæmorrhage into right lung cavity, due to penetration of the right internal jugular vein by a weapon which had passed from the neck into the top of the right lung cavity, (2) that the wound was caused by the use of considerable force, (3) that the weapon used was a cutting instrument, but was not, in our opinion, sharp-pointed, and (4) that the wound was not self-inflicted.

We examined the *locus* of the crime later, when the circumstances were reconstructed in presence of the principal witnesses. The body of deceased, when seen by the first witness, was in a sitting posture on a chair, which stood

beside a table in the apartment, her head being extended backwards over the back of the chair, but that this witness having left the room to fetch her husband, on return saw that the head of deceased was now hanging toward the right side of deceased. A knife was lying on the table beside the body, and there was a pool of blood on the floor close to the body. When the police arrived and lifted deceased's head, the wound on the neck was seen for the first time. The accused, husband of deceased, said to the police when they arrived that his wife had committed suicide. The results of our examination of the apartment, however, did not tally with the prisoner's statement, for on the woodwork in front of the bed-place of the room, 1½ feet from where the body of deceased was found in the chair, and at a height of 42 inches from the floor, was a smear of blood which measured 8½ inches by 3 inches, from the margins of which three different streams of blood had run down on the woodwork for a distance of several inches. Along the front bed-board, which forms the front of the bed-place, from the head end of the bed to the centre of this board, were many marks of blood streams, especially near the head part of the bed. Inside the bed-place at the head of the bed, on the plaster above the pillows, was a series of blood-stains of different shapes and sizes, some of them looking like bloody finger-marks. On the floor of the apartment, 15 inches from the bed and 24 inches from the wall of the apartment, was a stain of dried blood, irregular in shape, measuring 9 inches by 7 inches, around the margins of which were dried spots of blood. Having, between the date of post-mortem examination of the body of deceased and the examination of the *locus*, investigated and reported regarding certain stains found on clothing of the accused, as also on a knife with which the wound was alleged to have been caused, the physical appearances of the knife had attracted our attention. It was on an old breakfast table-knife, much worn by grinding or sharpening, its blade measuring 3½ inches in length, and 1 inch at its broadest part, which was well down the blade. It showed reddish stains on both sides of the lower half of the blade. The jacket and shirt worn by the prisoner at the time, when examined, showed stains. Those on the shirt were confined to the wrist-bands or cuffs, near the edges. After testing, those on jacket were found to be composed of mud or grease, those on the knife and on the shirt being of mammalian blood.

Taking all the facts into consideration—the position, direction, and depth of the wound on the neck, the character of the weapon, the partially intoxicated condition of deceased at the time, and the distribution of blood-stains in the apartment—we were strengthened in the conclusion arrived at in our report of the post-mortem examination of the body of deceased that the wound was not suicidally inflicted. The position of the wound was such that the point of impact of a weapon in the hand of a right-handed person was too high to enable the striking hand to exercise sufficient force to produce a wound of the direction or depth found, and it would be difficult in performance, if not more difficult, in a left-handed person. Further the blood-stains in the apartment indicated that the wound, however produced, had been made near the head of the bed—probably while the deceased was in bed—and it was extremely difficult to believe that after its infliction the deceased could have come out of bed and seated herself on the chair in the apartment.

The accused was tried at the February sitting of the High Court in Glasgow on a charge of murder. There being no eye-witness of the crime, no quarrelling heard, and two medical witnesses for the defence having sworn that the wound could quite well have been self-inflicted, the jury returned a verdict of not proven.

Passing now to the consideration of homicidal incised wounds to illustrate the same points, let us discuss those of the throat. It has been stated by some observers, that a homicidal cut-throat wound may be diagnosed by the determinate appearance which it presents from a suicidal one which is often of an indeterminate character, and by the situation of the wound, which in suicide is said to be higher up in the throat than a homicidal one. It has been further asserted that suicidal cut-throat wounds never sever the whole tissues of the neck. To such sweeping statements we must demur. One of the un-

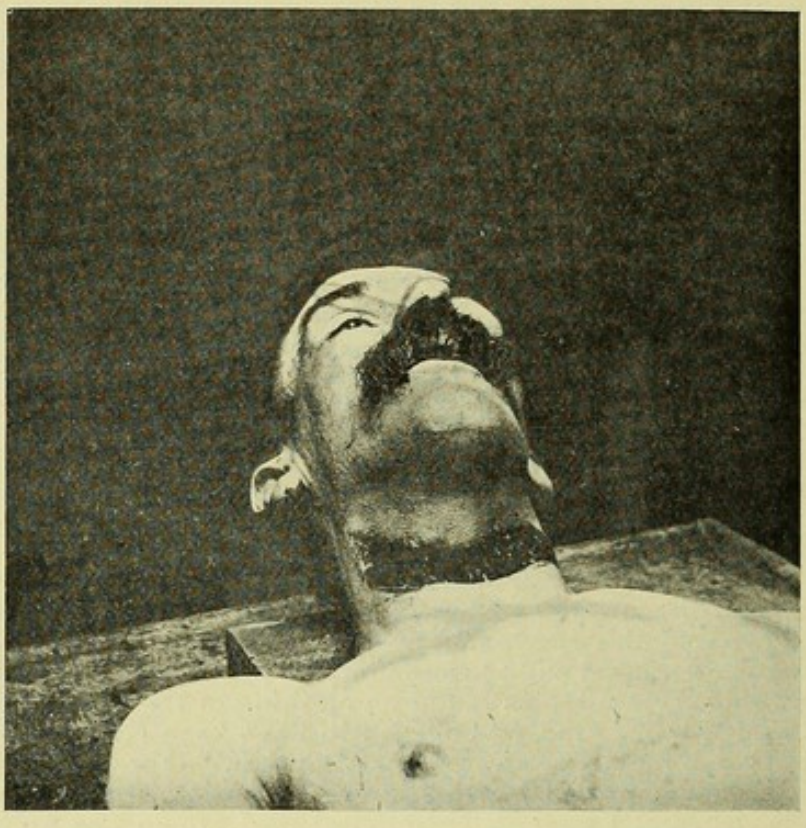

FIG. 64.—Suicidal Cut throat. The wound began on the left side of neck and terminated at a higher level on the right side. The lowest level of the wound was 1½ inches above the line of the clavicles. In the wound the whole of the tissues, down to the œsophagus were severed; the right half of the thyroid cartilage was practically torn out of the wound by the force used.



FIG. 65.—Another view of Fig. 64. The irregularly-pointed eminence at middle of upper edge of wound indicates the left half of the thyroid cartilage.

doubted suicidal wounds which we have examined presented the following appearances :—

It measured 8 inches in length, and severed completely all the tissues of the neck right down to the vertebral column, one of the bodies of which was nicked by the razor. This, however, was done by a young man who was insane. Another most interesting case, in which the severed carotid arteries and the jugular veins on one side of the neck were ligatured, and the patient recovered, is recorded by Mr Thelwall Thomas.[1] This patient was practially moribund when Mr Thomas began to ligature the vessels, but by the perfusion of warm saline solution, his breathing, which before was feeble and gasping, began to improve markedly. He recovered slowly, notwithstanding the grave lesions consequent upon the structures severed. The weapon used was a penknife.



Fig. 66.—Case of Homicidal Cut throat. Figure gives a view from the right side. The following wounds were found—viz. (1) an incised wound in front of, and below the level of right ear ; (2) an incised wound on front of neck above principal wound ; (3) the principal wound itself (*vide* Fig. 50) ; and (4) an incised wound in the hypothenar prominence of right hand, severing the muscles from the bone. This last wound was evidently caused by the victim resisting the attack or attempting to shield herself.

One other suicidal case, but a fatal one, is recorded by Galt [2] in which there was " tailing " at both extremities of the main wound, and a second, but more superficial wound, below the former. The weapon used was a large bread-knife.

While in some cases there would seem to be a tentative appearance in suicidal wounds, such is by no means common to all. Homicidal cut-throat wounds, too, present varieties of character and appearance.

[1] *B. M. J.*, vol. ii., 1895, p. 1420.
[2] *Ibid.*, vol. ii., 1898, p. 711.

Although they are comparatively rare, we have seen several cases. In the first, the situation and dimensions of the wound were as follows :—

The wound measured 7½ inches in length, and extended from a point 1 inch behind the left ear, and passed along the line of the lower jaw to a point 1¼ inches to the right of the middle line of the neck. At its extremity behind the left ear it tapered to a narrow point, but at the other, it had a notchy or serrated appearance. The line of the incision was not horizontal, but had a slanting direction downward toward the right side. In the wound, the larynx was intact, the left carotid sheath was opened, the left carotid artery was half-severed, as were also the internal and external left jugular veins and several muscles. There was no other wound on the body. The assault was made while the woman was asleep in bed, the bedclothing was saturated with blood, and jets of blood were found on the wall of the bed-place.

The second case was that of a woman who was murdered by her husband, who, afterwards, committed suicide with the same razor. The following illustrations show the wounds. (Figs. 64, 65, 66.)

The first illustration (Fig. 64) shows the wound on the throat of the man, which began on the left side of the neck and terminated at a higher level on the right. The lowest level of the wound was about 1½ inches above the level of the clavicles. The tissues were entirely severed down to the gullet ; the right half of the thyroid cartilage had been torn out of the wound by the force of the weapon, the left half remaining in the wound. The second (Fig. 65) gives another view of same wound. The third (Fig. 66) shows the position of the wounds on the right side of the body of the murdered woman, which consisted of the following :—(1) an incised wound in front and below the level of the right ear ; (2) a wound on the front of the neck, above the principal wound ; (3) a wound on the hypothenar prominence of the right hand, in which the muscles were severed down to the bone. This last wound was likely caused by the woman trying to protect her throat and face with that hand. Fig. 50 exhibits the wounds on the left side of the neck. The main wound extended from nearly the outer extremity of one clavicle to the other, and at the extremities was about half-an-inch higher than the clavicle. It severed the main blood-vessels, muscles of neck, and trachea. The upper wound, as is seen, was bifurcated at its anterior extremity, and cut deeply into the tissues.

Among more recent cases in our experience, the following individually present features of interest :—

Homicidal Cut-throat Wounding.—In July 1907, we examined the body of a young woman. It was clothed only in a chemise, which was soaked with blood. The body also was more or less covered with blood. The body having been washed, its surface was found to be very pallid in appearance. On the neck in front was an extensive, gaping wound, which extended from ear to ear. Its right extremity was under the right ear at a point 1¼ inches below level of lobe and 1½ inches behind it, and its left extremity at a point 2½ inches below level of left lobe and on a line downwards from lobe. At each extremity there were three distinct tails or gashes. The wound measured 8 inches in length, and it gaped for 3 inches. All the muscles in front of the neck, all the important blood-vessels and nerves and other structures were severed right down to the cervical spine, the bodies of the 3rd, 4th, 5th, and 6th vertebræ and intervertebral spaces having been more or less deeply cut into by the weapon. Lying in front of the spine was found a sharp-pointed, sharp-edged piece of steel, measuring ¼ of an inch long and ⅛ broad, which accurately filled a gap in a razor which was found and was in the possession of the police. Immediately under the point of the chin was a punctured-incised wound, ⅜ths of an inch long, which had passed through the entire skin, and between this and the main wound were numerous superficial scratches running at different angles. On the backs of right middle and ring fingers were superficial wounds which from their directions had apparently been caused by one and the same stroke of a sharp weapon. The contents of the stomach had a definite alcoholic odour. (Fig. 67.)

Accused was charged with murder at the August sitting of the High Court in Glasgow, a special plea of insanity at the time of the offence being tendered on behalf of the accused. There was no contest as to facts, as the accused, after being duly warned, confessed that he committed the crime. We had examined the accused while in prison as to his mental condition, and had reported that in our opinion he was not of unsound mind. Certain mitigating circumstances in favour of the prisoner emerged during the hearing of the evidence, and the jury returned a verdict of culpable homicide. He was sentenced to penal servitude for life.

On December 17, 1908, we examined the body of a young woman who had been murdered near Uddingston by a young man with whom she had been keeping company. The body was fully clothed as if for walking out-of-doors, and the clothing in front of body especially was saturated with blood. Both hands were more or less covered with blood, but there were no wounds on hands or fingers. The surface of the body was remarkably pallid. On front of the



Fig. 67.—Homicidal Cut-throat Wounding.

throat was a gaping wound, caused by a sharp instrument which mainly extended along the front and right side of neck. It extended from a point 1½ inches to left side of middle line of body across the larynx to a point ½ an inch behind the right ear, on a level with the lower edge of lobe of right ear. Its total length was 6 inches, and its breadth, due to gaping of lips, was 1½ inches. Closer examination revealed a definite tailing of wound at its left extremity, that the right wing of the thyroid cartilage had been severed for ¾ of an inch, and that this wound had penetrated the cavity of the larynx for ⅜ths of an inch. The deepest part of the throat wound was on the right side of neck. In the bottom and sides of wound at this point the deep muscles and tissues were laid bare, the carotid sheath had been opened, but the carotid vessels within were intact, although several other important vessels, arteries and veins, superficial and deep, had been severed, causing great and rapid loss of blood. The direction of throat wound was as follows :—Commencing on left side of throat at a level corresponding to about middle of the neck, it passed across the larynx at nearly same level, and then slanted upwards along

the line of the lower jaw on right side to its point of termination behind right ear.

Accused was tried for murder at the Circuit Court, Glasgow, February 1909. A special defence for accused was entered, that he was not guilty, and that at the time of the act he was insane and not responsible for his actions. The evidence showed that deceased and accused had been sweethearts, that an estrangement had occurred, but that deceased had resumed friendship with accused; that on December 15 accused went to the house where the deceased was then employed as a domestic servant, told the mistress of deceased that the father of deceased had that day been killed in a coalpit by an accident, and that he had been sent to take deceased home (all of which was untrue); that accused and deceased thereafter left the house, took a tramcar near by, and left the same at Uddingston; that they were seen later walking along a road, the arm of accused being around the neck of deceased; that another witness, walking along the same road to meet a friend, and near the place where they had been seen together, stumbled over something lying on the footpath, and lighting a match, saw the body of the girl; that information was sent to the police office; that in the meantime accused accosted two police officials, and stated that he had murdered his sweetheart by cutting her throat with a razor; that they took accused into custody, and that as they were entering the police station a sergeant of police reported to them that the body of a woman had been found lying on the road in question; that they went to the place, found the body of a young woman with her throat cut, and, with the aid of a lamp, that they traced blood-stains on the roadway for a distance of 105 yards in the direction of the spot where deceased had been previously seen with the accused's arm round her neck; that between the place where the body was found and the place from which the trail of blood began, there was no appearance on the ground as if the body had been dragged, or if the bleeding person had crawled, but as if the person had walked or had run; and that a blood-stained razor was found in a field adjoining the scene of the murder, 58 yards from the spot where the blood-trail commenced, and 155 yards from the place where the body was found. In support of the plea of insanity, it was stated that the month before the murder accused had attempted to commit suicide by taking poison, but a medical witness, who had been called on that occasion, stated that he did not think that accused really tried to commit suicide, but was anxious to attract attention, and that the affair was so trifling that he applied no treatment, but simply scolded accused. We examined accused at the request of the Crown, while he was in prison, and we arrived at the opinion that he was not a person of unsound mind, but the prison surgeon, who had had accused under constant observation while in prison, was of opinion that while accused was not irresponsible for his actions, he believed him to be stunted mentally and morally, and not responsible to the degree that a man of his age would be responsible. Counsel for prisoner thereupon tendered a plea of culpable homicide, which was accepted by the Crown. The jury having formally returned a verdict to that effect, the judge sentenced accused to fourteen years' penal servitude. From the foregoing facts, the following points of medico-legal interest emerge —viz. (*a*) that the attack by the razor was made upon the deceased on a dark road, and she was taken unawares, (*b*) that the attack was made by accused from the right side of deceased and from behind, and (*c*) that after the infliction of the wound, produced by one stroke of the razor, the girl was able to run a distance of 105 yards.

In March 1909, a man murdered his wife in Partick by cutting her throat and thereafter committed suicide in the same way. The noteworthy fact in the case of the woman was that after receiving the injuries to her throat she managed to walk into the adjoining room and awaken a lodger who was sleeping there, and then fell back on the floor and died. The assailant, who had two distinct gashes in his throat, was living when seen by the police surgeon and was sent to the Infirmary, where he died in about an hour after admission. (Fig. 68.)

At the Circuit Court, Glasgow, November 1900, a farmer's wife was charged with having assaulted her daughter by cutting her throat with a razor and murdering her. Her counsel tendered a plea of insanity in bar of trial in respect that accused was unable to instruct her defence. Medical witnesses testified that she was of unsound mind, and the judge ordered the accused to be detained during her Majesty's pleasure.

Angelo Lucchesi, a middle-aged Italian, was charged at the Circuit Court, Glasgow, in December 1903, with attempted murder, in that on Oct. 6, 1903, he assaulted a girl, aged six years, and on the following day, a boy, aged two years, by cutting their throats with a knife, with intent to murder them. A special defence was put in that on the days in question the accused was elsewhere than in the places named in the indictment, and also that he was insane ; but the latter plea was not adhered to.



Fig. 68.—Homicidal Cut-throat Wounding.

The mother of the girl stated that her daughter came into the house with a cut on her throat. The child said that a man had met her in the stair leading to the house, put his arms round her, and kissed her. The child identified the prisoner as the man. The mother of the boy stated that he went amissing on the 7th October, and on searching for him found him in the police office, whither he had been taken with his throat seriously cut. A woman testified that she saw the accused coming up a street, named in the indictment as the street in which the assault on the boy had been committed, leading the boy. She watched them. They went into an entry to a tenement, and soon after the prisoner came out alone. He ran away. She informed a policeman, but by this time he had disappeared. She saw him again on the following day and got the prisoner arrested. We gave evidence as to blood-stains found on his clothing. (*See* p. 361.) The jury returned a unanimous verdict of guilty, and he was sentenced to 10 years' penal servitude.

At the Circuit Court, Glasgow, Sept. 1905, a man was charged with having cut the throat of a newly-born male child and thus murdered him. Accused was a groom, and the mother of the infant was a domestic servant in the same house. Accused was said by the mother to be the father of her child, and that accused took away the infant from her as soon as it was born. She never actually saw the child. The infant's body was buried in a rabbit hole, a stone having been placed over the mouth of the hole. When found, it was seen that the throat had been cut from ear to ear. The medical witnesses were of opinion that the child had been born alive, but they could not say whether the throat had been cut before or after death. Accused was found guilty, and was sentenced to a term of imprisonment.

In the Maidstone tragedy of February 1904, where the husband and father killed his wife, and two daughters aged twenty and thirteen years respectively, by cutting their throats, and afterwards committed suicide by drowning himself in the river, it was shown in the evidence at the inquest that the throat wounds in each case were of an extensive character, those in the case of the daughters being practically from ear to ear, and that in the case of at least one of them a severe struggle had taken place at the time of assault. Blood-stained

razors, the blades being broken, were found in the house, and blood-stains were found on the walls of the bedroom occupied by the daughters.

The following case is a comparatively rare instance of cut-throat wounding of an infant by its mother.

At the High Court of Justiciary held at Glasgow in October 1906, a mother was charged with having thus killed her daughter, aged eleven weeks. She tendered a plea of culpable homicide. From the statement made by her counsel, in which he mentioned that the accused had for a time been in a depressed condition of mind, and that she had made a determined attempt to commit suicide, that the wound she inflicted on her child was not very violent, and that the infant at the time was in a very weakly state, the plea was accepted by the Crown, and she was sentenced to six months' imprisonment.

The two succeeding illustrations are those of a case recorded by Prof. Harvey Littlejohn,[1] which was also one of murder and suicide. When the room in the hotel, in which the parties were living as husband and wife, was burst open on the evening of the day in which they had not appeared, although called several times, both were found lying dead on the bed, fully dressed. The room was not in disorder, and there were no marks of blood in the room except upon the bed. The body of the woman lay on its back across the bed and the legs were hanging over its edge. Her face was covered with blood. On the left side of the neck was a clean-cut wound, 4½ inches in length, which extended from ½ an inch below the symphysis of the chin downwards and backwards to a point about 2 inches below the angle of the lower jaw. The wound divided the soft parts down to the deep vessels of the left side, severing the internal jugular vein but leaving the common carotid artery uninjured, though it was laid bare. The thyroid cartilage was divided, and the incision then passed backwards through the posterior wall of the pharynx down to the vertebral column, which was deeply scored. The deep vessels on the right side escaped injury, although they, also, were laid bare. In addition to the

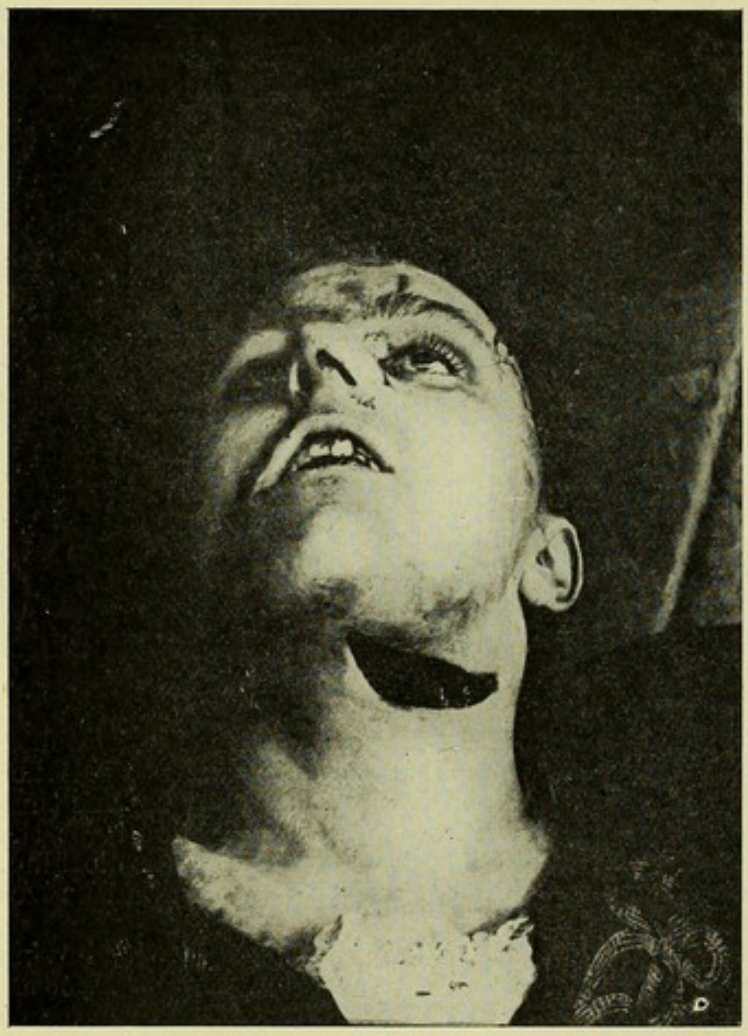

FIG. 69.—Homicidal Cut throat. The wound on the neck (left side) measured 4¼ inches in length, extended from ½ an inch below the *symphysis menti* downwards and backwards to a point below the angle of the lower jaw. All the soft parts were divided down to the large vessels of the left side of neck, the internal jugular vein being severed and the common carotid artery laid bare, but uninjured. The thyroid cartilage was completely divided just above the true vocal cords. The incision passed backwards through the posterior wall of pharynx to the vertebral column, which was deeply scored. For the use of this and Fig. 70 we are indebted to Prof. Harvey Littlejohn of Edinburgh.

[1] *Edin. Med. Journal*, April 1900, p. 363.

wound described, there were two superficial incised wounds on the face, one on the left side of the nose, the other in the middle of the forehead. (Fig. 69.) The wound in the man's throat showed that the thyroid cartilage was completely severed, all the tissues down to the deep vessels on both sides were cut through, but with the exception of the left internal jugular vein, which was severed, these deep vessels were uninjured. At the beginning of the cut on the left side several tentative superficial cuts were found, which were absent in the case of the woman. Lying close to the hand of the man was an open, blood-covered razor. (Fig. 70.)



Fig. 70.—Case of Suicidal Cut throat. In the wound, which extended from ear to ear, the thyroid cartilage was completely divided below its upper border, all the structures down to the deep vessels on both sides were severed, but the left internal jugular vein was the only vessel cut into. Tentative cuts were observed at the beginning of the incision in the skin on the left side.

In certain cases of cut-throat wounds, the body of the wounded person may be found either close to the point where the wound was inflicted or at some varying distance from that point. Most commonly there will be, in the latter, a trail of blood from a given point—believed to be the point of infliction—to the place where the body is found. The distance between the points has been found to vary in different cases. In a case recorded by Howie of a woman, aged 28, in whose throat wound the external and internal carotid arteries and jugular vein were found to be severed on the right side at the level of the upper border of the thyroid cartilage, which was also completely divided, it was found that she had traversed a distance of 22 yards before falling down dead.[1]

In the case narrated on p. 161, the man, after inflicting the wound on his throat, walked a distance of 200 yards before he finally ended his life by drowning.

In the Uddingston case, where a young man killed his sweetheart by cutting her throat on the public road, it was evident from the beginning of the blood marks on the footpath to the point where her body was found that she had traversed a distance of 105 yards. (*See* also p. 294, Partick Case.)

It is quite obvious from consideration of these and other cut-throat

[1] *B. M. J.*, vol. i., 1902, p. 332.

wounds that the possible distance which a person may traverse after receiving the wound, such person being in full possession of his senses at the time, must in chief measure depend upon the rapidity of loss of blood from the vessels severed. In certain suicidally-inflicted throat wounds, where the suicide ends his life in some other way, it is fairly clear that he has not succeeded in the wounding in doing much more than cutting into the larynx, owing, probably, to his having thrown his head back, thus making the larynx unduly prominent at the moment of infliction of the wound. Having failed thereby to end his life, no important vessel having been severed, should the suicidal intention



FIG. 71 shows a Mortal Wound by Stabbing which penetrated the Left Ventricle of the Heart. The wound is situated on the left side of chest 3 inches below, and 2½ inches to the right side of the left nipple, between the fifth and sixth ribs. It was an incised wound, and measured half-an-inch in length and $\frac{3}{16}$ of an inch in breadth. Coagulated blood was found between the lips of the wound, and dried blood, small in amouut, on the skin around it. The arborescent-like markings are due to post-mortem lividity. (*Vide* Figs. 72 and 73.)

still prevail he must seek some other way of satisfying it. Where the large blood-vessels on one side of the neck, and more especially on both sides, have been severed, it is clear that the rapid and large loss of blood will quickly induce syncope and thus the possible distance traversed after the infliction of the wound must be short. Where in any given case, therefore, the question of distance traversed may be one of some moment, the only answer will be obtained from a careful examination of the wounds on the throat and after inquiry into the general vigour during life of the person wounded.

One of the favourite sites of homicidal stab-wounds is the anterior

aspect of the chest, and in the neighbourhood of the heart; wounds in this position from suicide are comparatively much rarer. The following short notes of cases—most of them from our case-book—will illustrate their situation, and other points :—

Case I.—This fatal wound was caused by one Italian upon a fellow-countryman by one blow of a dagger-knife, and it was situated over the sterno-clavicular articulation of the left clavicle, measured $\frac{3}{4}$ of an inch in length, and entered the common carotid artery. Death was practically instantaneous.

Case II.—This fatal wound was produced in the same way. It was situated $1\frac{1}{2}$ inches below the level of the left clavicle, and $2\frac{1}{4}$ inches to the left of the middle line of the sternum, measured $\frac{1}{4}\frac{1}{6}$ths of an inch in length, $\frac{5}{1}\frac{}{6}$ths of an inch in breadth at its broadest part, and was fusiform in shape. The direction of the wound was from above downwards and from left to right,

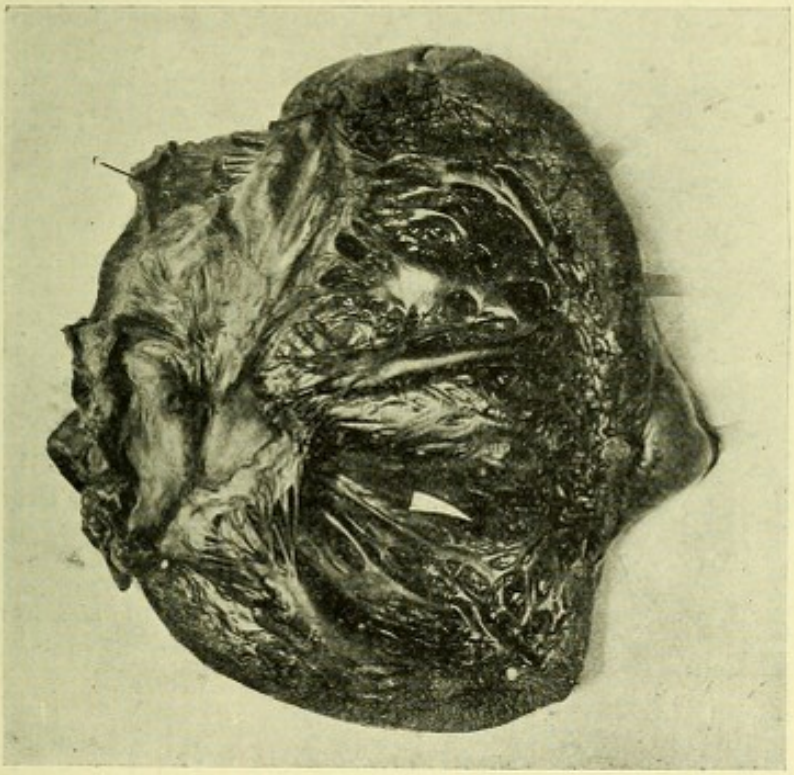

Fig. 72.—Mortal Wound penetrating Left Ventricle of Heart, caused by Stabbing (*vide* Fig. 71). The white-paper dart shows the site of the wound which, on the exterior of the wall of the ventricle measured one-quarter of an inch in length, but which on the interior of the wall was gaping and triangular in shape.

passed into the chest between the first and second ribs—incising part of the cartilage of the latter rib—through the mediastinum and pericardium, and entered the aorta at a point of $1\frac{1}{4}$ inches above the point where that vessel leaves the heart. The wound in the pericardium measured $\frac{1}{3}\frac{0}{2}$ of an inch in length, and that in the aorta, $\frac{9}{3}\frac{}{2}$ of an inch. These two wounds lay, with relation to one another, in a slightly slanting line from above downwards. The chest cavity contained many ounces of blood, and the pericardium about 10 ounces. The man only survived a few minutes. (*Vide* Fig. 56.)

Case III.—The subject of this fatal wounding was a vigorous young man, who after having been stabbed ran after his assailant not less a distance than 40 to 50 yards before he fell and died. On examination of the body we found on the left side of the chest, 3 inches below and $2\frac{1}{2}$ inches to the right of the left nipple, between the fifth and sixth ribs, a clean-cut wound, elliptical in shape, which measured half-an-inch in length and $\frac{3}{1}\frac{}{6}$ths of an inch at its point of greatest breadth. (Fig. 71.) Clotted blood was present between the lips of the

wound, and dried blood on the skin around it. This was the only wound on the body. On opening the thorax, clotted blood—not large in amount, however—was exposed lying on and in the tissues of the pericardium, in the centre of which was an incised wound ⅜ths of an inch in length. Twelve ounces of firmly-clotted and fluid blood were found within the pericardium. The wound on the inside of the pericardium was of the same length as that on its outside. Immediately underlying this wound was an incised wound in the left ventricle measuring one-quarter of an inch in length. When the left ventricle was opened this wound on its inner aspect was found gaping and to be somewhat triangular in shape. (Fig. 72.) All the heart cavities were empty of blood. The left pleural cavity contained 4 ounces of firmly-clotted blood. On further examination it was seen that the weapon had passed through the cartilage of the sixth rib. (Fig. 73.) From the above indications it was apparent that the weapon used was a sharp-pointed, and probably double-edged, weapon.



FIG. 73.—Mortal Wound by Stabbing (*vide* Fig. 71), showing the wound in the cartilage of the sixth rib close to its junction of the sternum. The illustration is of the interior aspect of the ribs, and the wound is indicated by the black line which runs nearly at right angles to the cartilage, which with those of adjacent ribs is attached to left half of sternum.

CASE IV.—At the High Court of Justiciary (Circuit Court), Glasgow, November 1900, a man was tried on the charge of murder by stabbing. The dead body of the victim was found in the public park, Paisley, stripped of jacket, vest, and boots, which the prisoner was wearing when apprehended. On the upper part of the left chest, between the second and third ribs, and two inches to the left of the middle line, an incised-punctured wound, horizontal in direction, was found, measuring half-an-inch in length. The left lung was found compressed by quantities of serum and blood, of each of which there was about 2 pints. There was a wound through the lung corresponding to the size and direction of the external wound. The pericardium was pierced by the wound over the line of the pulmonary artery, which was also penetrated at a point immediately above the semilunar valves. The total depth of the wound from surface of skin to pulmonary artery was nearly 2½ inches. There was no pneumothorax. The prisoner was convicted, and sentenced to 7 years' penal servitude.

CASE V. *Fatal Homicidal Stab Wound of Right Ventricle of Heart.*—In May 1903, during a quarrel in Partick, a man was fatally stabbed by another with a pocket-knife. On post-mortem examination, we found the external aspect of the body unusually bloodless. There were several marks of violence visible externally, including abrasions and superficial wounds of fingers of left hand, of brow, and left elbow, elliptical-shaped superficial wounds on back and behind left ear, each measuring half-an-inch in length. What proved to be the fatal wound was one of an elliptical shape, and clean cut, which was situated ⅞ths of an inch above, and half-an-inch nearer the mid line of the body than the nipple of the left breast. It measured ⅜ths of an inch in length. Dissection showed that it passed through the chest wall between the cartilages of the fourth

and fifth ribs. In the mediastinal tissues was much clotted blood. In the pericardial wall was a wound corresponding in position to that above it in chest wall, which measured $\frac{3}{8}$ths of an inch long. The pericardium was distended with blood, fluid in large part, but clotted partly, which, when measured, was found to amount to over 35 ounces. There was a wound on front wall of heart, close to septum, which measured half-an-inch in length. On opening the heart cavities, it was found that this wound had penetrated the right ventricle close to the septum. The direction of the entire wounding was nearly horizontal but from left to right. We reported that the cause of death was hæmorrhage from a penetrating wound of the heart produced by one stroke of a sharp-pointed weapon, probably of the nature of an ordinary pocket-knife. (Fig. 74.)

Assailant was tried for murder at the Circuit Court, Glasgow, at its July sitting. He was found guilty of culpable homicide.

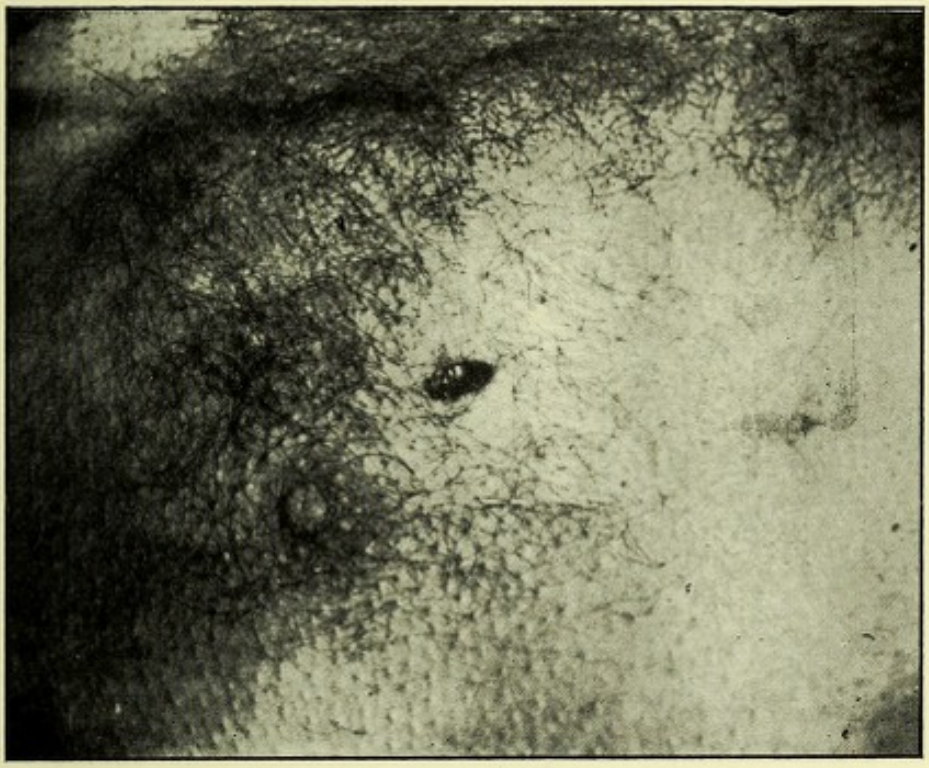

Fig. 74.—Stab wound in præcordial region from pocket-knife, spindle-shape in character. Wound penetrated the right ventricle of heart. Left nipple at a lower level and to left side of wound.

Case VI. *Fatal Wounding by Stabbing. Penetration of Pulmonary Artery.*—In Sept. 1903, a young man died in Wishaw from a stab wound in the chest. On examination of the body, which was at the time clothed as at the time of wounding, we found (*a*) a cut on the left breast of jacket, measuring on outer surface $1\frac{1}{4}$ inches, and on inner side, one inch in length, (*b*) on left breast of vest, beneath (*a*), a cut of $\frac{7}{8}$ths of an inch in length, (*c*) on a knitted woollen jersey, a cut measuring on its outer surface $1\frac{1}{2}$ inches, and in its inner surface, $1\frac{1}{4}$ inches in length, (*d*) on a woollen shirt, a cut 1 inch in length, and (*e*) on a woollen under-shirt, a cut measuring $\frac{7}{8}$ths of an inch in length. The under-garments were soaked with blood. On surface of left side of thorax, 2 inches to left of mid line of body, and $2\frac{1}{2}$ inches downwards and outwards from junction of left clavicle with sternum, on a line from clavicle downwards 2 inches to right side of left nipple, was an incised punctured wound. It measured 1 inch long. It was the only mark of violence found on the body. On dissection, the wound was found to pass through the structures of chest wall, severing completely in its course the cartilage of the second rib; this wound in cartilage measured 1 inch in length. It then entered the pericardium, and was found to enter the pulmonary artery close to the semilunar valves. The wound in the former measured $1\frac{1}{2}$ inches in length, and that in the latter, $\frac{15}{16}$ths of an inch.

Four ounces of clotted and liquid blood were found in the pericardium and 30 ounces in the left pleural cavity. We reported that the foregoing wounds externally and internally were produced by one and the same stroke of a sharp cutting instrument, probably of the nature of a dagger or dagger-knife.

The assailant, an Italian, was tried on a charge of murder at the Circuit Court, Glasgow, in October.

Case VII. *Murder by Stabbing in Chest and Abdomen, with a Pocket-knife. Multiple Wounds.*—In May 1907 a young woman was found murdered in a house in Castle Street, Glasgow. On examining the body, it was found externally to be very pallid. The front of the trunk, the neck, and the shoulders were much besmeared with blood, and there was some blood on both arms and hands. There were eleven stab wounds on the front part of the chest. Five of these were grouped over the left breast, five within an area of $1\frac{1}{2}$ in. × 1 in., situated $2\frac{1}{2}$ inches below left nipple and $1\frac{3}{4}$ inches to left of middle line of sternum, and one on right side of chest 3 inches below right nipple, and the same distance as last from sternum. All were spindle-shaped, and measured half-an-inch in length, with the exception of one which measured $\frac{3}{8}$ths of an inch. The lips of many of them were sealed with

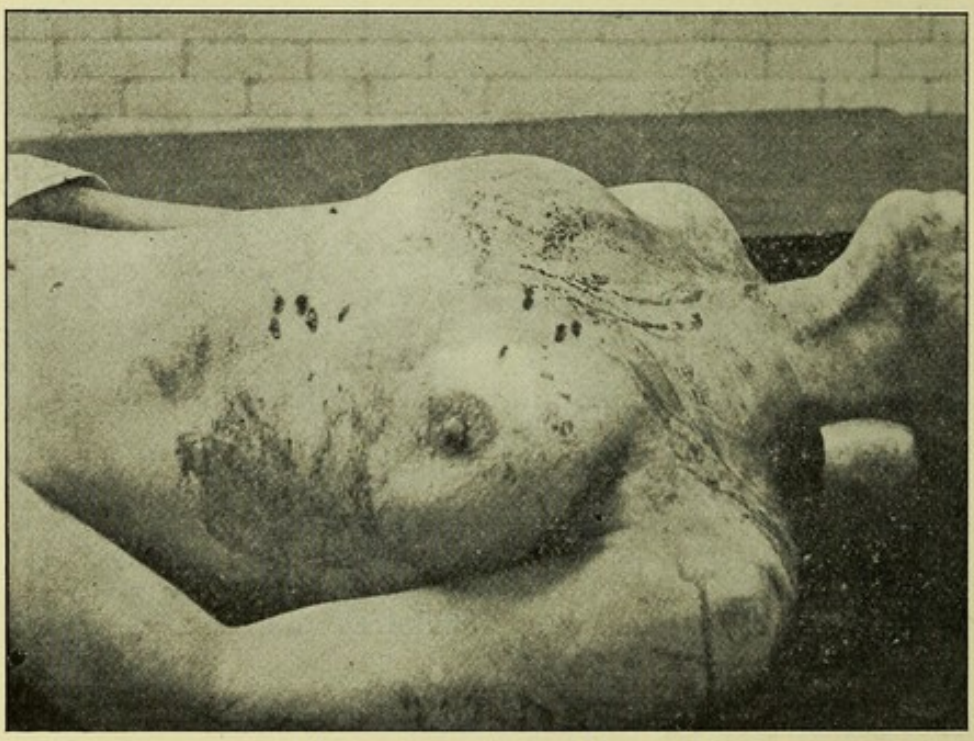

Fig. 75.—Shows eleven stab wounds on front of chest and abdomen produced by pocket-knife. These wounds penetrated the heart, lung, and left lobe of liver.

clotted blood, but those of the lower group were empty and gaping. There were no wounds on any other part of the body. On dissection, it was found that with the exception of the wound on the right side of chest, all had penetrated the thoracic or abdominal cavity, several of them wounding the rib cartilages in their course. Three wounds had penetrated the upper lobe of left lung, two had entered the pericardium and the left ventricle of the heart, and five had pierced the diaphragm on its left side. The lung wounds had penetrated for varying depths, the deepest to a depth of $1\frac{1}{4}$ inches in a slanting direction downwards. Two ounces of clotted blood were present in pericardium. Of the wounds in the left ventricle, one measured $\frac{5}{16}$ths and the other $\frac{3}{16}$ths of an inch in length. The five wounds which had penetrated the diaphragm corresponded with five wounds on the outer aspect of the left lobe of the liver, 2 inches from its anterior free border. These had passed through the substance of the lobe, which at this part measured $\frac{5}{8}$ths of an inch in thickness. *There was no appearance of effused blood around the liver wounds, nor was there any in the abdominal cavity.* On the other hand, 22 ounces of clotted and liquid blood and serum were present in the left pleural cavity. We reported that

deceased died from shock and from hæmorrhage due to these wounds described and that said wounds had been produced by a sharp-pointed cutting instrument used with considerable force, probably of the character of an ordinary pocket-knife. A feature in this case of especial note was the absence of any bleeding from the wounds in liver, which indicated that death had taken place by the time they were inflicted. (Fig. 75.)

The prisoner, a young man with whom deceased lived, was tried for murder at the Circuit Court in July of same year, was found guilty as libelled with a strong recommendation to mercy on account of his youth, and was sentenced to death. He was respited, and his sentence commuted to penal servitude for life.

The following case is unique in our experience, and we are not aware of a similar case in medico-legal literature :—

CASE VIII.—*Death by Incised Wound opening into Thorax and Abdomen.*—In May 1905, we examined the body of a boy aged 4 years. Shortly prior to his

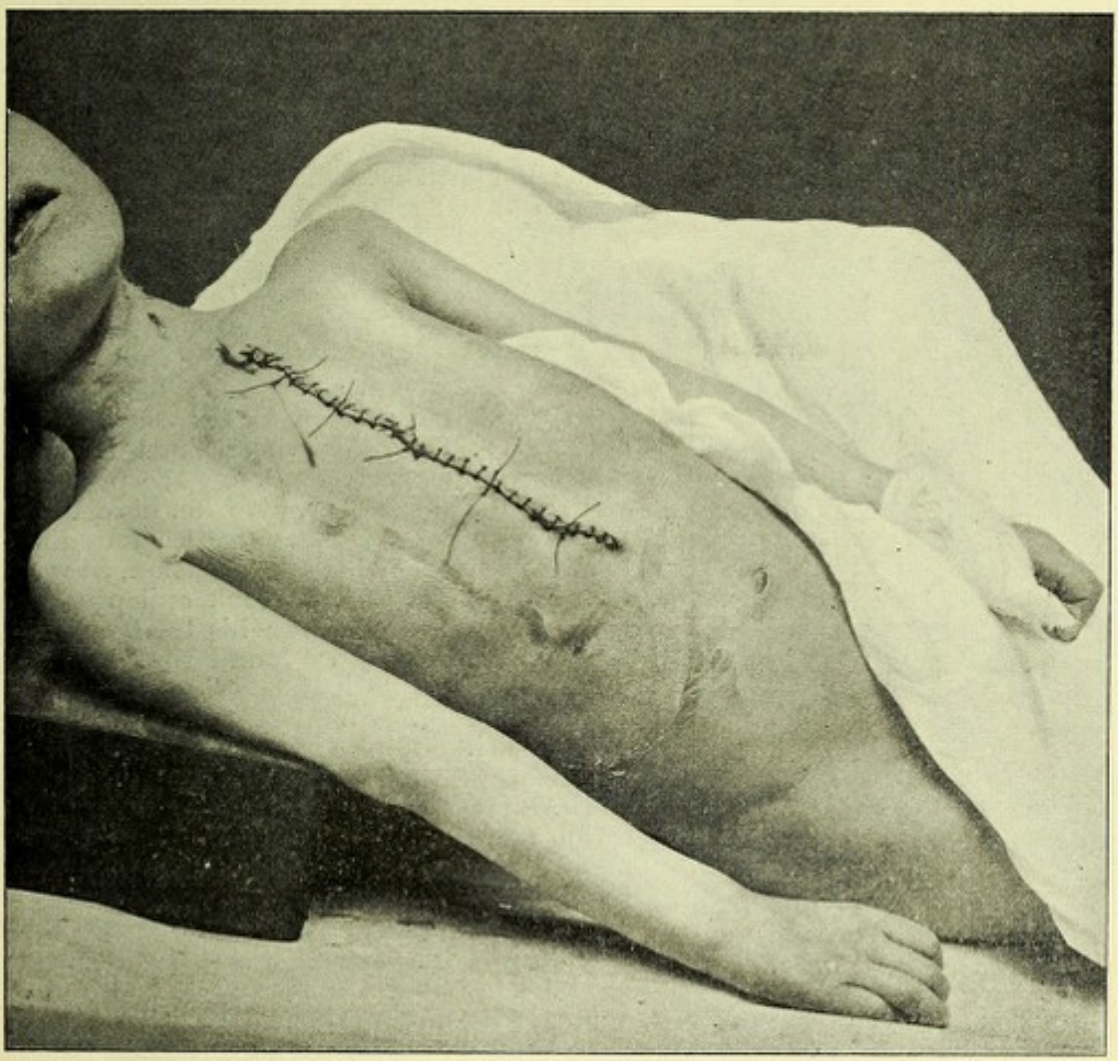

FIG. 76.—Homicidally-inflicted Incised Wound ripping open the chest and opening into abdomen.

death, he had been taken to an Infirmary, for, notwithstanding the extensive and serious character of the wounding, he was alive after its causation. We found the following marks of violence on his body :—(*a*) superficial scratches on left side of neck, (*b*) on the front of the chest, beginning at junction of left clavicle with sternum, and running downwards parallel to sternum on left side of chest, were two superficial incised wounds, (*c*) in the middle line of the body, commencing three-quarters of an inch from top of sternum, was an incised wound, somewhat irregular in outline, which measured 6¾ inches in length, and which had

been carefully sutured. It had a direction from the middle line of the body downwards and diagonally towards the right side, and passed on to the upper part of the abdominal cavity, and (*d*) a superficial incised wound on base of left thumb. On dissection, the chest wound had passed through (1) the superficial structures, (2) had cut through the cartilages of the second, third, fourth, fifth, sixth, and other cartilages of the ribs on the right side close to their junctions with the sternum, (3) that it had penetrated the right pleural cavity, and had bruised the lower front part of the right lung over an area of three-quarters of an inch by half-an-inch, (4) had divided the diaphragm for a distance of two inches, and (5) had entered the front wall of left lobe of liver, but not deeply, for a distance of 1½ inches. The right lung was collapsed. The right pleural cavity contained 4 ounces of blood and bloody fluid. We gave it as our opinion that death was due to the effects of severe wounding of the chest and penetration of the chest cavity over a large area, followed by pneumothorax, that said wounding was caused by forcible contact with a sharp-pointed instrument, and that the instrument had been used with considerable force. (Fig. 76.)

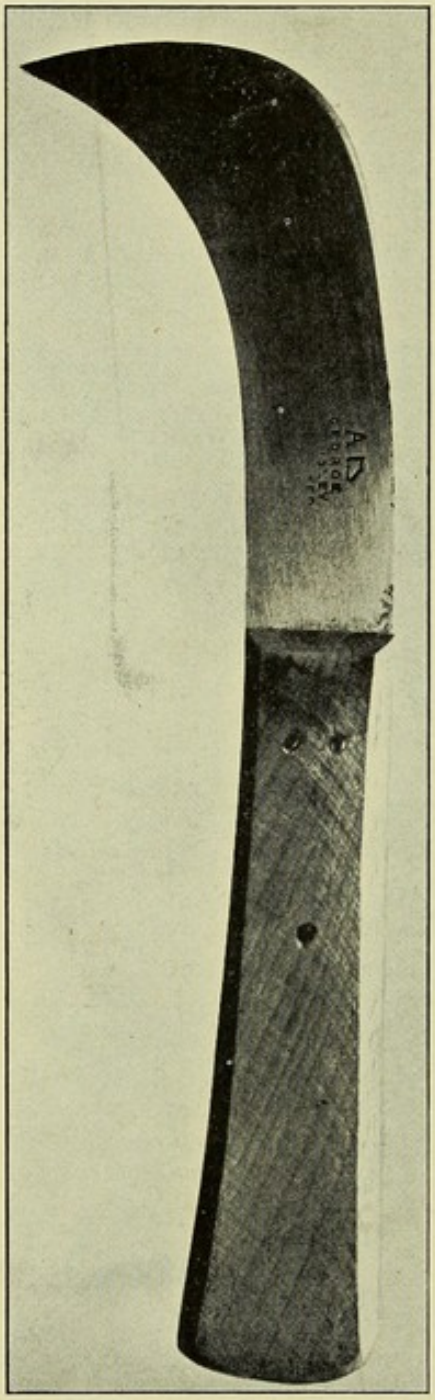

FIG. 77.—Packer's Knife. Total length, 9 inches; length of blade, 4 inches; length of handle, 5 inches; amount of projection of point of blade from front straight edge, 1½ inches.

The assailant was charged with murder at the Circuit Court, Glasgow. Previous to his trial, owing to certain facts which had emerged after his apprehension, and also during his term of custody, we were asked to examine the prisoner as to his mental condition. He proved to be a confirmed epileptic. This was ascertained from a number of persons who knew the prisoner well, such as his father, his wife, his clergyman, and others, and from a diary found on him at the time of his apprehension, as well as from the fact that he took epileptic fits while in prison awaiting his trial. From the prisoner's diary we found that he had put down that he had had 68 fits in 1895 (this was probably a mistake for 1905), and 136 in 1904. He had marked religious proclivities, and took an active part in Church work. His clergyman informed us that owing to his taking fits in Church meetings and his strange behaviour following the fits, he had had to ask prisoner to resign certain offices which he held in the church. On the morning of the day on which he attacked the boy, his wife informed us he had had a very severe and prolonged fit. That day was a public holiday, and he had been minding the baby. After, as she thought, he had recovered, she was surprised to see him attempt to get out of the window, which was three storeys up. She went downstairs some short time later on some household duties, and when she returned in a few minutes he had gone out and left the baby alone in the house. He did not return that night. Late the following night he returned, and in the interval the police had been inquiring for him. As they were watching the house, he was apprehended on his return. His statement to us was that he first came to realise where he was early in the evening of the day he came back, when

he found himself in Leith docks, but how he got there he did not know. Then he took the first train home. In these circumstances, we advised the Crown that the prisoner was insane at the time of committing the act with which he was charged, and that at the time he was suffering from post-epileptic insanity. A plea of insanity in bar of trial was entered on his behalf. After hearing evidence, the judge ordered him to be confined during his Majesty's pleasure.

It ought to be added that prisoner was a packer by trade, and that packers use a knife for trade purpose the blade of which is bent in shape (Fig. 77). Such a knife, which was usually carried by the accused to and from his work, and which at the time in question went amissing and was, so far as we know, never afterwards found, was a very likely weapon to have produced the wound found on the boy's body.

Homicidal wounds are not confined, however, to the anterior surface of the thorax, as the following cases show :—

Case IX. *Fatal Homicidal Stab Wound of Chest, penetrating Diaphragm and Stomach.*—In May 1903, a woman died from the effects of a stab wound in the

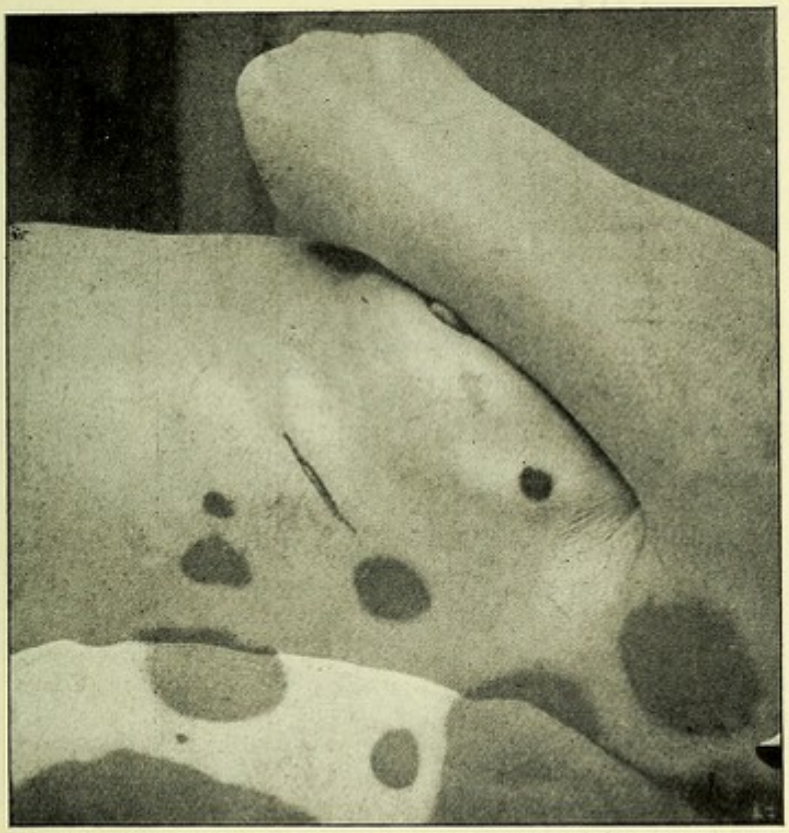

Fig. 78.—Incised Wound of Chest which passed through diaphragm, and penetrated wall of stomach. Weapon used, table-knife.

chest which had been inflicted by her husband. After the act, she was conveyed to hospital but died soon thereafter. On examination of her body, we found (*a*) a punctured-incised wound on the left side of chest over the lower edge of the seventh rib in a line with the left axilla, and 4 inches below it, which measured $1\frac{1}{4}$ inches in length, and entered the chest wall following the downward slant of the rib, and (*b*) a surgical wound on upper part of abdomen, in the mid line of the body, which commenced half-an-inch above the umbilicus and extended upwards for $4\frac{1}{4}$ inches. The latter had been carefully sutured after the manner of a wound produced by surgical operation. On dissection, the wound on chest wall was found to penetrate the left pleural cavity between the seventh and eighth ribs close to the junction of body and cartilaginous portions of these ribs. This wound on inside measured $1\frac{3}{4}$ inches in length, and in position was slightly anterior to the wound in the skin. There was no

wound of the left lung. In a line slightly downwards from the internal wound of chest wall was a wound of left side of diaphragm, into and through which had passed a knuckle of omentum, which wound measured 2¼ inches in length and 1 inch in breadth. In the left side of the wall of the stomach was a wound which had been carefully sutured. On removing the sutures, the wound was found to measure 2 inches long. The course of the wounding from start to finish was downwards and inwards. It appeared as if the knife at first impact with the body had struck, and had glanced off the lower edge of the seventh rib, and that this had determined its downward direction. We reported that the cause of death was shock due to the effects of the wound already described, that the wounding was produced by one stroke of a cutting instrument, with a broad extremity, and that the surgical operation was necessary to give the woman a chance for her life, and was skilfully performed.

The husband was tried later, and found guilty of culpable homicide. (Fig. 78.)

Case X.—At the High Court, Glasgow, February 1908, Robert Berwick and Robert Mailer were charged with having in an office in Glasgow assaulted a lady typist by knocking her down, stabbing her, rendering her unconscious and endangering her life. The medical evidence regarding the condition of the assaulted woman was that on her arrival at the Infirmary she was unconscious; that there was a considerable amount of blood about the face and clothes; that a piece of skin, about 1½ inches, had been stripped from the back of left ear, from which there had been a good deal of bleeding and there was a bruised swelling above and behind the left ear; that there were small wounds of a shallow character on the hands, seven wounds on the right side of the chest, and three wounds over the right shoulder-blade. One of the wounds on the chest was 2½ inches in depth. The wounds of chest and back were produced by a long, narrow, thin instrument, probably a penknife. We spoke to the presence of blood-stains on the clothing of Berwick at the trial of accused. Accused were found guilty and were sentenced to long periods of penal servitude.

Homicidally-inflicted stab (punctured) wounds of the neck, if we except that region immediately above each clavicle, are, perhaps, less common than the foregoing. When inflicted on the front of the neck, the danger to life arises from the likely penetration of a large blood-vessel or vessels, or the lungs.

The following are illustrative cases, the first and third being from our case-book:—

Case I. *Fatal Stab Wound of Neck. Severance of Right Vertebral Artery between Base of Skull and Atlas.*—In June 1907, in the course of a quarrel, a man was stabbed in the neck from which he died before he could be removed to an infirmary. In our examination, we found the following wounds on the body:—(1) in the left groin, 1½ inches above the line of Poupart's ligament, was a spindle-shaped clean-cut wound which measured half-an-inch long and ¼ broad at its broadest point; (2) on the front fold of right axilla, 3 inches down from the point of the shoulder, was a similar wound of the like dimensions; (3) on outer aspect of left buttock was a similar wound, but which measured ¼ of an inch long, and $\frac{5}{16}$ of an inch broad; (4) behind the right ear 1¼ inches from point of attachment of lobe of ear to scalp, and 2½ inches backward and upward from angle of lower jaw, was another similar wound which measured $1\frac{5}{16}$ inches in length and ⅜ths inch at broadest part. The direction of this wound was downwards and inwards, and it passed into the tissues for a depth of 2 inches. From all the wounds, but especially from that on the neck, blood had freely flowed. Dissection showed that the wound on left groin had not penetrated the abdominal cavity, but had passed through the skin into the muscles of abdominal wall; that the wound of right axilla had entered the thoracic cavity just below the lower margin of the second right rib, but had not injured the lung. Its dimensions on the interior of the chest wall were ¼ in. × ⅛ in. The wound on left buttock had passed into the tissues for a depth of ¾ of an inch. The wound on neck had passed through the tissues of the neck, had entered between the base of the skull and the atlas vertebra, and had therein severed the right

vertebral artery. It had not injured the spinal cord. We reported that death was due to hæmorrhage from the wound in the neck, and that this wound, and the three others had been produced by forcible contact with a sharp instrument. Later, we reported upon the character of certain stains found on articles of attire belonging to one of the accused (*vide post*). (Fig. 79.)

At the August sitting of the High Court in Glasgow, a man named M'Millan was charged with the murder of deceased. A verdict of culpable homicide was returned by the jury, and accused was sentenced to penal servitude for life.

Case II.—In the Clones tragedy, tried at the Ulster Winter Assizes, 1904,

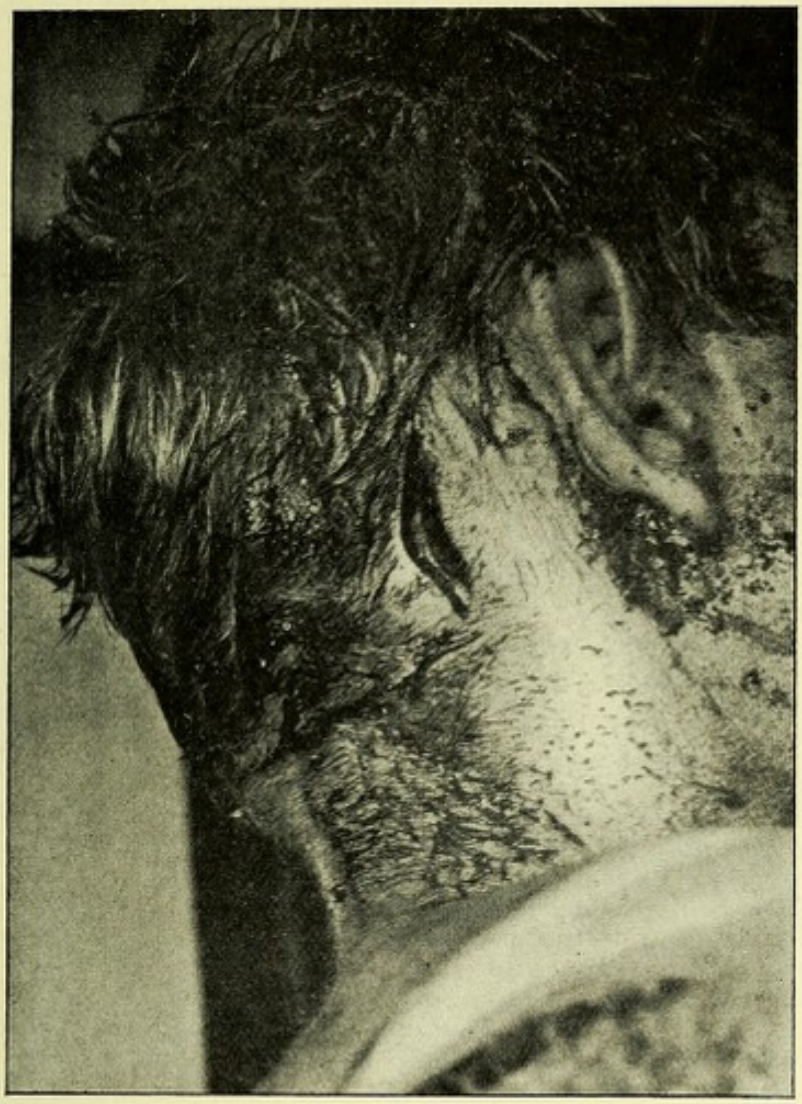

Fig. 79.—Stab Wound on back of neck which penetrated spinal canal between base of skull and atlas vertebra, and therein severed right vertebral artery.

the wound found on the throat of the deceased, whose body was found buried in a dung-heap, penetrated the thyroid cartilage, and measured 1 inch in length. It was called a "pig-sticker's wound."

In certain cases of neck wounding, the defence may be set up that the wound or wounds were accidentally or suicidally, and not homicidally, produced. Much will, therefore, depend upon the evidence of the medico-legal examiners where there has been no eye-witness. In order to form an opinion from all the available facts, it is advisable that the examiners should make a careful inspection of the place where

the body was found. In the case recorded on p. 287, the plea in defence was that the wound was suicidally produced.

Punctured (stab) wounds of the abdomen are not, in our experience, so relatively frequent in occurrence as are wounds of the chest or of the neck. They do, however, occur as the following case illustrates :—

In October 1908, a young man was tried at the High Court, Glasgow, the charge against him being that on September 11, he assaulted Felix Dolan, now deceased, and did stab or cut him on the abdomen, and did murder him.

We made a post-mortem examination of the body of the deceased man on September 15. The body was that of a well-nourished, well-built powerful man. There was a wound on the abdomen which was situated 1 inch to the right side of the middle line. It commenced 2 inches above the line of the umbilicus and extended upwards toward the lower ribs of right side. It measured 4 inches in length and had been surgically stitched. Inspection of the abdominal cavity showed internally in the neighbourhood of the wound, which had passed through the abdominal wall, a limited area of peritonitis, with exudation of lymph. The instrument was found to have perforated the omentum in the line of the abdominal wound. The perforation measured about half-an-inch in diameter and was of an irregularly circular shape. On the small intestine was a wound about the size of the head of an ordinary nail, in which the muscular coats were severed, but which did not penetrate through the mucous lining. Around the wound the surface of the bowel was discoloured by extravasated blood. Four ounces of fluid blood were found in the pelvis, and the surface of the intestines was more or less freely marked with effused blood. The other organs of the abdomen were uninjured. We reported that death was due to shock and hæmorrhage from wounding of the abdomen. A plea of guilty of culpable homicide was tendered and accepted, and accused was sentenced to 7 years' penal servitude.

But in homicidal woundings there may be many lesions instead of only one, and these may be caused by different weapons. The following case, from our note-book, is illustrative :—

The dead body of a woman was found lying in the front garden of a detached cottage where she had been attacked and murdered by her husband. The following lesions, grouped together, were found upon it :—(1) a lacerated wound on the left side of the forehead, measuring 1 inch in length and severing the tissues to the bone, but unaccompanied by fracture ; (2) four incised wounds on the left side of neck, situated between the angle of the lower jaw, the clavicle, and the suprasternal notch, which severed several of the large deep blood-vessels ; (3) a slight abrasion over the right knee, and abrasions of skin and bruising of left hand. The weapons used were an axe-hammer and an ordinary breakfast table-knife, on both of which blood-stains were found.

There is another class of woundings which from their severity and situation might easily be considered homicidal, but which are actually self-inflicted. The following is a most instructive case [1] :—

J. B., a single man, aged 29, on Dec. 5, 1879, called his medical attendant to attend to the following injuries :—the left testicle was lying completely outside the scrotum suspended by the spermatic cord, which was unharmed, as was also the substance of the testis. The wound in the scrotum measured 1½ inches in length. He volunteered the statement that he had been attacked about a quarter of a mile from his home by three men, and assaulted in the above manner. Three men—neighbouring farmers—were apprehended on the charge. At the assizes, the assaulted man swore to the identity of two of them as his assailants. The two men were convicted, and sentenced to ten years' penal servitude. Again on Feb. 13, 1881, he summoned his doctor, by reason of

[1] *B. M. J.*, vol. i., 1882, p. 72.

his having sustained another injury to his genital organs, which consisted of a wound 2 inches in length, at the lowest part of the scrotum, the direction of the wound being at right angles to the raphé. He said that on this occasion he had been attacked by four men, and he related circumstantially the details of the attack. He would not, however, vouchsafe any further information to the police authorities, or to anyone else, as he said he wished the affair to be kept quiet. He, at the same time, expressed a feeling of regret that he had prosecuted in the first case, as he thought the men had been too severely punished. Being the subject of cardiac valvular disease, congestion of the lungs set in, of which he died in December of that year. A few hours before his death he confessed that the men who had been convicted were innocent, that he wished them liberated, because he had himself produced the injuries. In consequence of this confession, the Home Secretary caused a bill of indemnification to be brought before Parliament, whereby sums of money were given to the men for their unjust punishment, they having been at once liberated.

Another case of the same nature, with a confession of self-infliction, but without any accusation, is recorded,[1] in which, as a measure of atonement for having lived with a prostitute for some days, owing to a quarrel with his wife, a man cut open his scrotum with his pocket-knife, severed his left testis, and threw it from him.

Self-mutilation to evoke the sympathy of the charitable, or while labouring under delirium tremens, is probably not very common, although it is by no means unknown.[2] On the Continent, where the law of conscription obtains, limited self-mutilation to unfit the person for service is common, but it rarely takes the form of self-amputation of both feet by strangulation of the circulation and subsequent gangrene, as in a case recorded by Dr Jamieson of Shanghai, of a Chinese beggar,[3] or of one foot by a carving-knife, by a patient in delirium tremens.

There can be little reasonable doubt that self-inflicted injuries of the genital organs in the case of males have their origin in more or less declared sexual monomania. Various cases might be cited to further substantiate this statement. Thiersch of Leipsic narrates the case of a young man, who, between the ages of 18 and 32, while single, and also after having been married and having become a father, performed upon himself the following operations:—at the age of 18, circumcision; later, and when married and a father, slit up his abdomen from symphysis pubis to umbilicus, which healed up; a year after, he laid open one side of his scrotum, from which the testis prolapsed but was replaced, and the parts were healed; some years later, in 1880, he again laid open his abdomen, which was again healed; in May of the same year, he removed his right testis, and stitched up the wound which he had made; and a month later, he removed the left testis. According to the narrator of the case, these acts were performed under the direct incentive of an uncontrollable impulse, which only disappeared after the removal of both testes.[4] In like manner, foreign bodies introduced into the urethra indicate a prurient tendency, or an early mode of manifestation of sexual monomania. In one case[5] a man inserted into his urethra a big bonnet pin for a lady's hat, and in trying to remove it, broke it, and left about 1½ inches of the round head end in the passage. Another unique case was one which fell within our experience, in which a man, a teacher, of gradually developing eccentric manner, one night threaded his scrotum and penis through the head of an ordinary large door key, and because of his inability to remove it on account of the swelling of the parts, sought our assistance.

A case is recorded in which acute delirious mania accompanied self-mutilation. The person, a young man, suffering from religious mania, had severed his testicles with a hand-saw, in addition to severely wounding the penis. He became apparently quite sane after he recovered from the effects of the chloroform which had been administered for the purpose of permitting surgical treatment of his wounds, but only for a few hours, for the mania returned worse

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[1] *B. M. J.*, vol. i., 1882, p. 397.
[2] *Med. Press.*, vol. ii., 1885, p. 382.
[3] *Ibid.*, p. 397.
[4] *Med. Record*, 1881, p. 253.
[5] *B. M. J.*, vol. i., 1900, p. 633.

than before, and he died on the ninth day in a state of coma, epileptiform fits having appeared on the fifth day, and having become more frequent up till the time of death.

Dieters records the case of a woman, the victim of post-climacteric melancholia, who opened her abdomen, and cut into her intestines with a pair of scissors. Notwithstanding the fact that, when she was seen, six feet of the intestine protruded from the abdominal wound, and that there were at least twelve irregular wounds in the protruded part, she recovered after surgical treatment. Her melancholia, however, returned as she recovered.[1]

But injuries to the sexual parts may, undoubtedly, be homicidal; it is enough to cite the series of Whitechapel and Lincoln (1898) tragedies to prove this. It is more than probable that these deeds were the result of monomania in the perpetrator.

Apart, however, from any suggested mental derangement of the perpetrator, abdominal and vulvar injuries are not infrequently the consequences of brutal assault by responsible persons. Such injuries may be multiple or single. The following cases are illustrative :—

1. Nikouoff narrates a case in which a young girl of sixteen years, who was pregnant, was stabbed by her brother in fourteen places. One of the abdominal wounds was 4 in. long, and out of it the uterus, in part, and coils of intestine protruded. The wounds were treated surgically, and notwithstanding the apparently hopeless character of the surgeon's task, she recovered.[2]

2. At the High Court of Justiciary held at Glasgow, November 1900, a man was charged with having caused the death of his wife by kicking her in the vulva and wounding her. The medical evidence showed that the deceased had died from the effects of loss of blood, due to wounds in the vulva which might have been produced by a booted foot. The accused had acknowledged in presence of witnesses that he had given his wife a kick because she was intoxicated. The defence was that deceased met with her injuries from having fallen against some pointed body while intoxicated. Accused was found guilty of culpable homicide.

We have seen more than one case in post-mortem examination of women who have died from hæmorrhage the result of vulvar woundings due to kicking.

In these cases the wounds were situated within the labia minora and on the under side of the symphisis pubis. Not infrequently, owing to the kicking being done in the absence of eye-witnesses, and to the disinclination on the part of a wife to inform against her husband, and to surgical aid not being called for at the time, difficulty is experienced by the authorities in bringing such brutal assailants to a bar of justice.

Accidental injuries to the vulva, sometimes of a severe character, are also not rare, due to the accidental breaking of chamber vessels on which the female may have been sitting at the time. Such wounds are usually of an incised character. In all cases of vulvar woundings, there is danger to life from the severe and rapid hæmorrhage, owing to the very vascular composition of the tissues.

The suicidal tendency may exhibit itself in woundings on other parts of the body. Instead of attacking the throat, suicides occasionally attempt decapitation by cutting the neck from behind. Little[3] records the case of a woman recently discharged from an asylum, who, with a blunt and rusty table-knife with which she had been peeling potatoes, made an attempt in this way to sever her head from

[1] *Munch. med. Woch.*, No. 36, 1900 ; *B. M. J.*, vol. i., 1901, s., p. 98.
[2] Vratch, No. 15, 1901 ; *B. M. J.*, vol. i., 1902, s. p. 350.
[3] *The Lancet*, vol. ii., 1889, p. 791.

her body. She had succeeded in cutting through the skin, muscles, ligaments, and into the spinal canal itself, without however injuring the cord. She died from septicæmia on the sixth day after. Alston records the case of a young Venezuelan, in chronic ill-health, who committed suicide by inflicting on himself (*a*) an incised wound in the pharynx, which missed the large blood-vessels and did not open the larynx, and (*b*) an incised wound at the back of the neck, $6\frac{3}{4}$ inches long, which passing deeply through the soft tissues, entered between the first and second cervical vertebræ, opened the sheath of the spinal cord, and slightly cut the spinal cord itself. A razor was found lying in his relaxed right hand.[1] Suicides, too, may inflict many wounds upon their bodies. At an inquest held in London, it was shown in evidence that a suicide had inflicted seventy-one wounds on his body ; in addition a dozen lucifer matches were found in his stomach.

Injuries to the skull are most usually accidental or homicidal, and

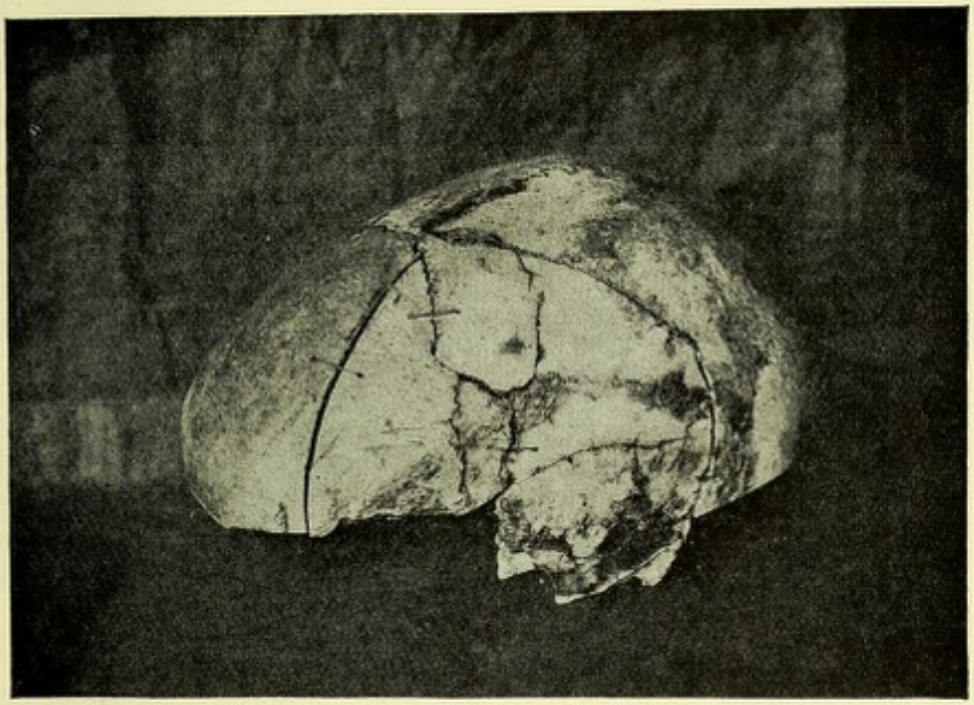

Fig. 80.—Comminuted Fracture of Skull produced by a fall from a window 28 feet from the ground.

but rarely suicidal. In the differentiation of the cause, the attendant circumstances commonly reveal the truth, but it is by no means difficult to conceive cases in which, from the examination of the body, it would be impossible to distinguish between the two first-named classes. The following case, which was tried at the Circuit Court, Glasgow, Dec. 1898, is illustrative :—

The prisoner was tried on the charge of murdering his wife by throwing her, or pushing her, out of a window, whereby she fell a distance of 28 feet, and sustained such bodily injuries that she died thereof. The post-mortem dissection of the body revealed compound and simple fractures of the skull,

[1] *B. M. J.*, vol. ii., 1901, p. 1865.

fracture of left jaw, fracture of left arm, and compound fracture of right arm. The whole question of the guilt of the accused depended upon the lay evidence, which, not being sufficient to establish the charge, led to a verdict of " Not Proven " against the prisoner. (Figs. 80, 81.)

In another case tried at the same sitting of the Court, the injuries, inflicted by a poker with a rounded head, consisted of twelve lacerated wounds of the scalp, and a large compound fracture of the skull on the right side of the forehead, in which broken bits of bone and brain-substance were mixed up together The evidence in this case was in the main circumstantial, and one of the points of evidence which connected the prisoner with the crime was our discovery upon his clothing of spots of mammalian blood, circular, oval, and inverted soda-water-bottle in shape, which indicated, at least, that the blood had been bespattered over his clothing. These facts pointed to homicidal causation.

Of the homicidal infliction of the following injury there cannot be the remotest doubt. The following are taken from our notes of the dissection:—

The body bore the following marks of violence:—a bruise on outer aspect of right arm below shoulder measuring $5\frac{1}{2} \times 3\frac{1}{2}$ inches; right eye ecchymosed;

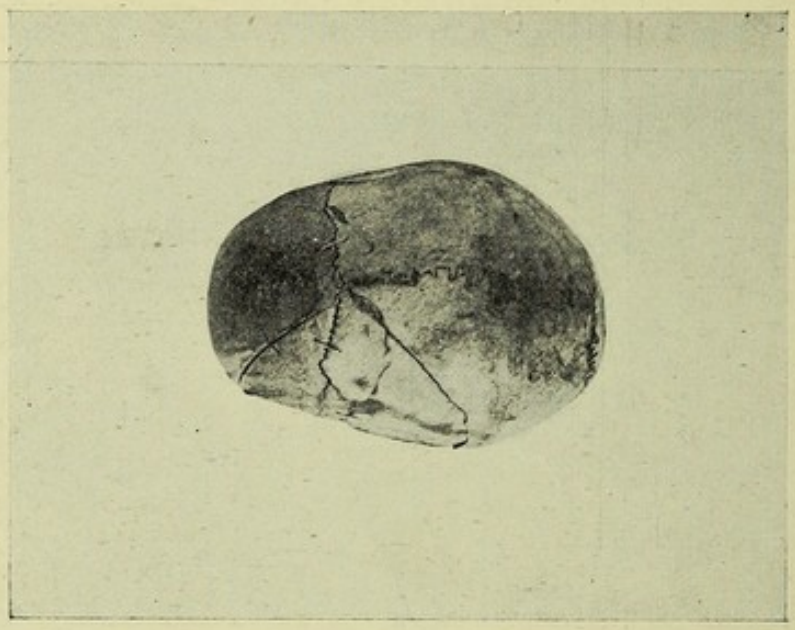

Fig. 81.—Another view of Fig. 80. The bones of the skull in this case were unusually thick.

left eye similarly bruised. In the lower left eyelid, toward the inner canthus was a lacerated wound measuring $\frac{7}{8}$ths of an inch in length, which passed through the tissues of the lid, penetrated the tissues on the inner side of the orbit, and fractured the orbital plates of the upper maxilla and ethmoid bones. So much could be seen externally. On opening the skull and removing the *dura mater*, the surface of the right hemisphere of the brain was found covered by a thin layer of extravasated blood, which was markedly greater on the front and under surfaces of the right frontal convolutions. On carefully removing the brain, a laceration of the brain-substance into which the little finger could easily be put, situated on the under surface of the right convolutions, was found, into which the *crista galli* of the ethmoid bone, which had been detached by the blow, was driven. Although these injuries were so severe, the man lived for five days after their receipt. All of the head injuries, beginning from the wound in the eyelid and ending in the injury to the brain from the driven-in bone, were caused by a violent thrust of a comparatively narrow, sharp-pointed poker, which, upon examination later, showed abundant evidence of blood-stains. We also made an examination of the woman's clothing and found many blood-stains on her jacket and petticoat. It appears that at the time of receipt of the wound the man was lying in bed in a state of semi-intoxication, with his face toward the fireplace, that he used provocative language to the accused, and

that, in a fit of temper, she thrust at him with the poker, with the above result. She pled guilty at the trial. (Fig. 82.)

Punctured wounds of the skull may also be produced in young children by a variety of weapons, such as a gouge.[1]

In a case tried before the High Court of Justiciary at Glasgow in 1903, death of the victim was due to a knife having been driven into the brain through the temporal bone. The skull was unusually thin.

It has been said, and in the main it is correct, that in hæmorrhage found in the brain, its situation relative to the bones of the calvarium, *dura mater*, and brain-substance, may assist in enabling the examiner to arrive at an opinion as to whether it has been due to violence or disease; that where the blood is found extra-durally—that is, between the



FIG. 82.—Fracture of Skull through orbit produced by Pointed Poker. The position of the quill indicates the point of entrance. (Author.)

bone and the membranes—the cause is due to violence, and that where it is found intra-durally or sub-durally, or into the substance of the brain, the cause is disease. From our experience, we believe that such a hard-and-fast rule should be received with great caution, for although it applies to the large bulk of cases, there are, nevertheless, cases where violence has undoubtedly been used, in which no fracture of skull has resulted, but meningeal hæmorrhage or laceration of the brain with consequent sub-dural effusion of blood.[2] Such a lesion is most likely to arise from *contre-coup*. Of very many bodies which we examined in which foul play was suspected, or in which there was definite evidence of violence, in several there was fracture of some part of the skull with extra-dural hæmorrhage, in some fracture with

[1] *B. M. J.*, vol. i., 1900, p. 700.

[2] For references to cases of meningeal hæmorrhage, due to injury, without racture of skull, *vide Lancet*, vol. i., 1889, p. 117.

laceration of brain and intra-dural hæmorrhage, in others laceration of brain only with intra-dural hæmorrhage, in not a few fractures in which the fractured bones had entered the brain-substance with intra-dural hæmorrhage, and in the remaining cases the cause of death was apoplexy with hæmorrhage into the brain-substance.

Various views have also been recorded as to the lines of fracture which are likely to result from falls upon the feet, falls upon the head, and from blows from different kinds of instruments. When it is considered how variable in thickness are the bones of the head in persons of the same sex, how relatively thicker or thinner may be the bones of one person of one sex compared with the average condition of the bones of that sex, and how multiform are the modes and angles of impact of violence however occasioned, we should pause before committing ourselves to any general theory. Some of the thickest skull-

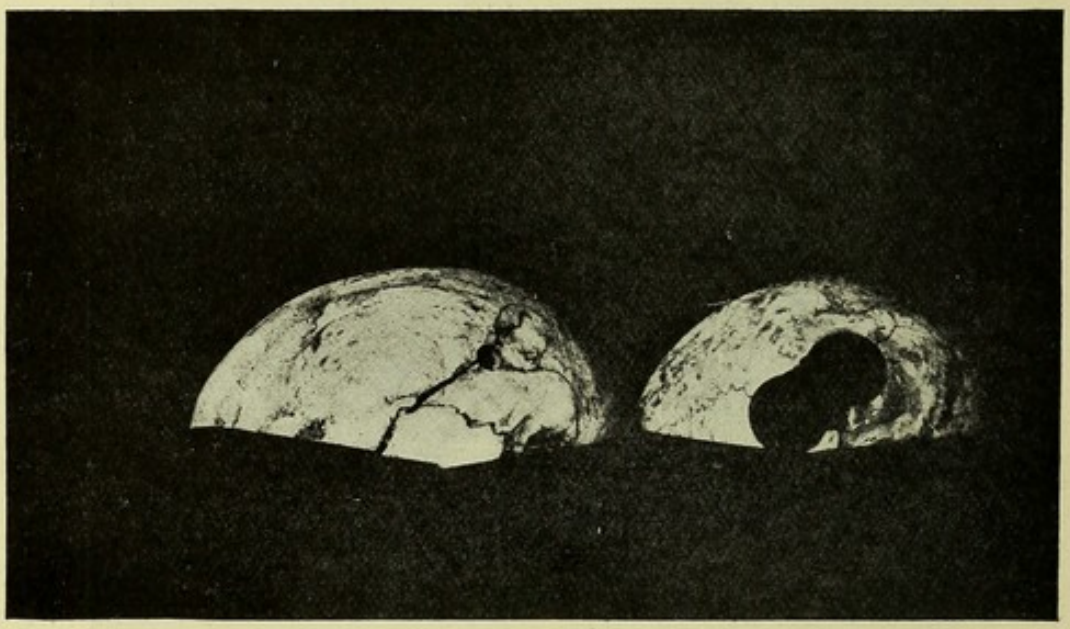

Fig. 83.—Fractures of Skull from applied Violence by blunt instruments. The openings are due to trephine marks, the persons having been operated upon during life. (Author.)

bones we have ever seen belonged to women, and some of the thinnest, to men. (Fig. 84.) The easiest fractures to diagnose from their appearance, relative to their cause, are those produced by pointed iron instruments, such as a pickaxe, a slater's hammer, or a lath-splitter's tool, all of which produce definitely localised, and irregularly-circular fractures of the vault. The following cases will prove of interest :—

1. A young man was charged with culpable homicide in that he had knocked over a man who had assaulted him, and who, in falling, had struck his head violently against the kerb of the pavement, from which he died. Our notes of the dissection of the body show that the deceased had sustained a recent fracture of the base of the skull extending up on the calvarium, and measuring in its total length three and a half inches, with accompanying hæmorrhage. But, in addition, on the vault of the skull, corresponding to a circular depression on the head found externally before the head was opened, was a depressed fracture composed of pointed parts of bone all of which, however, were rounded off, thus indicating that it had been present for several years. On further inquiry, it was ascertained that twenty-one years before his death, this man had

been assaulted on the head by one of his fellow-workmen with the pointed end of a slater's hammer. His wife volunteered the statement that, since that

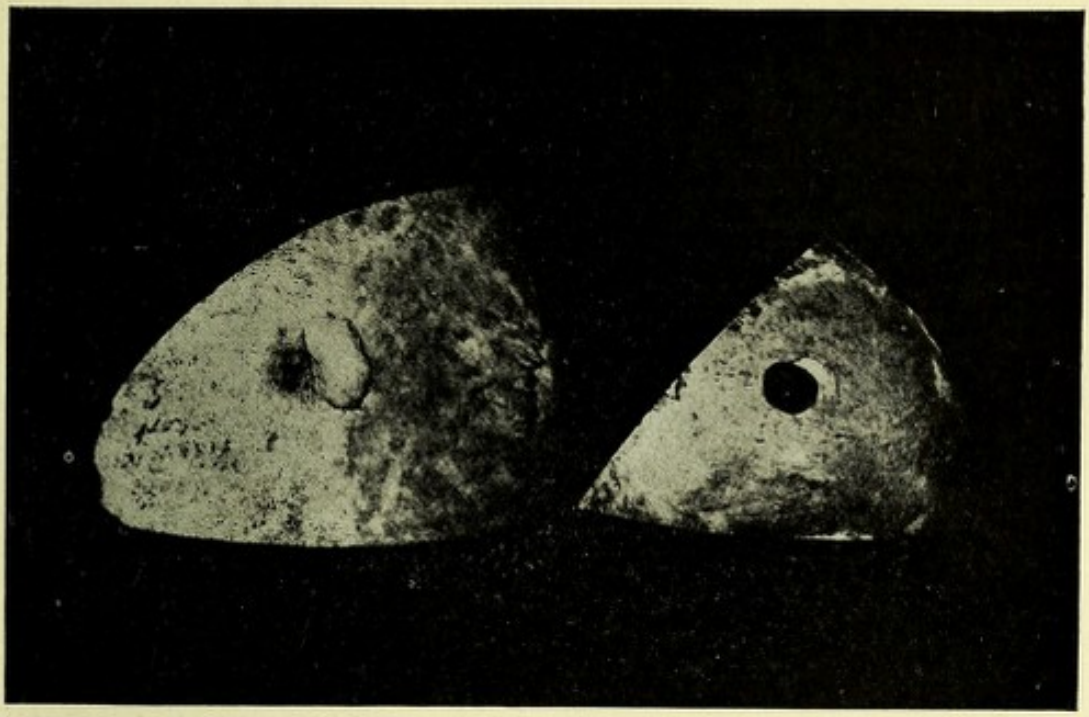

FIG. 84.—Fractures of Skull produced by Pointed Instruments, viewed from exterior of Skull. That on the left was produced by a miner's pick, and that on the right by a slater's sharp-pointed hammer. The lines of fracture of external plate indicate the direction of the applied force. (Author.)



FIG. 85.—Views of Fig. 84 from interior of Skulls. In the one on the left, bevelling of the inner plate is plainly marked. In that on the right, the depressed pieces of bone formed an irregular cone which pressed on the *dura mater*. (Author.)

time, when he got intoxicated, he had developed an irascibility of temper and quarrelsomeness which were unknown to him before.[1] (Figs. 84, 85.)

[1] This fracture may be considered as a typical hole-fracture—the "loch-bruch" of the Germans.

2. *Compound Depressed Fracture of Vertex of Skull, produced by Corner of an Axe* (Sept. 1903).—This was found on the body of a young man. The left leg had been amputated at the upper third of the thigh some years before, thus causing deceased to use a crutch. On the left side of head and nearer the back than the front, 2½ inches above upper level of lobe of left ear, was a clean-cut wound, measuring 1½ inches long, which passed down to the bone. On reflecting the scalp, immediately beneath the wound, there was found a depressed fracture of the skull, which measured ⅞ths of an inch in length. On removing calvarium it was found that the fracture had extended through the parietal bone, and that the inner plate had been broken into four different lines of fracture, which had, however, not wounded the *dura mater*. Between the bone and the *dura mater* was a mass of clotted blood, the centre of which was the skull fracture, which measured in size from before backwards four inches, and from above downwards, three and a half inches. This had produced marked compression of *dura mater* and underlying portion of brain. In the depressed area of brain substance, the brain tissue exhibited marks of contusion over an area of 2 in. × 1¼ in.

The accused, the father of deceased, was tried for culpable homicide at the Circuit Court, Glasgow, in December 1903. The evidence showed that deceased, who was under the influence of drink, attacked the accused by striking him with his crutch, and that accused picked up a coal-axe with which to defend himself, and with it struck deceased. After receipt of the blow, deceased left the house, went to the Police Office to get his injury attended to, but left because he would not await the arrival of the surgeon. He continued drinking during the course of the afternoon and evening, and late at night went to sleep in an empty house with a companion. When the companion woke in the morning, deceased was found to be dead. The jury found accused guilty of culpable homicide under great provocation and recommended him to the leniency of the Court. His Lordship, in giving accused a light sentence, stated as his opinion that the circumstances of the case, if they did not amount to provocation, very nearly approached it.

The situation and incidence of fractures of the skull of newly-born children are said by some to be of considerable importance in deciding whether the injuries may have been produced during, and as the direct consequence of, difficult labour, or of precipitate labour where the head of the child is projected forcibly from the mother's parts on the floor or ground, or by infanticidal violence. That congenital fissures may be found is without question, their position most commonly being in the occipital bone, or in the parietal bone at its posterior and upper part, near the parieto-occipital suture; but fractures are comparatively rare in normal labours, or even in difficult labours, unless the mechanical aid of the forceps has been invoked.

Extensive cranial fractures are always the result of applied violence. Four illustrative cases will suffice:

1. A man assaulted his wife with a poker while she was carrying in her arms her child of a few months old. The child was struck, in consequence of which it died. We found on dissection of its body, the following fractures of the skull —viz. (*a*) on left side of head, a fracture measuring 4 inches in length, running parallel to the vertex of the head from before backwards; (*b*) at right angles to (*a*) a fracture 2 inches long; (*c*) on right side of forehead, a fracture 2½ inches long; (*d*) on right side of head, a fracture 4 inches long; (*e*) at right angles to (*d*), a fracture 3 inches long. The man pled guilty. (Fig. 86.)

2. A man assaulted his wife, and stabbed her several times in the back with a knife, while she was carrying her child. In the struggle, when the woman was attempting to run away, the infant fell or was dropped by her on the pavement. We found the following fractures on the child's skull:—(*a*) a fracture on right side, 4 inches in length; (*b*) in occipital bone and extending to left side of head, a linear fracture of 3½ inches in length. The brain was much lacerated,

and brain tissue had escaped from cavity of head into a hæmatoma on right side of head. He was found guilty. (Fig. 86.)

3. On the body of a newly-born child, found on the banks of the river Kelvin, Glasgow, was a fracture in the left parietal region of the skull which measured 3½ inches in length ; between the cranial bones and the *dura mater*, much extravasated, clotted blood was found. The child had freely breathed.

4. At the High Court of Justiciary, Glasgow, February 1904, John Macdonald was indicted with having assaulted his infant daughter, aged eight weeks, and did seize her by the legs and dash her head on the floor, and fracture her skull, and did thus murder her. On the night of December 8, accused came home under the influence of drink. He had been drinking heavily for some time before. The infant had been laid to sleep on a chair. Accused seized the child by the legs and held her as high as he could reach, and then dashed her to the floor. We examined the body on December 9, and the following appearances indicative of violence were found :—On the right side of the head was a large swelling which extended from a point half-an-inch behind the level of the outer angle of right eye, backward to the middle line of the back of the head, and which measured in length from front to back five inches, and in breadth three inches. This swelling was bluish in colour. It showed no

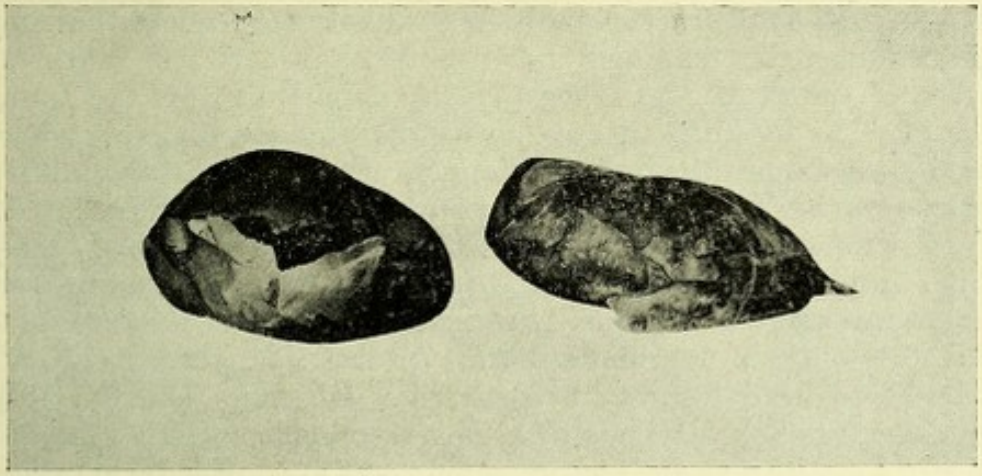

Fig. 86.—Fractures of Skulls of Infants. The one on the left was caused by a poker, the other by a fall from the arms of the mother while running.

abraded surface. On the left side of head was another swelling which extended from outer angle of left eye backward for four and a quarter inches, and from the upper level of lobe of left ear upward for four inches. It was also bluish in colour. At one part it showed superficial bruising of skin. Both swellings were fluctuant to the finger. On dissecting the head, blood and brain matter escaped from the usual scalp incision, and fluid blood was present in the deep tissues of the entire scalp. A complete circular fracture of the skull was revealed, which extended from the right frontal bone at orbital cavity right round skull to the corresponding point of opposite side, but the fracture did not extend across frontal bones. The fracture in circumferential measurement was nine and three quarter inches. The brain was extensively lacerated and broken up, and there was great destruction of brain tissue. The Advocate-Depute, on addressing the Court, said that he found it consistent with his duty to restrict the charge against the accused to one of culpable homicide, and thereupon the accused tendered a plea of guilty of that charge. He was sentenced to 10 years' penal servitude.

Of fractures of the skull generally, it may be said that where heavy bodies suddenly strike or are propelled against the vertex of the skull, the line of fracture will be determined by the resultant of the lines of force and of resistance. The force being one of compression, acting in the direction of the line of impact compresses the skull and its contents

in lateral directions, thereby producing points of distension, due to resistance, their line being at right angles to the line of force, at which points the fractures take place, and at which the separation of the fractured surface is greatest; and from these, radiating toward the point of impact, and oppositely to the point of distension, run the lines of fracture. Where the force is applied laterally, it will depend upon the relative values of the force and the resistance, whether the fracture occurs at the point of impact—where the force is relatively much greater than the resisting power, as in the case of a pointed instrument—or at the opposite side of the head by *contre-coup*, where the resistance being relatively more equal to the force, the area of greatest distension falls upon the side opposite to that of the applied force, and thus produces a fracture, or, it may be, laceration or contusion of the brain-surface without fracture of bone. The part of the skull which, on the application of force, seems to us to fracture most easily—because it is usually the thinnest part of the skull—is the squamous portion of the temporal region, above the level of the articulation of the lower jaw and in front of the ear. In skull fractures which are likely to become the subject of legal inquiry, the examiner should note, as a matter of routine, the thickness of the skull, and especially any departure from the average, with a view to forming an opinion of the amount of likely violence required to produce the injuries found. Fracture of the skull, and frequently of the base, in persons who at the time are intoxicated, is, in our experience, far from uncommon. While it is generally true to say that intoxicated persons escape from bodily injuries more readily than non-intoxicated persons, when thrown down, because of the relaxed state of their muscular system, it is our experience that they are more liable to head injuries, because they fall more heavily. These are but general observations which, however applicable they might be in a case of fracture if all the factors were known as a mechanical problem, fail in their practical application in most cases, because of the absence of that very knowledge.

Fractures of other parts of the osseous frame may, however, have a fatal ending by reason of (*a*) their situation, (*b*) their extent, or (*c*) superinduced complications. Of considerable importance are rib fractures, especially in lunacy practice. While in certain cases of maniacal persons considerable physical force has to be employed for the purpose of restraining them, and during its exhibition fractures of ribs may occur, there is reason to suspect that, occasionally, greater physical force than necessary is employed with ensuing fatal results. While in general paralysis of the insane there is sometimes found an unnatural development of the medullary structure of the rib, and, therefore, a greater frangibility, it is not always found. This *fragilitas ossium* is also found in workers in phosphorus. Should fractures of ribs be found on post-mortem examination of the bodies of persons who are under asylum care, the examiner should specially test the frangibility of these structures by testing one or more unbroken ribs. But more located rib fractures may induce serious consequences; as where the point of the fractured end wounds the pleura and sets up pleurisy, or even pneumonia.

Fractures of the spine do not usually cause death at once, although paralysis of the parts of the body below the seat of fracture commonly

supervenes at once, especially if there be displacement of the fractured portions. The extent of range of the paralysis will obviously depend upon the position of the fracture. We adduce two illustrative cases, both of which were produced during fights.

Possible fractures of the pelvis in accidental injuries by falls and crushes should always be looked after.

Fractures of the long bones, even when compound, are now rarely fatal, unless septicæmia supervenes. We give one illustration.

The following cases are taken from our case-book :—

A. *Fractures of Spine, arising from Violent Injuries during Quarrels.*—In June 1903, within a few days of one another, we had to examine the bodies of two men, in each of which death was due to spinal fracture.

1. The first was that of an emaciated man. The following marks were found externally on the body—viz. (*a*) a recently formed scar of a lacerated wound on the back of the head, three quarters of an inch long, (*b*) an area of ulceration on outer prominence of right elbow, measuring about two inches square, and (*c*) a similar area of ulceration, but smaller, on same part of left elbow. The history of the case pointed to a spinal lesion. Examination of the spine revealed a fracture of the fifth cervical vertebra with displacement, the upper part being displaced backward, thus producing undue pressure on spinal cord at sixth cervical vertebra, and consequent paralysis of upper limbs, trunk, and lower limbs of body. Above and below seat of fracture the meninges of the cord and the cord itself were inflamed. The urinary bladder was found to be much enlarged, and its walls much thickened. In parts it was adherent to the lower abdominal wall, and in its interior were several areas of deep ulceration of the mucous membrane. The paralysis succeeded immediately a forcible fall backwards on a large piece of rough slag during a quarrel some weeks before.

2. In this case the marks of violence externally were confined to the parts around the left eye, these being discoloured. Internally the lungs showed marked anthracosis. The urinary bladder contained about four ounces of ammoniacal urine. Dissection revealed a spinal fracture through the sixth and seventh cervical vertebræ. Around the fracture there was extravasation of blood into the tissues, and on the back of the body, among the deep muscles of the spine, was another and larger area of extravasation. Death in this, as in the former case, was due to paralysis and consequent exhaustion.

B. *Fractures of Ribs and Other Injuries in Lunacy Patients.*—1. In Nov. 1901 we examined the body of an elderly man, a patient in a lunatic asylum. On the left side of the chest were strips of adhesive plaster covering a breadth of 8½ inches, and extending from sternum to spine. There were slight abrasions of both lips, on both shins, on outer side of right ankle, and on outer side of right knee. There was extravasation of blood in the left temporal tissues and muscle, part of the muscle-fibre being reduced to pulp. This area of bruising measured five inches by four. Bruising, but not so severe, was also disclosed in right temporal tissues. The *dura mater* was found to be thickened, and to be adherent to *pia mater* in parts. The surface of both hemispheres was covered with fine lymph from inflammatory action. The vessels of meninges and brain were engorged. Fractures of the 2nd, 3rd, 4th, 5th, 6th, 7th and 8th ribs of left side were found. In the 2nd, 3rd, 4th, 7th and 8th, the fracture was situated at the junction of cartilages and bone, but in the case of the two others the fracture was in the bony substance of the ribs. None of the fractured ribs had penetrated the pleura. There were also fractures of the 2nd, 3rd, 4th and 5th ribs on the right side, those of the 2nd and 3rd at junction of bone and cartilage, and those of the other two in the bony structure. None of these had penetrated the pleura. Pleurisy and congestion of bases of both lungs were also found. Our opinion was that the cause of death was pleurisy and congestion of lungs consequent upon the extensive fractures of ribs, that the said fractures of ribs were due to direct violence, as was also the extensive and severe bruising of left and right sides of head, and that the most likely form of violence to have produced the fractures of ribs was a crush, or the forcible application of the knees of a person kneeling on the chest of the

deceased. On the same date, and at same time, we made an experiment with one of the whole ribs to ascertain whether or not any unusual brittleness or any other condition of ribs existed. The whole rib was forcibly bent until it broke. From the amount of force required and from the appearances of the fresh fractured surfaces, it was evident (*a*) that no unusual brittleness existed, and (*b*) that the constitution of the rib was normal.

2. In March 1905 we examined the body of a lunatic who was a patient in another asylum. Externally, the body showed bruising and blackening of both eyes, with ecchymosis of both conjunctivæ. Internally, there was extravasation of blood into left temporal muscle and tissues. The third, sixth, and seventh ribs of left side were fractured, the third, at junction of cartilage with bony part of rib, pus being found between the fractured parts, the other two, in the bony part about an inch to left side of junction. There was no pleurisy. The lungs were somewhat collapsed, were œdematous, and were congested at their bases. There was no unusual brittleness of ribs proved on testing as before.

3. Three days later, we had to examine the body of another lunatic patient in the same asylum. The body was somewhat emaciated. Two small bruises were found on top of left shoulder, and an area of yellowish discoloration, the remains of former ecchymosis, on upper part of front of chest, measuring six by four inches. On right buttock was a bed-sore, which measured two inches by one and a quarter. On making the usual incision in the mesial line of the body, extravasated blood was revealed in the line of incision in the deeper tissues of neck and chest wall. This area was found to extend from one inch below lower end of thyroid cartilage of larynx downwards to front of chest, and measured 7½ inches in length. In the chest muscles on right side, in the neighbourhood of the right nipple, was another area of extravasation measuring two by one and a half inches. There were fractures of the third right rib at junction of bone and cartilage, and of the third, fourth, and fifth ribs of left side at the same point. On the pleural surface of all the fractured ribs extravasated blood was found. Beneath the sternum an area of extravasation, measuring eight inches long by two inches broad, was revealed. Examination of the larynx showed externally patches of extravasation on each wing of the thyroid cartilage, that on the left side being larger and more elongated than that on the right side and internally extravasation of blood into the mucous membrane of both wings of the thyroid. The lower lobe of the left lung was found consolidated from the congestive stage of pneumonia. Our opinion was that the deceased died from pneumonia, and that the rib fractures, as well as the bruising of larynx and of chest wall, were the result of the application of considerable violence in the form of compression. These two cases formed the subject of an inquiry by the General Board of Lunacy. They regretted extremely that the perpetrators of the outrage on the second patient had not, owing to paucity of evidence, been brought to justice. With regard to the first patient the result of their inquiry was that he was an exceptionally violent man, and it was necessary for the attendants to exert all their strength in controlling him.

C. *Fracture of Tibia. Septicæmia. Death.*—In October 1908 we examined the body of a muscular strong young man, who had died in one of the hospitals of the city whither he had been taken about three days before. The right leg from the knee downwards was greatly swollen and much discoloured of a livid red colour. The epidermis over the front of the tibia was peeled off. Within this area were smaller areas of dark-coloured ecchymosis. The right foot lay in an unnatural attitude in relation to the leg. Movement of the limb showed that it was fractured. Around the ankle the skin was found in large vesicles which contained dark red fluid, and above the knee were some smaller vesicles of a similar colour. On dissection of the tissues of the limb, they were found highly reddened in colour and œdematous. An oblique fracture of the tibia was exposed at the junction of its middle and lower thirds, and the upper fractured end was riding over the lower. Around and within the seat of fracture was a quantity of reddish-coloured purulent fluid with a bad odour. The fibula was intact. Internal examination showed engorgement of vessels of meninges of brain, and some enlargement of the spleen. We gave it as our opinion that the cause of death was septicæmia, the result of septic cellulitis and incipient gangrene of leg, and that the fracture of tibia was due to direct injury.

Three men were charged with culpable homicide in that they had knocked deceased down, kicked him, and fractured his leg, in consequence of which he died. It was proved that one of the accused kicked deceased on the leg, that deceased immediately fell, and that deceased, anxious to get away, obtained the assistance of a man passing by who helped him home, a distance of about half-a-mile, carrying him most of the way on his back. We were bound to admit that had deceased been removed by ambulance to the hospital instead of being assisted home, a fatal issue would probably not have happened. Two of the accused were found guilty as libelled, and they were sentenced to a term of penal servitude.

Penetrating wounds of the abdomen may be homicidal, suicidal, or accidental; but they are more generally homicidal. Danger to life arises from three main causes—viz. shock, wounding of intestines or other organs, and septic absorption and peritonitis. By reason of the comparative thinness of the abdominal wall, it is often difficult to say what are the internal injuries. This difficulty is, perhaps, greater in gun-shot wounds than in others, but it is not little in any case. Where sharp-pointed instruments have been used and the instrument itself can be examined so as to ascertain the greatest depth it could reach, that point and the symptoms will assist one in forming an opinion of gravity of the wound.

1. Mr Mayo Robson reports [1] a case of penetrating abdominal wound occasioned by accident, in which the sharp end of a file, without a handle, having been caught in the revolving wheel of a lathe, was pushed through the clothes of a young man into the abdomen, but from the effects of which, with appropriate treatment, he recovered, although when seen at first he had all the symptoms of internal hæmorrhage and shock. Another case, with protrusion of the injured intestine produced by the goring of a bull, is recorded.[2]

2. *Homicidal Stab Wound in Abdomen. Death from Shock and Peritonitis.*—In May 1904 a young man, a Pole, during a quarrel, was stabbed by his father in the abdomen. Shortly after the occurrence he was driven in an ambulance to an infirmary in Glasgow, where he died soon after. On examination of his body, we found on the lower right side of abdomen, beginning at a point one and a half inches above Poupart's ligament, a wound which measured $3\frac{1}{4}$ inches in length, the direction of which was slantingly upwards following the curve of the right ileum. The wound had the appearance of having in whole or in part been produced surgically, being partly sutured surgically, and having protruding from its upper extremity two drainage tubes. On the front aspects of the fore and middle fingers of right hand were superficial incised wounds. On dissection, the abdominal wound was found to have passed through the abdominal parietes. On the inside of abdominal wall in the neighbourhood of the wound and extending towards the left side was an area of extravasated blood measuring 12 in. × 4 in. Peritonitis was general. There was, however, no wound of any part of the intestines. Several ounces of a blood-tinged fluid were present in abdominal cavity. We reported that death was due to shock and peritonitis following a penetrating wound of the abdomen, the dimensions of which we were unable, however, to determine on account of the surgical treatment, which, in our opinion, was necessary and skilfully performed.

The accused was charged with murder at the July sitting of the Circuit Court at Glasgow, was found guilty, and was sentenced to death. He was afterwards respited.

3. Another case of a similar kind was tried at the High Court, Glasgow, October 1908, the fatal abdominal wound having been inflicted with a razor. Accused pled guilty to culpable homicide, which plea was accepted by the Crown.[3]

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[1] *B. M. J.*, vol. ii., 1897, p. 76.
[2] *Ibid.*, 1898, p. 897.
[3] *Vide* also *B. M. J.*, vol. i., 1905, p. 627.

Ruptures of internal organs may be produced from violence by a blunt instrument being applied externally, and, as has been pointed out, without any visible external mark of violence.

The liability to rupture from violence of the different abdominal organs largely depends on (1) their measure of protection in the abdomen by overlying structures, (2) their condition at the time the violence is offered, and (3) the nature of the violence. We have already, on p. 270, noted the liability of intestinal rupture from directly applied violence. Of the abdominal organs the intestines are the most exposed; the other organs, while in their normal state, being more or less protected. The urinary bladder and the spleen are, perhaps, the two chief organs most liable to injury when abnormal, the former when distended, an occasion not uncommon in intoxicated persons,[1] and the latter when enlarged from malaria, and in the condition known as "spleen-cake." While rupture of the former from violence is not uncommon, there is usually a history of distension at the time. Rupture of the normal spleen, on the other hand, is rare in this country. A case, however, has come under our notice. A young married woman, advanced in pregnancy, was pushed by her husband during a trifling altercation. Her abdomen came in contact with the comparatively sharp corner of a table. She complained almost immediately of faintness, and before her husband arrived with assistance she was unconscious, and in a short time was dead. On post-mortem examination, a large quantity of fluid blood was found in the abdomen, the source of which was discovered to be a ruptured spleen. There was no external mark on the abdominal wall. (*Vide* also *B. M. J.*, vol. ii., 1905, p. 1668; "Comptes Rendus de la Soc. d'Obstet," Paris, Oct. 1905.)

Rupture, on the other hand, is relatively common in malarious countries. Crawford has made an investigation from the medico-legal records regarding ruptured spleen in eleven districts of Bengal. He examined 9876 reports of medico-legal cases, and found that in 304 cases, or 3·08 per cent., the cause of death was ruptured spleen. In the very malarious district of Hughli, the percentage was 7·56, while in the less malarious districts of Bihar the percentage was less than 3·08, the average of the whole of the districts. Of the 304 cases, in only 8 was the spleen found to be normal in size, and of the total cases a little over one-third were caused by blows with a heavy stick or similar weapon, one-sixth by blows with the fists or by kicks, 22 cases were caused by falls, while 17 had been run over by vehicles. Spontaneous rupture of the spleen has also been many times recorded.[2]

Woodruff relates the case of a Malay boy aged 10 years, who was seen to fall on some broken stones while running away from an American white man whom he had been annoying, and who died soon after from hæmorrhage from ruptured spleen. The American was charged with assault by kicking. He was tried before a native court and was held responsible for the result and sentenced to one year's imprisonment. He was, however, liberated on bail pending action on a petition for pardon.[3]

Rupture of the normal liver is in our experience rare from ordinary violence, but by no means uncommon from crushing of the body between

[1] *B. M. J.*, vol. i., 1906, p. 921.
[2] *Indian Medical Gazette*, June 1902; *B. M. J.*, vol. ii., 1902, p. 637.
[3] *Amer. Med.* (New Series), vol. i., No. 7, p. 400.

moving bodies, such as railway carriage or waggon buffers. In the case alluded to on p. 270 the following particulars will supply a picture of the occurrence and its sequel :—

Rupture of Liver from External Violence. No External Mark of Violence.—In the beginning of January 1902, a man was walking homewards accompanied by two friends. Coming in an opposite direction was a tipsy man, who, on approaching the three men, commenced to run, and putting down his head, butted one of them in the stomach, upsetting him backwards, his head striking the kerb of the pavement producing a lacerated wound. The assailant continued on his course and disappeared in the darkness. The injured man picked himself up, walked home with his friends, and went to bed about his usual time. His bedfellow was awakened by him about five A.M., when he asked for and received a drink of water. When his companion awoke later, he was found to be dead. On examination of the body, we found a lacerated wound of the scalp on back of head, measuring one inch in length, which, however, did not completely sever the scalp tissues. With this exception no evidence of injury was found on the body. On opening the abdominal cavity, fluid blood issued from the incision. The cavity was found to contain between 32 and 34 ounces of blood, clotted and fluid, and bloody fluid. A rupture of the liver was found. It had been torn or ruptured at the junction of right and left lobes, the rupture passing into the hepatic tissue for a depth of two inches, and measuring at point of greatest breadth nearly one inch broad.

Spontaneous rupture of the gall-bladder may occur where it is distended with gall-stones. Braithwaite has recorded such a case.[1] But the condition is rare.

There is one condition, fortunately rare, which simulates somewhat closely traumatic rupture of the liver, and which the medico-legal examiner ought to have in mind when faced with a hepatic lesion in a case the subject of medico-legal inquiry, and that is, aneurysm of the hepatic artery. Rolland,[2] in recording a case which fell within his experience, has collected 40 cases of this rare aneurysm. Where the aneurysm ruptures into the peritoneal cavity, he points out that on cursory examination the breach in the liver surface appears like an ordinary traumatic rupture. We refer the reader to his paper for details.

Rupture of the kidney in its normal position is also rare from ordinary applied violence. We have not seen a case, but it is not uncommon as the result of crushes or from falls of débris, and, in these cases, several of which we have examined, as in those of ruptured liver, there is usually accompanying extensive fracture of ribs on one or both sides.[3]

Rupture of the stomach, except when over-distended or dilated, is likewise uncommon from ordinary violence by blunt implements, but it is by no means unknown to have been caused by kicks.[4]

The following illustrative cases of rupture of the intestine and other internal organs are taken from our case-book :—

1. *Assault by Kicking, Rupture of Intestine, Death.*—In October 1907 we examined the body of a sparely-nourished young woman. It bore externally

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[1] *B. M. J.*, vol. ii., 1908, p. 1746.

[2] *Glasgow Medical Journal*, May 1908.

[3] *Vide* Griffiths, *B. M. J.*, vol. i., 1908, p. 979 (two cases) ; Dodgson, *ibid.* vol. i., 1906, p. 977.

[4] Pinatel, *B. M. J.*, vol. i., 1902, s. p. 73. ; Tubby, *Lancet*, vol. i., 1902, p. 1306.

various marks of violence. The right eye was blackened and swollen, especially from lower eyelid down on cheek to level of mouth. Over the right cheek-bone this discoloured area was abraded. There were bruises on the brow. The lower lip on left side was blackened and swollen. There were scratches on the chin, and a series of superficial abrasions on front and sides of neck from chin down to clavicles. There were many discoloured bruises on left elbow, forearm and hand, some of them as large in area as 3½ in. × 2 in., bruises on right arm and hand, and on both lower limbs.

In the middle line of the abdomen was a surgical wound, duly sutured, which measured in length 6¼ inches. On the abdominal cavity being opened, avoiding the surgical wound, general peritonitis was revealed. Underlying the surgical wound was a wound of the small intestine, measuring 2½ inches long, which was also sutured. This wound was at right angles to axis of bowel. There was no mark of violence apparent on the abdominal wall. We reported that death was due to peritonitis owing to a rupture of the small intestine, and that said rupture was due to violence suddenly and forcibly applied.

At the December sitting of the Circuit Court, Glasgow, the accused, husband of the deceased, was charged with the murder of his wife by striking her with his fists, pulling her out of bed to the floor, kicking her, and knocking her head on the hearthstone. The evidence showed that deceased was given to drink, that on the occasion of the assault she was lying in bed in a drunken sleep when her husband returned expecting a meal to be ready for him, that he struck her on the mouth with his fist, pulled her out of bed, that she then fell and her head came in contact with the hearthstone, and that while she lay on the floor he kicked her twice on the abdomen. The aunt of deceased stated that deceased often bore marks on her face from ill-usage, that on this occason, after being maltreated by her husband, deceased crawled out of the window, which was on the ground level, and came to her house, and that the day following she called medical aid, and deceased was ordered to be taken to hospital. The deceased in her dying deposition said: "He [her husband] trailed me out of bed, and he kicked me and smashed me." Prisoner was found guilty of culpable homicide.

2. *Fatal Assault by Kicking. Rupture of Small Intestine.*—In December 1908 we examined the body of an elderly man who had died from the injuries received by him from a kick. There was a surgical wound on front of abdominal wall commencing below the umbilicus and extending downwards in mid line of body for 3¼ inches. It had been carefully sutured in surgical fashion. There was no visible mark of violence on abdominal wall. On internal examination, there was revealed a recent injury to the intestine. At this point the intestine had been sutured, and around it there was an area of peritonitis. On removal of this part along with an uninjured portion of intestine above and below it, and on submitting the entire portion to a test it was found that the treated part of the bowel was water-tight. On examining interior of intestine, the original rupture was irregular in shape, and was at right angles to axis of bowel. It measured 1¼ inches long. The seat of rupture was in the small intestine about four feet downwards from pyloric end of stomach when intestines were removed from the mesentery. We reported that this rupture had been produced by the application of a suddenly-applied force, probably of a pointed character, to the abdominal wall, that death was due to peritonitis and shock, and that the operative procedure was necessary to give the injured man a chance for life, and was skilfully performed. The assailant was tried at the Circuit Court, Glasgow, in Feb. 1909, the charge against him being that he assaulted the deceased and kicked him on the abdomen and ruptured his intestines, and did murder him. He pled not guilty to the charge of murder, but after consultation with his counsel he intimated his willingness to plead guilty to culpable homicide, which was accepted by the Crown. His counsel stated in mitigation of sentence that accused was under the influence of drink at the time he committed the assault, that he had gone into the shop of deceased, that deceased took him by the shoulder and asked him to leave the shop, and by way of retaliation, accused then kicked deceased, for which he was heartily sorry. The judge, who characterised the assault as a cowardly and a dangerous one, sentenced accused to 7 years' penal servitude.

Vide also the following :—Rupture of Large Intestine : Battle, *B. M. J.*, vol. i., 1908, p. 1412 ; Rupture of Small Intestine from Kick of Horse: *ibid.* vol. ii., 1909, p. 268. From Various Causes. (Berry and Giuseppi, *Proc. Roy.*

Soc. of Med., Nov. 1908: Analysis of 132 Cases in London Hospitals, 1893-1907.)

3. *Rupture of Urinary Bladder by Kicking.*—At the Circuit Court, Glasgow, in Feb. 1905, a man was tried for the murder of a woman in a house in Greenock. The evidence of witnesses was that the accused kicked her. From the post-mortem report, we found that the skin of the abdomen was in various parts slightly roughened on the surface, and on internal examination that the upper surface of the urinary bladder was ruptured, the tear measuring two inches in length, and the edges of the tear were irregular. Peritonitis was general.

The assailant tendered a plea of culpable homicide, which was accepted, and he was sentenced to 7 years' penal servitude. We are indebted to Dr Cook for the particulars of the post-mortem examination.

4. *Death from Crush between Waggon-buffers. Trifling External Injury. Severe Internal Injuries* (Jan. 1909).—This was the body of an elderly man, employed on a colliery siding in waggon-shifting, which was found lying close to the outside rail of a rail-track. The external surface of body was remarkably pallid in appearance. The only mark of injury observable was a dull reddish-blue mark over the seventh right rib in a line downwards from right armpit. There were no injuries found internally in the head. On dissection of the thorax it was found that all the cartilaginous part of the ribs was ossified. An area of bruising of about two inches square was found in the mediastinal tissues at middle of sternum. Large amounts of liquid blood were seen to be present in both pleural cavities. The lungs bore the very black colour characteristic of persons who have worked for a long time underground in a coal-pit. Each cavity of the heart was empty of blood. There were eight ribs fractured on right side of chest, in four of which the fractured ends had penetrated the pleural cavity. In each case the fracture had occurred at the angle. Nine ribs were fractured on the left side, as well as the left clavicle near its junction with the sternum. Here, also, the fractures were at the angles, but none of the fractured ends had penetrated the pleural cavity. The abdominal cavity contained many ounces of fluid blood. The anterior surface of liver was marked with clotted blood. The liver had been badly ruptured in five different places, the main rupture, however, taking place at the point where the left lobe had united with breadth of substance the right lobe; the other ruptures in the substance of left and right lobe, two in each respectively, were more linear in character, but extending to a length of 2½ inches. Both kidneys were ruptured, the left in two places, the right in one. The urinary bladder was uninjured. It contained twelve ounces of urine. At the Fatal Accidents Inquiry, we gave it as our opinion that death was due to shock and hæmorrhage from the extensive and severe injuries, and that these were most likely to have been caused by the body of deceased having been caught between the buffers of moving waggons.

But abdominal wounds may be inflicted upon females by the forcible introduction of instruments *per vaginam*.

At the Liverpool Assizes, March 1896, a man was arraigned before Mr Justice Kennedy on the charge of murdering his wife by plunging an instrument into her abdomen by this channel, and by otherwise assaulting her.[1] Post-mortem examination of her body showed between forty and fifty recent bruises on the limbs, and four wounds in the vagina. Three of these wounds could admit the little finger, and the fourth was much larger. Two of them entered the peritoneal cavity, and there was evidence to show that the point of the instrument had reached as high up as the pyloric orifice of the stomach. The medical witnesses for the Crown were of opinion that the internal injuries were caused by a poker, and that it was physically impossible for them to have been self-inflicted. The medical witnesses for the accused affirmed that they might have been, and possibly were, self-inflicted in the effort to procure abortion, as the deceased had stated to a female witness that she would take care that she should have no more children. This, coupled with the fact that the deceased

[1] *The Lancet*, vol. i., March 28, 1896.

was of intemperate habits, doubtless enabled the jury to return a verdict of "not guilty."

Occasionally very rare forms of wounding are reported.

Biondi relates the case of a man of 64 years, whose penis was pulled off by an energetic young woman, with whom he was attempting sexual intercourse. The case was brought before the court, and the assaulted and assailant gave a different version as to how the affair actually happened. The story of the woman was that the man was trying to seduce her, and that in self-defence she pulled forcibly at the penis, which came away in the struggle. From experiments made by the medical witness with a view to elucidate the question, it was found that the nature of the injuries sustained by the man were exactly similar to those produced by forcible avulsion, and that while avulsion of the flaccid organ was beyond the power of an ordinary person, avulsion of the erect organ was quite within the power of a person of average strength.[1]

On the whole general question of wounding with respect to accidental, suicidal, or homicidal causation, it may be said that the field is too wide, both as to kinds of wounds and as to surrounding circumstances, to permit of the statement of such guiding principles as might be of absolute value to the student. It is in this particular that the powers of observation and logical faculties of the observer are most brought into play, and in the ratio in which he is able to display both will he be likely to prove helpful to the criminal authorities, and more especially where the evidence is purely circumstantial. But in this last-mentioned contingency it behoves him to proceed to his conclusions with caution, since circumstances are apt at best to prove deceitful and delusive. It is more satisfactory for the purposes of retributive justice that a suspected person should receive the benefit of any doubt than that an innocent person should suffer; therefore, while facts may point to certain logical conclusions, it is better not to unduly press them.

There are not a few cases, however, in which there cannot be the remotest doubt in the mind of the examiner that the wounding seen on the body has been homicidally produced, by reason of the position, serious character, and multiplicity of lesions found. Most commonly there is no eye-witness of such deeds; and should circumstantial evidence lead to the apprehension and trial of a suspected person, while there can be no doubt regarding the lesions on the body of the deceased, there may be regarding the manner in which they were caused, or the kind of weapon by which they were produced. It will be remembered, for instance, that in the Arran murder case, which was tried before the High Court of Justiciary in Edinburgh in 1889, the mode of causation of the fractures and bruises found on the body of the murdered man was the subject of considerable difference of opinion among the medical witnesses. The following three cases from our case-book illustrate different points:—

1. One of the most brutal murders that has come under our notice is revealed in the following facts:—In Nov. 1904 a woman, who kept a milkshop in a burgh adjacent to Glasgow, was found dead in her shop with marks of great violence on her body. We examined the body where it lay, before ordering its removal to the mortuary for examination and dissection. It was lying on the

[1] *La Clin. Mod. An.* 12, No. 18; *B. M. J.*, vol. ii., 1906, s. p. 26.

floor of the shop behind the counter. The arms projected upwards from the body when the body lay on its back. This was caused by the fact that the wrists, which were placed close together, had been firmly bound together by some strong cordy material, and the arms had stiffened in that position. *Rigor mortis* was generally present in the body when inspected by us. The wrist-ligature looked like trimming cord used by dressmakers for edging certain articles of clothing. It was tied by a " granny " knot. On undoing the knot, it was found that the binding had been effected by two separate pieces of cord of different lengths. One of the cords was passed twice round the wrists, the other only once, before in each case being tied. The clothing around the neck and on upper part of body was much saturated with blood. When the body was removed, there was found lying beneath it an axe-hammer, with a wooden shaft which was broken in two pieces. The weapon was covered with blood. Lying on the floor was an empty glass siphon-bottle, on the bottom edge of which was a mark of blood, and on the neck a bloody finger-print. On the floor of the short lobby leading to the back apartment in which the deceased lived was a footprint in blood, and on the brass handle of a door leading to the common entry to the tenement dwelling above was a second bloody finger-print. Certain articles of furniture in this back apartment had been ransacked, the contents of their drawers having been scattered over the floor. Examination of the body in the mortuary showed that the brow and top of head were one mass of wounds, there being little whole skin over the entire front half of the scalp from the eyebrows backwards, but no other marks of violence on any other part of the body. There was some blood on hands and fingers, especially the left. A detailed account of the wounds on head would be tedious ; it is sufficient to say that the whole front half of scalp was reduced to ribbons and pulp, and that the entire top of skull was broken by eleven fractures of varying lengths, the broken bones lying loose in the scalp tissues. Some of these fractures extended into base of skull. The frontal lobes of the brain were much lacerated, and the surface and base of brain covered with effused blood. From the appearances of the wounds, it was apparent that some, if not most of them, had been produced by a relatively sharp-edged weapon, and some by a blunt weapon. Such wounds were likely to have been produced by the axe-hammer found, one end of which was of axe formation, the other of hammer-head shape. The sexual parts were virginal. The assailant has not yet been found.

2. Earlier in the same year we had to examine the body of another woman, the victim of horrible brutality. The face, trunk, arms and thighs were covered with dirt mixed with blood, and although the legs and feet were dirty there was no blood upon them. After the body was washed, its surface was seen to bear many wounds. In particular, the surface of face was covered with wounds and bruises ; there were several wounds on the left side of face, all lacerated in character, the left ear was almost completely torn away from the head, and the cartilage itself split up in various directions ; the wounds on right side of face were fewer in number, but the upper half of the right ear was also torn away from the scalp. The upper lip on its inner surface was smashed into pulp, and protruding from between the lips was a fractured portion of upper jaw to which some teeth were attached. A point of some significance regarding several of these wounds was their almost uniform size and shape. They measured $1\frac{3}{4}$ inches in length, and were crescentic in form. The front of the chest and neck, from a line drawn one inch below the nipples upwards to the line of the lower jaw, was covered with bruises ; indeed, there was hardly one square inch of normal skin at any one part : and on the left side was a crescentic-shaped wound of the same length as those on the face. The thighs and arms bore very many bruises, many of which were of the same form and shape as the wounds on face and body.

Dissection of scalp revealed a pulpy condition of left temporal muscle with much extravasation and similar, but not so marked, bruising of right temporal muscle. There was no fracture of any part of skull. Dissection of the face showed extensive bruising of tissues, especially of left side, with the following compound fractures on left side :—(*a*) floor of left orbit, (*b*) of zygomatic process (comminuted), (*c*) of upper maxilla (comminuted), (*d*) of lower maxilla, on right and left sides (comminuted), and (*e*) of nasal bones. There were fractures of the second, third, and fourth ribs of right side, each rib in two places, and of the second and third ribs of left side. The stomach contained some blood, which

had probably been swallowed during life. On examining the *locus* of the crime, we found the floor of the apartment, the lower parts of one of the walls, and some furniture much bespattered with blood. We were of opinion, from the appearances, uniform size, and uniform shape of the wounds and bruises, that the violence had been inflicted with one and the same instrument, not improbably the toe of a boot.

A few days later, certain articles of clothing and the boots worn by the prisoner on apprehension were submitted to us for examination (*vide* p. 361). The boots, which were of a heavy make, plated at toes and heels with iron plates, and soled with nails, were found by us to be thickly covered with blood. The prisoner, Thomas Gunning, paramour of deceased, was tried for murder in July of that year. He was found guilty, and was sentenced to death, and, later, was executed.

3. *The Case of Oscar Slater.*—On December 22, 1908, we were asked to visit and inspect the house at 49 West Princes Street, Glasgow, in which on the previous night a murder was alleged to have been committed. The premises were then in possession of the police. The body of an elderly lady was found lying outstretched on the rug before the dining-room fire. It was identified by three witnesses as the body of Miss M. G.

The body and furniture in the room was left as they had been discovered, with the exception of a chair and a hair-rug which had been displaced from their original position, and of a coal-box, the position of which had been slightly altered.

The head was pointing diagonally toward the fireplace and the feet toward the door of the room. The right arm was extended at right angles from the body, and the left arm was lying alongside and parallel to the body. The left leg was crossed over the right below the knees.

The head and face had been very much smashed. There were wounds on right cheek extending from the mouth, wounds of right forehead, and of the right side of head. There was a deep hole on left side of face between the eye socket and left ear. The left eyeball was entirely amissing, having either been driven into the cavity of the brain or having been gouged out. The right eyeball was partially torn out of its socket by a deep fracture of the right side of the brow. There was much blood on and among the hair of the head. Between the point where the head lay and the fender of fireplace were found a piece of brain tissue weighing about three-quarters of an ounce and other smaller pieces. Between the head and fender there was also found a complete gold plate of artificial upper teeth. On the carpet rug beneath the head on both sides was a considerable amount of clotted blood, and fluid blood had soaked into the fabric of the rug. The fire-irons were in their places. They were bespattered with blood, as were also the grate and the fire-bars. No part of the fire-irons had been used as the weapon. The legs of the chairs, the carpet, one of the legs of the table, and the outer surface of the hanging portion of the table-cloth facing the body, all of which were in the vicinity of the body, were also bespattered with blood, the spots showing from their shape that they had forcibly come in contact with the surface of the articles. All these signs indicated that the injuries had been inflicted where the body was lying, the injuries having been produced by very forcible application of some instrument. The surfaces of both hands were remarkably pallid. There was no blood on the right hand or fingers, but there was dried blood between the fingers of the left hand. When the body was first discovered, a skin rug was found thrown over the body, and more or less covered the body. Blood was found on and among the hairs about the middle of the rug. The spectacles of deceased were found lying on the table in front of an open magazine. The chair, referred to as having been removed from its place, originally stood, when the body was found, at the side of the table in front of the magazine, standing on its four legs. Examination of the room in which the body was found, and of other rooms, was made for any likely weapon. From our examination it did not appear that any of the fire-irons had been used for the purpose of inflicting the injuries found, as the marks of blood consisted merely of discrete spots of inverted soda-water-bottle shape. Nor had any of the mantelpiece ornaments been used. We were shown by the police a much-rusted piece of a large steel auger or screw-bit which they had found in the open space behind the house in a line with the kitchen window. Adhering loosely to this instrument were several grey hairs.

We instructed that the body should be removed to a mortuary for further examination and dissection.

The post-mortem examination was held the following day.

The body was that of a well-nourished elderly woman. *Rigor mortis* had entirely disappeared. The skin was markedly pallid. The following marks of violence were seen externally: Speaking generally, the face and head were both badly smashed. In particular, the following injuries were found:—(1) Extending from right angle of mouth backwards on right cheek for two and a quarter inches was a gaping, ragged wound, divided into two parts by a bridge of skin one and a half inches broad, the mouth cavity and the wound being one continuous cavity. At the base of this wound were several fractures of the lower jaw, upper jaw, and cheek bones, the bones being driven into the mouth; (2) on inner side of right orbit was a lacerated wound, irregular in shape, one and three-quarters of an inch long and three-quarters of an inch broad, which extended deeply into the base of nose. On deeper examination, it was found that the bones of the orbit, the nose, and the forehead at this point were completely smashed in and broken into many pieces; (3) from the upper part of wound (2), a wound extended upwards on brow and head for a distance of three inches and towards the right temple for a distance of two inches, in which the right frontal bone had been broken asunder from the rest of the bones of the skull and exposed the brain and brain-substance, of which latter a considerable portion had escaped; (4) the lobe of the right ear was completely torn asunder from the cheek attachments; (5) three-quarters of an inch in front of right ear was a spindle-shaped wound measuring three-quarters of an inch long and one quarter broad, which extended deeply into the tissues down to the bone; (6) behind this ear was a series of wounds; (*a*) at a distance of half-an-inch, a spindle-shaped wound of like dimensions to last, (*b*) a wound of similar shape one inch long by one-quarter inch broad, and (*c*) a like wound half-an-inch long by one-eighth inch broad; (7) half-an-inch behind the series just described was an irregular-shaped, lacerated wound which measured three and a half inches long by one inch at greatest breadth, and which was divided in the middle by a bridge of tissue, at the bottom of which several fractures of the bones forming the right temple and back of the head were found, some of the broken pieces of which were driven in on the brain; (8) on the top of the head, behind the line of hair at top of right brow was a lacerated wound one and a half inches long by one inch broad, which led down to a fracture of the bone communicating with the cranial cavity; (9) half-an-inch to right side of wound (8) was a lacerated wound two inches long by five-eighths of an inch broad, at bottom of which was a large fracture of skull from which brain-matter was protruding; (10) on the left side of face were the following injuries:—(*a*) a lacerated wound of irregular shape at left side of nose and left lower eyelid, which measured two inches by three-quarters; in this wound the entire eyeball and parts of both eyelids were found to have been driven into the brain cavity, the eyeball itself being burst and collapsed. Further dissection of this showed that the floor of the left orbit had been completely broken away from surrounding bones, and also a fracture of right frontal bone which extended across brow into left frontal bone; (*b*) on the left cheek, one inch from outer angle of left eye and on the same level, was a lacerated wound which measured two and three-quarter inches long by one and a quarter inches broad, the backmost part of which extended into the middle and upper portions of the left aural appendage; at bottom of this wound fractures of upper jaw and upper part of lower jaw were found, the pieces of which were loose; (*c*) one inch above the upper level of the last wound was a spindle-shaped wound which passed down into the deeper tissues and which measured half-an-inch by one-quarter of an inch, and at the lower edge of this, another wound of like shape and dimensions, but not so deep; (*d*) on upper left temple, two inches back from outer side of left eye, was a semicircular-shaped wound with comparatively clean-cut edges which measured two and a quarter inches round its outer edge, in the base of which was an area of exposed skull in which was a linear fracture.

The entire hair of the scalp, which was greyish at the roots, was saturated and covered with blood, the scalp itself being also covered with blood.

Internal Examination. *Head Cavity.*—The deep tissues of scalp, more or less over the entire head, were much bruised and discoloured with effused blood, but more especially over the vertex and right side of head. The

meninges were torn through in different places where were the fractures. The brain itself was greatly torn and disorganised. Several portions were amissing, especially from the right frontal region. Several pieces of bone of different sizes were found driven into the brain-substance at different points. On removal of brain, it was found that the skull was fractured through its base from front to back. The skull-bones were thicker than in the average female skull. *Chest Cavity.*—The sternum was fractured completely through its entire thickness about its middle, the area of fracture being surrounded with effused blood. On the right side of chest in front, fractures of the third, fourth, fifth and sixth ribs were found, the third rib being broken in three different places, the fourth and fifth each in two places, and the sixth in one place. On the left side, the fourth rib was found to be broken close to the junction of bone and cartilage. The left mamma was found to be bruised, the surface tissues being discoloured. The heart was very healthy for an old woman. *Abdominal Cavity.*—All the organs of this cavity were examined separately and in detail. The stomach contained some partially digested food; both kidneys were granular from chronic kidney disease; the rest of the organs were normal. We reported that the cause of death was extensive wounds and fractures of bones of face and skull, fractures of sternum and ribs, and shock and bleeding therefrom; that said injuries were produced by forcible contact with a blunt weapon repeatedly applied; and that the violence had been applied with considerable force.

Suspicion having fallen upon a man who then called himself Oscar Slater, and it having been found that he was on his way to New York, the police authorities caused him to be apprehended on his arrival at that port, and his luggage to be seized and placed under the care of the New York police. On being confronted by witnesses taken from Glasgow, he was identified to the satisfaction of the magistrate in New York, and was duly extradited. When his luggage in the hold came into possession of the detectives who were sent to New York to bring him back to Glasgow, the following articles among others were found in his trunks—viz. (1) a waterproof coat, (2) a hat, (3) a claw-hammer. These, together with hair taken by us from the scalp of deceased at time of post-mortem examination, and the auger found by the police were submitted to ourselves and Professor Harvey Littlejohn for examination and report. We duly reported as follows:—

Waterproof Coat.—This appeared to be a comparatively new coat. On inspection small faintly-coloured stains were visible on different parts of the garment externally and internally. These numbered twenty-five in all. They varied in size from five-eighths of an inch long by one-quarter inch broad down to large pin-head size, and varied also in shape, many of them having the appearance of spatters. To the naked eye most of them presented a faint brownish-red colour, the remainder being blackish in colour. The latter on further examination proved to be rubber. After treatment of the brownish-red stains and on microscopic examination, corpuscular bodies resembling in general appearances and in measurement mammalian red-blood corpuscles were found in certain of them. We were unable, however, to affirm positively that these were red-blood corpuscles because, by reason of the very small amount of material at our disposal, confirmatory tests for blood, even spectroscopic, could not be employed. The stains bore the appearance of having been sponged or washed.

Hat.—No stains were found upon this article.

Hammer.—From the head of hammer to about half-way down the shaft, the shaft had the appearance to the naked eye and by a hand-lens of having been scrubbed, the surface of the wood being roughened and bleached, as if sand-papered. Yellowish stains were found on both sides of head and on both flanges. Portions of these stains as well as some adherent matter found between the claws were scraped off and examined microscopically. In addition to particles of rust and of a tissue which in our opinion was vegetable in character, a few corpuscular bodies were found. These resembled microscopically and by measurement red-blood corpuscles of the mammalian type.

Measurements of Hammer. Head.—Total length of head including claws three and a half inches; diameter of rounded extremity, three-quarters of an inch; length of claws, each, one-quarter of an inch; length from edge of one claw across gap to outer edge of other claw, three-quarters of an inch; length of shaft and head, nine and a half inches.

Auger.—This measured thirteen inches long, and was thickly coated with scaly rust. To it was attached by means of a piece of string (the string placed there by police) a small quantity of loosely intertwined human hairs. Examination of scrapings of matter from surface of angur gave no indications of presence of blood. The hairs above-mentioned were found to be greyish in colour, to measure in length from eighteen inches downwards, and to have well-defined diameters. Some of them possessed roots which on microscopic examination proved to be healthy. These were compared with the hairs retained from the post-mortem examination, and were found to correspond generally in length, colour, and diameter.

The question arose at the trial, whether it was possible that such a weapon as the hammer found could have produced the injuries found upon the body of the deceased, and, if so, whether the hammer was the likely weapon. It will have been observed that several individual wounds found on the head and face of deceased measured three-quarters of an inch in length and had a spindle-shaped character, and that the left eyeball, together with portion of the upper and lower eyelids, had been driven into the skull cavity, the floor of the left orbit being completely broken away from surrounding bones. The average measurements of the skeletal orbit will be found to be as follows:—from roof to floor (that is, perpendicularly), one and three-eighths to one and a half inches, and from side to side (that is, horizontally) one and five-sixteenths to one and a half inches; and its depth about two inches, contracting as it goes backwards. The nature of this injury indicated the use of a pointed weapon. The striking part of the head of the hammer on its edge was three-quarters of an inch. This corresponded to the size of the individual wounds named. Since portions of the upper and lower eyelids had been driven into the skull cavity, along with the eyeball and since the floor of orbit had been fractured, only a weapon of relatively pointed character could have produced the injury. The head of the hammer measuring three-quarters of an inch in diameter would just fit the orbit and carry before it the eyeball together with the portions of eyelids referred to. We stated as our opinion, for the reasons given, that such a weapon as the hammer could have produced the injuries named. It will also be noted that the claw portion of the hammer also measured three-quarters of an inch in breadth. Such an instrument as the hammer, in the hands of a powerful man, could in our opinion have produced the injuries found on the body of deceased. We were unable to account for the presence of the hairs upon the auger.

The accused was tried at the High Court of Justiciary in Edinburgh, before Lord Guthrie and a jury on May 3, 1909, and after evidence, was found guilty and sentenced to be hanged. The sentence was, however, respited to penal servitude for life.

It hardly requires special training in certain cases to divine the causal relationship of such a case as the following, where a man clambers on to a roof, rests against the chimney-head, there deliberately cuts his throat, and then falls in a dying condition into the public street, since the facts unmistakably point to suicide while in a condition of insanity; on the other hand, it does require the exercise of all the powers of observation to be able to say, when a body with mortal wounds upon it is found in a room with the door locked on the inside, whether the wounds are homicidal or suicidal, since murder and suicide have happened under such circumstances. A murderer may escape from an apartment by descending a convenient wall pipe. Nor is it difficult to say in a case in which a dead body is found with a wound or wounds upon it, and in the hand of which a weapon is found firmly grasped, that death is due to suicide; or where two bodies are found marked with woundings, in the hand of one of which a weapon is present, that we are dealing with a case of murder and suicide. But beyond such cases there is a large class in which the medical evidence derived from

examination of the body is simply corroborative of the crime as beheld by eye-witnesses, compared with which the class of cases in which the medical evidence is of chiefest importance is but small. There are strange vagaries in suicidal woundings. In some cases, unless the fact of suicide had not been known as certain, the magnitude of the injuries



FIG. 87.—Shows entrance wound of a revolver bullet which passed through the head. Size of wound is indicated by circular disc of white paper placed in wound.

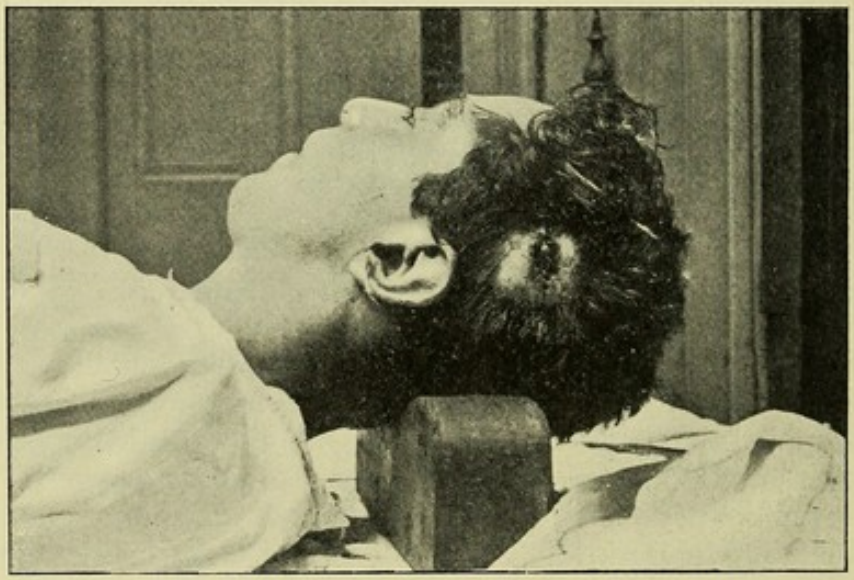


FIG. 88.—Shows the exit wound of a revolver bullet which traversed the head. (Fig. 87.) Wound of exit in this case was larger than that of entrance, the edges being everted.

found upon the body would point to accident or homicide as the more likely cause; for example, where a man puts a quantity of blasting gelatine in his clothing, or dynamite into his mouth,[1] deliberately explodes it, and is blown to pieces; or, as in a case reported from

[1] *B. M. J.*, vol. ii., 1881, p. 159; *Med. Press and Circular*, vol. i., 1887, p. 80.

Milwaukee, where a man makes a small cannon, charges it with bullets and powder, places the muzzle to his abdomen, fires it, and is blown almost in halves; or where suicides precipitate themselves from a height, or down pit shafts, or before a railway train. Where the suicide is the outcome of suicidal mania the woundings are often very shocking. An extraordinary case occurred in the Glasgow Lunatic Asylum, Gartnavel,[1] where a patient with a hammer and spike so battered his head that the brain-substance protruded: but he recovered, apparently little the worse; in another case, a man drove a dagger through his skull into the brain with a mallet, and succeeded in driving the weapon practically up to the hilt. He also recovered.[2]

Some words must be said respecting the diagnosis of suicidal gunshot wounds from marks of scorching, smoke, or engraining or tattooing with particles of unconsumed gunpowder While some, or all, of these signs may be noted—indeed, are likely to be seen—in wounds fired at close distances with cartridges containing black gunpowder, it ought to be borne in mind that, by the use of smokeless powder in modern cartridges, such marks as are due to the imperfect combustion of the black powder will be awanting. Fig. 54 illustrates tattooing by gunpowder. Major Blenkinsop, R.A.M.C.,[3] has recorded three cases of suicidal gunshot wounds in which small-bore rifles—Lee-Metford—bullets of small calibre and cordite powder were used, and in which the missile in each case was fired at close distance. In none of them was there any blackening or charring or tattooing of the tissues in the neighbourhood of the wounds. The recorder adds that where cordite ammunition is used it is no longer possible to judge the distance of the part struck from the point of firing, by reason of the absence of the above markings.

Therefore all that can be said is, that the whole circumstances of the wounding, and the environment of the body when found, must be completely observed, considered, and weighed, before a pronouncement of opinion is made with respect to accidental, suicidal, or homicidal causation.

[1] *Glasgow Med. Journal*, 1858.
[2] *The Lancet*, vol. ii., p. 845.
[3] *B. M. J.*, vol. i., 1900, p. 434.

CHAPTER XI

BLOOD-STAINS, AND EXAMINATION OF BLOOD

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

The relation of the direction of a spray of blood to the position of a wounded body when found, and the presence of such in the vicinity of the body or the place where the body is found, ought to be carefully noted on a rough plan sketched upon the spot, after measurements have been duly taken, because such may indicate the position of the person at the time of wounding, or the place where a given wound might have been caused. The cases already narrated illustrate these points. This is especially important where, in a charge of homicidal assault, a plea of accident is set up. In a case recorded by Ogston,[1] he was able to locate the place where the violence had been offered, although the body was found in a field about thirty yards away, by the fact that on the side-posts of the door of the house and on the wall-plaster adjacent, he found jets of blood at a height of four or five feet from the ground. The attack had been made by a weapon, such as the back of an axe, and although the victim had died at the spot where the body was found, judged by the large quantity of blood found, it was evident that he had been able to flee from his adversary before succumbing to the effects of the violence. In the cases already given (pp. 281, 285), it was quite evident that in the former, the only place where the only wound found on the body could have been produced was the wooden facing of the window of the bedroom, and in the latter that the violence had been inflicted upon the victim while her assailant, chasing her round the apartment, was battering her head and face with a brick. In the examination of blood-stains on wood or on any other surface, any hairs or other substances present ought to be taken possession of for future examination, as they may prove of value in elucidating certain points. Loudon[2] affirms that with some experience it is not difficult to differentiate between the hairs of man and those of the lower animals, nor even to decide to what species of animal a given specimen belongs. This we can corroborate; but it can only be accomplished after careful and deliberate study of a great variety

[1] *Op. cit.* p. 468.

[2] *Archives d. Sciences Biolog.*, vol. vii., No. 2.

of different animals' hairs. He declares that if a hair-bulb has been forcibly extracted, the bulb will be irregular, will possess an undulating surface, and will show excrescences of different shape and thickness; and that a naturally-shed bulb will be small with a rounded extremity and will have a smooth surface. On the other hand, in addition to the appearances microscopically of the bulb itself, we attach more importance to the condition of the sheath of the bulb. In a forcibly-plucked bulb the sheath will be found ruptured, as shown in Fig. 60. Hassall [1] gives a drawing of the sheath of a hair which was forcibly extracted, which shows the rupture of the sheath as seen in the above figure. It ought to be noted that polarised light is absolutely necessary to distinguish fine differences in hairs. So, likewise, bloody footprints, or footprints in blood, ought to be carefully measured in view of the possible raising of questions having reference to the identity of an assailant or assailants. This question, however, rises to higher importance, probably, in the detection of blood-stains upon clothing or other fabrics, weapons, leather, plaster, or wood, for in this way a suspected person may occasionally be associated with a given crime, while the evidence, otherwise, is circumstantial.

COLOUR OF BLOOD-STAINS

The colour of blood-stains varies, and depends upon a number of circumstances, the principal of which are the following—viz.

1. The age of the stain.
2. The amount of blood composing it.
3. The nature and colour of the material upon which it has been effused.

Generally speaking, recent stains are reddish in colour, old stains, brownish. On certain cloth-fabrics, stains of blood are less visible in daylight than by artificial light, as, for example, on brown, blue, and dark-coloured stuffs generally; whereas on others, they are best seen in good daylight, as on light-coloured fabrics, on leather, wood, iron, or stone. By reason of their albuminous composition, blood-stains, when dry, impart a stiffened or starchy feel to thin fabrics, such as those composed of cotton, wool, silk, or linen; and even on thick worsted or woollen tweed-stuffs, blood mats together the fibres, as seen through a hand-lens. On iron, steel, or metal generally, they look like dark, shiny spots or smears, and when desiccated are often found fissured or cracked.

The fact that a stain or mark has a reddish or brownish colour goes no further, however, than establishing in the mind of an examiner an *a priori* suspicion that it may be due to blood, and the need for further detailed investigation. There are many other substances which produce such coloured stains on the materials upon which, if liquid, they have been shed or smeared, such as jams, jellies, vegetable colouring solutions like those of cochineal and madder, solutions of various coloured dye-stuffs, aniline dyes, rust, snuff, fœcal matter, high-coloured urine, organic

[1] "The Microscopic Anatomy of the Human Body," vol. i. Plate xxviii.

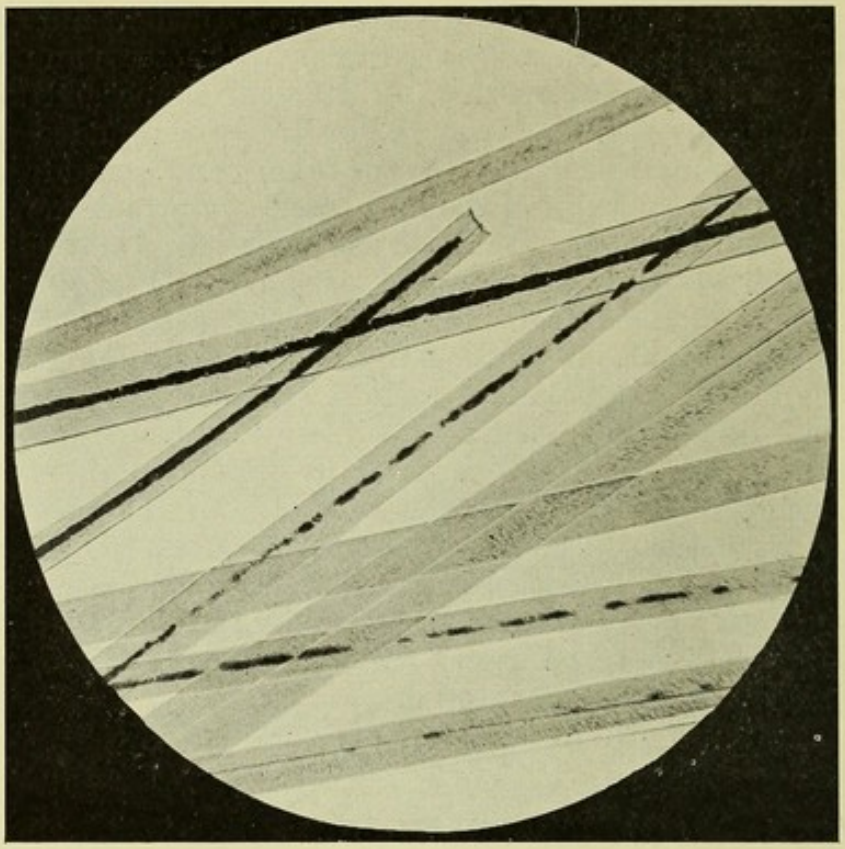


FIG. 89.—Photo-micrograph of Human Hair becoming Grey from Age. Pigment is disappearing. ×500 diameters. (Author.)

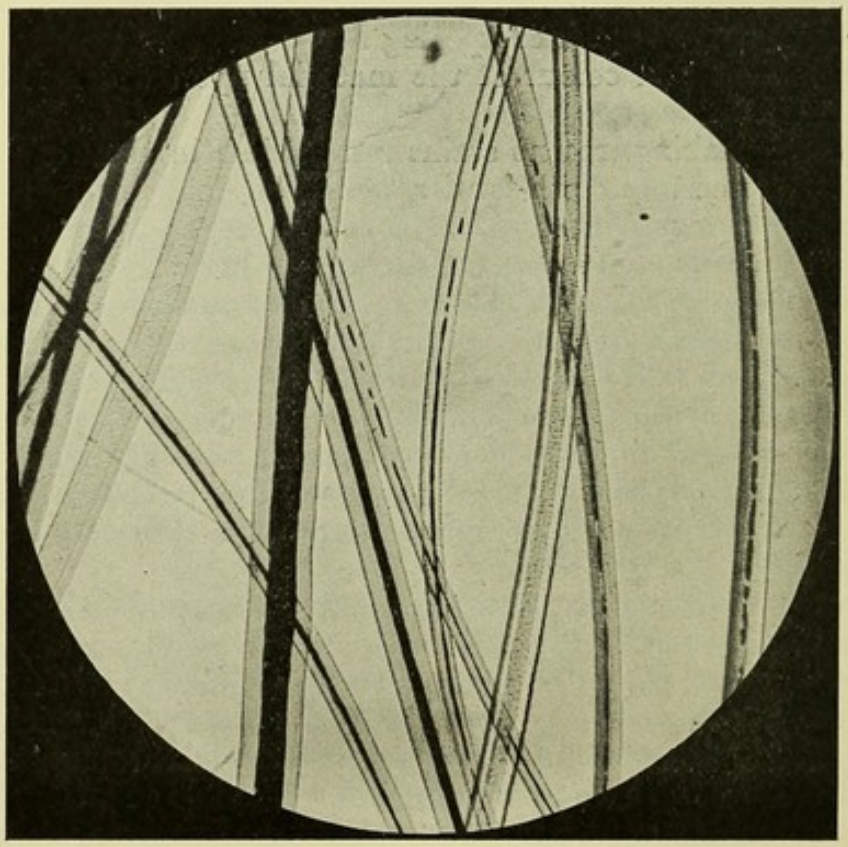


FIG. 90.—Photo-micrograph of Hair of Polar Bear. ×500 diameters. (Author.)

salts of iron, and various solutions of chemical substances. Nor do these named exhaust the list. In addition to the coloured matters which most readily simulate stains of blood, there are other materials which, under differing sets of circumstances, leave such appearances upon fabrics or weapons, as to compel the medical jurist, when pursuing an investigation for blood, to examine and test them fully and completely. Such are the marks produced by dark-tinted paints, tar, pitch, and grease on dark-coloured fabrics, and dried solution of rubber at the seams and other parts of mackintosh garments; and experience compels us to say that an investigation is not rendered easier by the discovery that on a single garment, it may be, or on different garments belonging to an accused person, stains or marks due to more than one of these substances, as well as to blood, are discovered, because then each stain will require to be examined.

As a final word of precaution, we urge that no one should undertake the investigation of the character of stains in cases where the issue may involve the life of an accused person unless after long experience in this line of inquiry, and that, such an enterprise having been undertaken, should the result be in any measure doubtful the accused should receive the benefit of that doubt.

EXAMINATION OF BLOOD-STAINS

What course ought to be systematically followed in the Examination for Blood-stains, and in the Identification of coloured stains with Blood? In the first place, caution and carefulness must be exercised throughout the whole inquiry, for, if an opportunity offers, a guilty person will attempt to wash away the evidences of his guilt. In the examination of clothing, therefore, it is very necessary to examine especially those parts of the clothing which are most likely to be overlooked in the cleansing process, or those parts of articles of attire which may entirely be overlooked, such as seams of clothing, soles of boots, etc.

A. Physical Examination.—Given, then, certain spots or marks of stains on cloth-stuffs which may be blood, the following is the course which ought to be pursued in their examination :—

I. Examine them critically with a good hand-lens. By this means, matting of fibres, or even minute coagula may be discovered.

II. Note accurately the positions on the garment of the stains examined. (*Vide post.*)

III. Cut out the piece of cloth on which the stain is found (or, where several stains are found, some of the stains), for the purpose of noting the solubility of the colouring matter in a solution composed of water and some other substance. It is always advisable, where multiple stains are found, to leave some of them untouched for the use, it may be, of another examiner. The solubility of a blood-stain depends upon two main factors—viz. (*a*) the composition of the stain in respect of its age, and (*b*) the material upon which it is found; to these, in certain cases, may be added a third, (*c*) the treatment

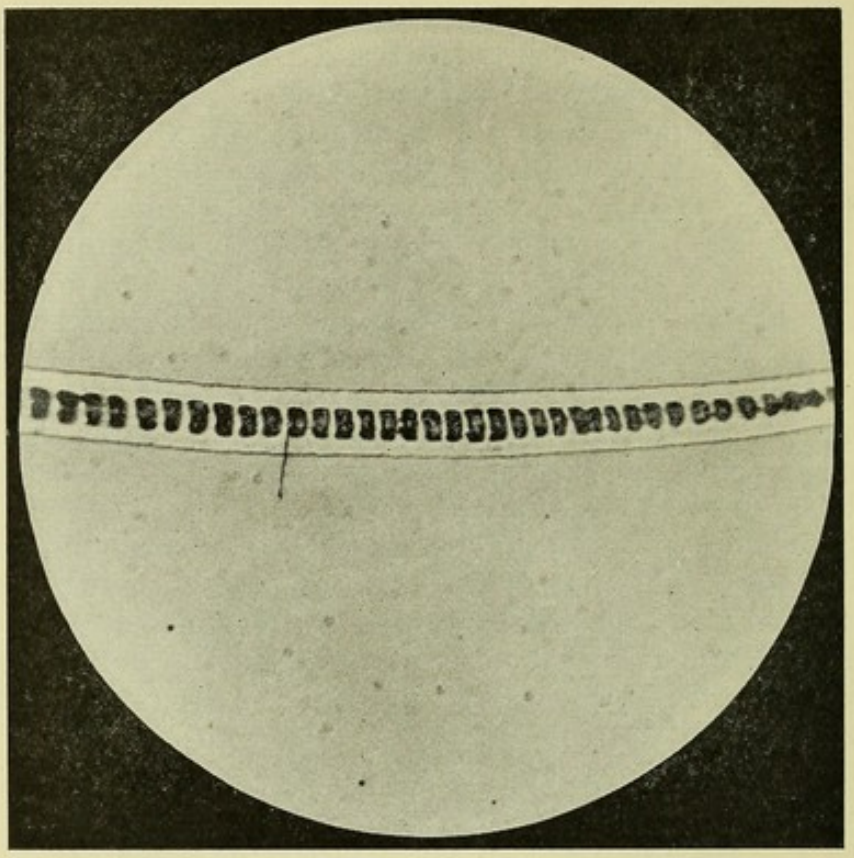


FIG. 91. — Photo-micrograph of a Hair of the Rat; magnified 500 diameters. (Author.)

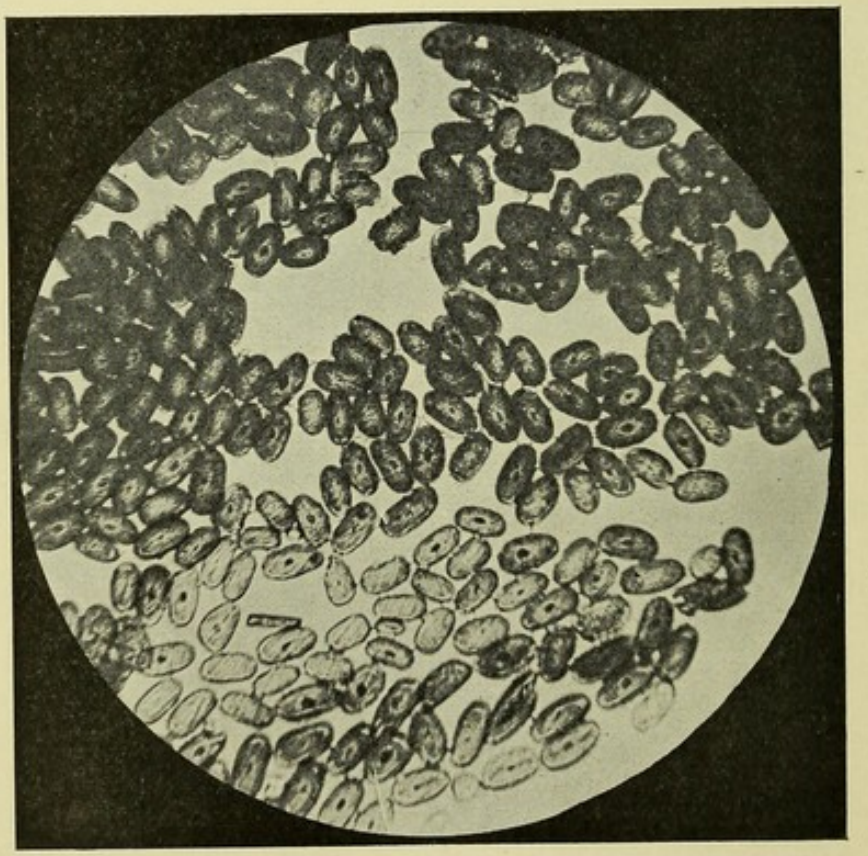


FIG. 92. — Photo-micrograph of Cross Sections of Human Hair, showing pigmentation. ×500 diameters. (Author.)

received by the stain after it has been shed. The following general proposition may be affirmed :—the more recent the stain, the greater its solubility; and the converse is equally true. In recent stains, the hæmoglobin is more or less soluble, but in very old stains, solution is not effected because the soluble hæmoglobin has been converted into insoluble hæmatin. In trying to obtain a solution of the blood-stain, where the material available is very small, the object is not to obtain a coloured solution for chemical and spectroscopic purposes only, but, if possible, to obtain the contained corpuscles for microscopic examination in as natural a form as possible, so as to identify the class of animals to which the corpuscles belong; therefore, the solvent used should simulate as nearly as possible the specific gravity of the *liquor sanguinis*. One of the best solvents for this purpose is one composed of seven parts of water and one part of glycerine (sp. gr. 1030), or Pacini's solution which is made up of one part of chloral hydrate dissolved in ten parts of water, or normal saline solution, containing 9 grammes of sodium chloride per litre of distilled water. Where water alone is used the corpuscles appear swollen like globules, due to endosmosis, because of the water being less in specific gravity than the serum of the blood; where, on the other hand, a solvent of higher specific gravity than that of the serum is used, the corpuscles appear misshapen, crenated, or punctated at the edges, due to exosmosis. But difficulty, if not indeed failure, to achieve solution of a stain by ordinary solvents may be experienced if the garment upon which the stains are present has been ironed, or, if upon a weapon, it has been exposed for some time to high temperature, or, if on a dyed garment, the dye has acted as a mordant, or if the garment has been washed with soap and water, or if on leather, or on wood of oak or elm, the contained tannic acid has fixed the blood.

Hankin and others who have had to make examination of suspected blood-stains in warm countries declare that they might be overlooked by the tests ordinarily in use owing to the rapid changes which blood-stains undergo in such climates. If, for example, the stains are kept damp, they rapidly putrefy, and, if dry, they become so insoluble as to be acted upon with difficulty only—if, indeed, at all, in some cases—by the ordinary reagents. He has found that although the blood-colouring matter is in an undissolved and insoluble condition, it may be made to yield a solution which gives the spectrum of hæmochromogen. To apply this test, cut out the suspected stain; plunge and keep it in boiling water for a few minutes; thereafter teaze out part of the fabric, place it on a microscope slide, and moisten it with ammonium sulphide; focus the slide under the microscope till a portion of the field composed of the coloured fluid only is exposed to view; remove the eye-piece of microscope and replace by the microspectroscope. If the stain be of blood, the two characteristic bands of hæmochromogen will be visible. Should, however, these bands not be visible, put a drop of 10

per cent. solution of potassium cyanide on the stain (the KCN solution having a marked solvent action on blood). If the stain be of blood, the two bands which become visible, will resemble the spectrum of hæmochromogen, but will be in a position nearer the red of the spectrum.

Stains may have to be examined upon any of the following substances—viz.

1. Cloth-fabrics.
2. Wood.
3. Plaster.
4. Metal.
5. Leather.

The following procedure, in respect of each, is recommended, in order to obtain a solution, if such be possible :—

I. *Cloth-fabrics.*—Cut out the stain, moisten it in one of the foregoing solvents, and assist maceration by gentle bruising of cloth with a piece of glass rod. This procedure is applicable to large stains ; but where the stain is small, and the quantity of colouring matter available is also small, it may be necessary, after moistening the stain in the solvent, to squeeze out with flat-pointed forceps tiny drops on a series of glass slides for examination by the microscope, and to reserve the remainder for the spectroscopic test. In dyed fabrics, the mordants used may so fix the blood-stain that solution fails, and this is especially true when it has been attempted to wash away the stain with soap and water. To obtain a blood-solution in such cases, it is necessary to digest the cloth in either a weak solution of citric acid or of ammonia—which of them can be ascertained by parallel experiment—when the blood-colouring matter will readily yield to solution.

II. *Wood.*—Cut off a thin shaving of the wood, noting, if possible, the kind of wood, especially if oak or elm, and treat the stain, if on ordinary wood, with the solvent, but if on oak, with a 2 per cent. solution of hydrochloric acid. The reason for this will be discussed later.

III. *Plaster.*—Scrape off plaster with stain, and proceed as for cloth or wood. Filter if necessary.

IV. *Metal.*—If on a clean, unrusted weapon, and the stains are thick like a spot of dried jelly, then gently heat, over a spirit flame, the opposite side of the blade to that upon which is the stain, when, if the stain be recent, it will probably peel, curl up, and fall off, or may be easily loosened. This must be done with great care. But the same end may be attained without the risks attending the foregoing, by scraping the stain into a watch-glass. Where the stain is thin, or mixed with rust, scraping is the only available method for detaching it. Where the weapon is rusty, or the stain is apparently mixed with rust, a preliminary test, based upon the behaviour of blood toward hydrogen peroxide, may be employed to a small corner of the stain. An account of it is given by Ganttner,[1] and it may, therefore, be called by his name.

[1] *Zeitschrift für Anal. Chem.*, 1895, Zweites Heft, pp. 159-160 ; also *The Analyst*, vol. xx., p. 186.

The test, which we have corroborated several times on old rusty instruments known to be blood-stained, is best carried out thus: it may be performed on the weapon itself, or, better, if the weapon has to be more fully examined, by scraping off a part of the rusty deposit into a watch-glass placed on top of a piece of black paper, then to drop on the scrapings, after adding a drop of water made feebly alkaline, a tiny drop of hydrogen peroxide, and watch the result. If blood be present, even in the slightest trace, numerous comparatively large bubbles of gas are developed, which, gradually becoming more numerous, give a white, beady appearance to the surface of the material. According to Ganttner, this frothy appearance develops from the outside of the drop toward the centre. But this is only seen where the scraped material is mainly composed of blood. Where the rust only contains blood in some of the particles, the gas only shows in those particles which contain blood. There is little fear of mistaking this frothy appearance for air-bubbles, but lest this might be a source of confusion, it is better, after adding the alkalinised water, to dissipate any air-bubbles which may form round the particulate matter with a piece of sharp-pointed glass rod, and thus have the mixture clear before adding the hydrogen peroxide. Should the above reaction not take place on the addition of the peroxide, then it can safely be affirmed that no blood is present. It is, therefore, an excellent negative test. But it is not an equally safe positive test of the presence of blood, because other fluids of the body when mixed with rust, such as saliva or pus, give equally well the same reaction; so that other tests, such as Teichmann's, must be applied to another portion of the scrapings, in order to obtain, if possible, hæmin crystals. The age of any stain, however, is no bar to its employment from the negative side, but where response is given to the test, positive proof of the presence of blood must be given in other ways, as that of Teichmann, or by the spectroscope.

V. *Leather.*—Special care must be exercised in the examination of stains upon this medium, owing to the fact that the tannic acid in the leather forms a compound with blood which is insoluble in either of the solvents named; and for the same reason, this applies to oak, or any other wood which contains much tannin. But if a long, thin shaving of the leather bearing the stain be sliced off with a sharp knife, and the shaving be doubled so that the stain is upon its convex side, and if the surface of the stain be made just to touch the water-glycerine solvent without coming in contact with the leather, a coloured solution may be obtained if the stain be recent. Should this fail, Sorby recommends that the leather-shaving should be placed in a small quantity of a 2 per cent. solution of hydrochloric acid in water—no more, and no less.

B. Chemical Examination.—Having obtained a coloured solution, to a certain portion of it, depending upon the total quantity at disposal, certain chemical tests should be employed—viz.

1. To a small portion of the coloured fluid, add a drop or two of a weak solution of ammonia and water. If the colour be due to blood, it will either become slightly more red, or it will remain practically unchanged. If, however, it be due to the red juices of fruits or jellies, or jams, the colour will be changed to green, and if due to logwood, madder, cochineal, or Brazil wood, to crimson in colour.

Note.—If the ammonia used be too strong, a brown colour may be produced in the case of blood.

2. To a second portion, apply heat to boiling, when the following three changes will happen, if it be due to blood :—
   (*a*) The colour disappears.
   (*b*) The colour becomes milky from coagulation.
   (*c*) A precipitate falls, which may vary in colour from a dirty-grey to brownish, depending upon amount of blood-colouring matter present.

   To the precipitate add Caustic Potash and apply gentle heat, when the precipitate will dissolve, and the resulting solution will show a different colour depending upon whether it is viewed by transmitted or by reflected light. This phenomenon is called the *dichroism* of the blood. Respecting the colours as seen, authorities differ : some declare that the colour by reflected light is green, and by transmitted light, red, while others affirm the opposite. As a matter of fact, the phenomenon is chameleon-like as regards colour, so that both sets of observers may be considered right or wrong.

3. To a third portion, add a drop or two of fresh Tincture of Guaiacum (upon which the fluid will become white owing to the deposit of the guaiac resin by the water of the solution) and, thereafter, a few drops of ozonised ether or turpentine, or 3 per cent. peroxide of Hydrogen, when, if blood be present, a blue colour more or less marked, depending upon the amount of blood-colouring matter present, will develop at the junction of the fluids. This colour may vary from a very pale shade of blue to a distinct sapphire-blue.

   This is a valuable negative test only. It must be kept in mind that a positive reaction may be obtained from material other than blood, such as gluten, milk, bile, sweat, solutions of common salt and of soluble copper salts, potassium iodide, chlorides of ammonium, lithium, potassium, iron, and aluminium, bromides of sodium and potassium, and potassium nitrite.

   This test is known as Van Deen's test, or as Day's test, from Dr John Day of Geelong, or as Schönbein's test, from this observer having proposed its use for this purpose in 1861. There is no other coloured corpuscular substance which gives this reaction, and this test, moreover, is an exceedingly delicate one.

4. Concentrate a portion of the coloured solution, place a drop upon a microscope slide, add and mix a drop of glacial acetic acid and a tiny crystal of chloride of sodium, beat gently to dryness, and examine, thereafter, microscopically ; if blood be present, crystals of hæmin, which is the hydrochloride of hæmatin, will be found, which may vary in colour from faint yellowish-red to brownish-black, and which may be rhomboidal, or six-sided in shape, and may be found in clusters, as separate crystals, or in masses. This is called Teichmann's test. The formula for hæmin, according to Mörner, is (C_{35} H_{35} N_4FeClO_4), and to Küster, (C_{32} H_{31} ClN_4 FeO_3) x C_5 H_{12} O. It is well to verify the crystals as those of hæmin, which may easily be done by placing over them a tiny drop of hydrogen peroxide, upon which the evolution of gas-bubbles of oxygen will take place, as already described. (Fig. 93.)

C. Spectroscopic Examination.—To a second portion of the coloured fluid, the spectroscopic tests should be applied.

Before doing so, however, there are two or three points respecting the nature of the blood-colouring matter with respect to its varied states of oxygen-combination which must be stated for the clear comprehension of what is to follow :—

1. The colouring matter of fresh blood is called *hæmoglobin*, and we may leave out of count the name *cruorine* which Stokes gave it. It may exist as oxidised hæmoglobin, as in arterial blood, or blood which has been exposed to the air, or as deoxidised hæmoglobin, as in venous blood, more especially when taken, under certain precautions against aeration, from the heart cavity of an animal newly asphyxiated.

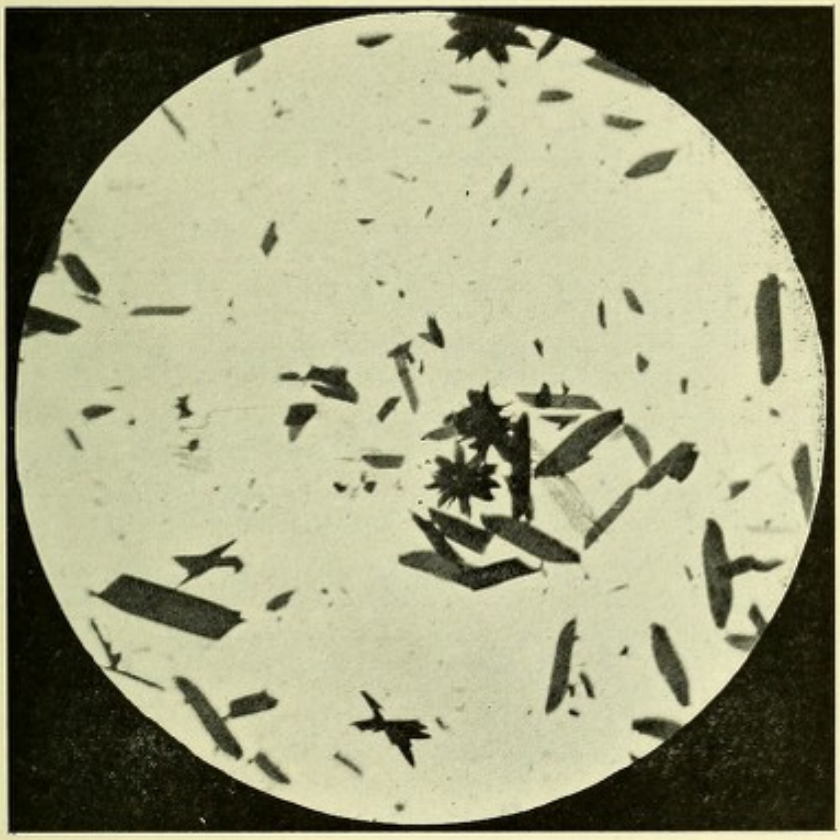


Fig. 93.—Photo-micrograph of Crystals of Hæmin. ×500 diameters. (Author.)

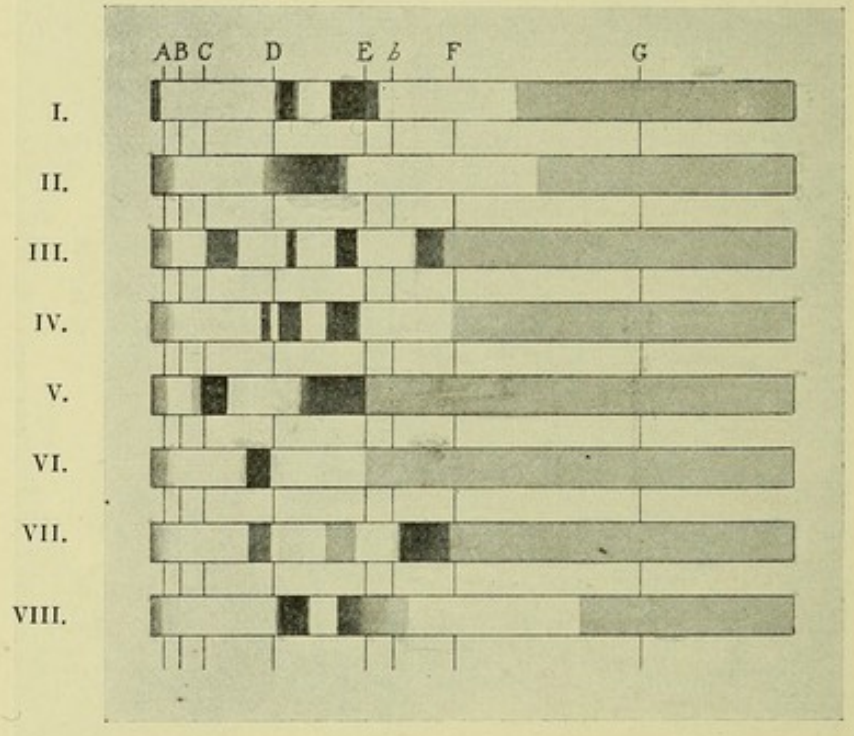
2. If the stain has become dry, as it is likely to do quickly upon various media, and if it has been exposed to an atmosphere in which the products of coal combustion are present, the hæmoglobin becomes changed into *met-hæmoglobin*, a body which seems to be composed of hæmoglobin and loosely-combined oxygen, and which may be considered as the first stage of the hæmoglobin-deoxidising process. This conversion does not take more than a few weeks at the outside, under the circumstances named.
3. If the stain has been kept damp, by lying in a damp place, it becomes gradually converted into *hæmatin*, which according to Nencki and Sieber, has the chemical formula (C_{32} H_{30} N_4 FeO_3).
4. Under any circumstances—taking longer, however, when the stain has been kept dry—the hæmoglobin becomes sooner or later converted into hæmatin.

On examination of any given sample of blood from a stain, therefore, difference in spectrum will be found, depending upon the precise

condition of the colouring matter of the blood of the stain and the solvent used; in other words, the number and position of the bands in the spectrum may be different. The following spectra are characteristic of the principal states of the blood :—

1. Of Oxidised or Scarlet Hæmoglobin—
   Two bands in the yellow half of the green, the one at the violet end twice as broad as the other; or, more scientifically, there are two distinct bands between the Frauenhofer lines *D* and *E*, the one nearest *D* being about half the breadth of the other and more defined. (I. Fig. 94.)

Fig. 94.—Blood Spectra.



I. Oxidised Hæmoglobin or Oxy-hæmoglobin.
II. Deoxidised Hæmoglobin or Reduced Hæmoglobin.
III. Met-hæmoglobin.
IV. Alkaline Met-hæmoglobin.
V. Acid Hæmatin.
VI. Alkaline Hæmatin.
VII. Sodium-Fluoride Hæmoglobin.
VIII. Carbonic Oxide Hæmoglobin or Carboxyhæmoglobin.

2. Of Deoxidised or Purple Hæmoglobin—
   One single broad band in the green; or one broad band between *D* and *E*. (II. Fig. 94.)
3. Of Blood, after short exposure to air—a mixture of HbO and Met-hæmoglobin;
   Two bands as in (1), but less marked, with the addition of a third band in the red;
4. Of Blood, after long exposure to air—chiefly Met-hæmoglobin;
   The bands are as in (3), but the band in the red becomes more marked, and the two in the green less marked;
5. Of Blood, after long exposure to air, with Ammonia added—alkaline Hæmatin. (VI. Fig. 94.)

The band in the red disappears, those in the green become more pronounced;

6. Of Blood as in (5), but with addition of Citric Acid, and without Ammonia—acid Hæmatin. (V. Fig. 94.)
   A broad band appears in the red, and a second in the green;
7. Of Blood with Carbon Monoxide—
   Two bands as in (1), but nearer violet end of spectrum. (VIII. Fig. 94.)
8. Hæmochromogen. This spectrum, which consists of two bands in the green between *D* and *E*, is obtained by treating blood solution with acid or alkali, and then adding NH_4 HS to the resulting solution. Some observers believe this to be one of the most delicate spectra of blood, and urge that it should always be looked for.
9. Hæmatoporphyrin, or Iron-free Hæmatin. This may be obtained by adding to a very small amount of blood solution some strong H_2 SO_4, and thereafter gently warming the mixture. If this be diluted with a little absolute alcohol and water the spectrum of *acid* hæmatoporphyrin will be got, which consists of two bands, one narrower and less well defined than the other lying to the left of the *D* line, and the other, broader and well marked, to the right of the former between *D* and *E*. The spectrum of *alkaline* hæmatoporphyrin is obtained with more difficulty by neutralising the acid solution slightly in excess with solution of KHO. It consists of four bands, three of which are more marked than the fourth. The band in the green, between *E* and *F*, is the darkest and broadest, and the other three will be found to the left of this, two being between *D* and *E* and the other between *C* and *D*. This substance has been frequently found in the urine of patients who have died from, or who are under the influence of, the toxic effects of sulphonal, and, occasionally, in other circumstances.

The only spectra which may be confounded with those of blood are those of certain vegetable colouring matters, but, fortunately, they can easily be differentiated by chemical means. Of these vegetable colouring matters, the principal are the following :—

1. Cochineal in alum, which gives two bands as in oxidised hæmoglobin, but on adding boric acid to the solution the bands move into the violet end of the spectrum, while those of blood, similarly treated, remain unchanged.
2. Lac-dye, alkanet root, madder, and others give spectra which, in some measure, resemble those of blood, but they are entirely altered, or removed altogether, by the addition of ammonia or potassium sulphite, while those of blood, treated likewise, are unaltered.

The spectroscope, therefore, is the most reliable test for blood, as it is capable of detecting the $\frac{1}{1000}$th part of a grain of hæmoglobin. In cases in which a stain upon any of the media formerly named, with the exception of leather or woods containing tannin, will not yield a coloured solution by the treatment already detailed, it is advisable to add a few drops of dilute ammonia, when, if the

insolubility has been due to the colouring matter being in the condition of hæmatin, it will now dissolve, and thus a solution available for testing is obtained. In certain cases it is advisable to filter the solution, especially when it contains particulate matter such as rust, ordinary dirt, or like substances: if, however, the solution obtained be fairly clear, it will be quite suitable without filtration for spectroscopic examination. The technique of the examination, however, will depend upon the amount of blood-stain, and, therefore, the amount of coloured solution at the disposal of the examiner. If the amount be sufficient to yield about half-an-ounce of coloured solution, then the spectroscopic examination may be quite easily conducted with the ordinary hand direct spectroscope and a flat glass cell; on the other hand, if the amount of solution be only one or two cubic centimetres, or less, the examiner must then fall back upon the micro-spectroscope, by which he is enabled to examine minute quantities of solution. Regarding the technique of the former, no special explanation is necessary; but it is essential that something should be said concerning the latter, since it requires some measure of manipulative dexterity.

Probably the best micro-spectroscopes of to-day are those made by Zeiss, Watson, Beck, and other makers, after the pattern suggested by Sorby. This fits into the barrel of the microscope made by the particular maker, but a junction tube can easily be obtained to unite the spectroscope and microscope where such have not originally been made to fit. The instrument consists of prisms arranged for direct vision which are placed in the eye-piece. These prisms are usually made of low dispersive power for blood-work, but the power of dispersion may be graduated by using different sets of prisms in different eye-pieces. Below the prisms is an achromatic lens, which is capable of adjustment by a rack-screw. The slit by which the spectrum reaches the eye from the object can be opened or shut by a screw, by means of which the better definition of the spectrum is secured. Arrangements are also provided in the instrument for a parallel spectrum, so that a second spectrum for comparison can be obtained at the same time as the other. This is effected by placing the substance, the spectrum of which is to be compared, on the stage with which the apparatus is provided. In the centre of this stage is an adjustable slit, behind which is a right-angled prism which throws the second spectrum into the field of vision parallel to the other, and thus comparison may be made. In using the micro-spectroscope, the eye-piece of the microscope is removed, the spectroscope is put in its place, and by means of focussing-screws the spectrum is thrown sharply into the field of vision. It is best to work with a low-power object-glass, in order to obtain satisfactory light.

The micro-spectroscope manufactured by the Messrs Beck differs from the foregoing type of instrument in that instead of being fitted in the place of the eye-piece, it occupies the place of the lens.

Apparatus required.—In addition to the microscope, into the eye-piece opening of which is fitted the spectroscope, the following apparatus is required—viz.

1. *Cells.*—These are usually made of barometer glass-tubing, of $\frac{1}{8}$th inch internal diameter, and of $\frac{1}{2}$ inch in length. But as

these are difficult to keep in position when the combined instrument is canted for light purposes, we have had cells made of the above with a glass foot added for steadying purposes, which have been found to answer every purpose much better;

2. *Platinum Spatulæ*, in the form of wires of two different thicknesses; in one of which the extreme end is hammered out into a shape like a miniature garden hoe, for the purpose of better mixing of reagents; and one of a loop ending, for the purpose of adding reagents.

Reagents.—The following in small stoppered bottles, which, like the foregoing, are kept solely for spectroscopic purposes, will be found useful—viz.

1. Dilute Ammonia, 30 per cent. solution;
2. Dilute Citric Acid, 60 grains to the ounce of distilled water;
3. Solution of Rochelle Salt, to prevent precipitation of Fe_2O_3;
4. Dilute Hydrochloric Acid, 30 per cent.;
5. Dilute Boric Acid;
6. Dilute solution of Sodium or Potassium Sulphite;
7. Fresh Ammonium Sulphide;
8. A solution of $FeSO_4$ in water, to which Tartaric Acid has been added and then rendered alkaline with Ammonia (Stokes' solution).

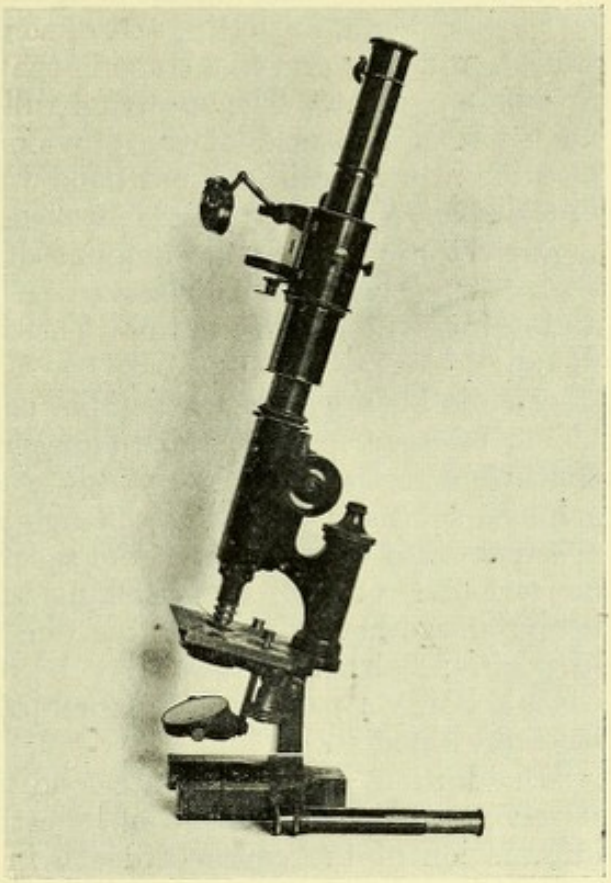


Fig. 95.—Shows the Micro-Spectroscope fitted in microscope ready for work. In the front of the figure is a small direct-vision Spectroscope.

If the stain is recent—as evidenced by its ready solubility—the colouring matter will likely be present in the watery solution as oxyhæmoglobin. Therefore, the spectrum of that substance will be visible. If, then, a loopful or two of Stokes' solution, or ammonium sulphide, be added, this will be reduced to the condition of reduced hæmoglobin, as shown by the change in the number and position of the bands. If the solution in the cell, however, be stirred freely with the platinum hoe, the likelihood is that the contained fluid will become reoxidised, and the spectrum of the former will reappear; if, now, a loopful or two of dilute citric acid be added, they will again disappear, and the solution, where Stokes' solution has been used, will have become turbid; thereupon add some dilute ammonia, when the solution will clear up and will give the spectrum of hæmatin. According to Macmunn,[1] this

[1] "The Spectroscope in Medicine," 1880.

last reaction distinguishes blood from most coloured substances in that the latter, after having been changed by acids, are restored to their original spectrum by alkalies, whereas in the former, after like treatment, the spectrum is changed. One further change can be produced in the colouring matter of blood—viz. by adding to the solution, after the addition of the ammonia, a loopful or two of solution of iron sulphate, the hæmatin is converted into reduced hæmatin. It will also be well to look for the spectrum of hæmochromogen.

Where the stain is some weeks old, and where it has been kept dry in a room in which the products of combustion of coal or gas are present, the colouring matter is likely to be composed of a mixture of met-hæmoglobin, hæmatin, and of some other ill-defined colouring substance, probably due to a stage in the metamorphosis of blood-pigment into bile-pigment. The spectrum will therefore consist of one of those named in Nos. 3 or 4 of the previous list. If, then, dilute ammonia be added to the cell, the red band will disappear, and the two bands in the green will become more marked.

In the case where the amount of blood is exceedingly small, the spectra most likely to be observed are these : (*a*) oxidised hæmoglobin, and (*b*) deoxidised hæmatin. These spectra are absolute proof of blood.

To discover whether vegetable colouring matters are mixed with blood, or have formed stains alongside of those of blood—a possible contingency—the addition of dilute ammonia, boric acid, or sodium sulphite solutions will either change the position of the bands in the spectrum into those parts of the spectrum in which those of blood are never found, or will, by bleaching the colouring matter, destroy the bands altogether, whereas those due to blood will remain unchanged in position, although they may become fainter. The reader should consult Sorby's papers on this subject,[1] and Sutherland's exhaustive work on Blood-stains.[2]

In addition, however, to the condition of the blood-colouring matter relative to its state of oxidation, spectrum analysis may afford valuable information of the cause of death in certain cases, owing to certain more or less fixed combinations which take place between certain toxic substances in gaseous form and the blood-colouring matter. There are certain forms of death in which profound alterations occur in the blood-colouring matter, which can only be definitely ascertained by spectroscopic examination. In deaths from asphyxia, the blood, as has been pointed out, is usually dark in colour, and in death by carbon monoxide it is cherry-red in colour. Since death by asphyxia is essentially due to accumulation of CO_2 in the blood, it might be expected, *a priori*, that this gas should be discovered on spectrum analysis. If the blood of the heart be examined immediately after death from this cause, it is true that the spectrum will not be found that of oxy-hæmoglobin but of reduced hæmoglobin, showing that a combination has taken place between the CO_2 and the hæmoglobin by CO_2 being substituted for the oxygen. But in ordinary medico-legal practice, it

[1] *Monthly Microscop. Journal*, vol. vi., 1871, p. 9.

[2] "Blood-stains : Their Detection and the Determination of Their Source," 1907.

unfortunately happens that, before the arterial blood is examined, it has become again restored to the condition of oxy-hæmoglobin, and, therefore, no information is vouchsafed on this point. But the same objection does not apply where death is caused by the action of *carbon monoxide*, as this gas forms with the blood-colouring matter a much more stable and definite compound, which remains for a much longer period of time than that which usually elapses between the death and the examination of the body, and the resultant compound gives a definite and unmistakable spectrum—viz. two absorption bands which in relative breadth correspond to those of oxy-hæmoglobin, but differ from the latter in their position in the spectrum, being nearer the violet end than those of oxy-hæmoglobin. This, however, would be too precarious a test upon which to base an opinion; therefore, further manipulation is necessary before decision. In the first place, the cherry-red colour of the blood itself is most striking. If a drop of blood be taken from the finger and mixed with 19 parts of distilled water, and if one drop of the cherry-red blood be similarly treated, a distinct difference is at once perceived—viz. the former will have assumed a faintly yellow colour, but the latter will be of a pinkish colour. By examination of both in the spectroscope, two bands will be seen in each, the relative position of which can only be ascertained by exact measurement. If to each a loopful or two of fresh ammonium sulphide be then added and stirred well, and the spectroscopic examination be repeated, it will be seen that in the former, only *one* band is now visible, whereas in the latter both bands retain their position. The non-reducibility of the blood indicates surely, therefore, the carboxy-hæmoglobin, which is the name given to the compound formed between carbon monoxide and hæmoglobin. In all deaths by this gas, no matter what its vehicle—coal-gas, water-gas, charcoal or lime-burning, or blaise-heap fumes—the above characteristic spectrum is found in the blood in the manner indicated. The reader is referred to a succeeding chapter for further and fuller discussion of this subject. (*Vide* vol. ii., on estimation of CO in air.)

In like manner, sulphuretted hydrogen forms a compound with hæmoglobin, although more evanescent than that of the former, of which the spectrum is that of reduced hæmoglobin, with the addition of a third band in the red of spectrum, which has received the name of sulphhæmoglobin; and hydrocyanic acid and potassium cyanide, a compound called cyanhæmatin, which gives a single broad band not unlike that of deoxidised hæmoglobin, but different from it in that it is nearer the violet end of the spectrum, and in being more shaded on the violet side. If a reducing agent be added, two other bands appear, but nearer the violet end than those of blood. These results, however, have only been obtained in the laboratory by mixing the blood with the poison; they have never been obtained from the blood of a person who has been poisoned either with the acid itself or with its potassium salt; therefore, from the practical point of view, they may be ignored.

In poisoning by hydrofluoric acid, or sodium fluoride, the spectrum found in the blood will consist of (*a*) a band between *C* and *D*, close to the *D* line, and (*b*) a second and broader band between *E* and *F*, close to the *F* line (VII. Fig. 94); and in poisoning by arseniuretted

hydrogen, potassium chlorate, and pyrogallic acid, the spectrum will be that of met-hæmoglobin.

D. Microscopic Examination.—The next point in the inquiry consists of the examination for cells or corpuscles either in the coloured fluid itself, or in the residue where the fluid has been filtered. If the precautions formerly given have been observed, we may hope to be able, at least, on corpuscles being found, to state to which class of animals they belong. Our practice is, as soon as solution of a stain has been effected, to examine at once for red corpuscles. If these are found, it materially assists in the further investigation, for then Schönbein's test, if responded to, becomes of positive value, and Teichmann's crystals can at once be looked for. It is, however, difficult to conceive of conditions in medico-legal cases in which, by micrometric measurements of the corpuscles, the exact animal to which the corpuscles belonged can be certainly determined, although some would even dare to condescend upon such particulars. This would, in our view, be unwise, because it is unsafe; it is enough, in the present state of scientific knowledge and manipulation, to state the class of animal to which the corpuscles belong. The filtrate, or fluid, ought to be carefully examined also for other cell-contents and constituents, as epithelial cells, spermatozoa, or fragments of hair.

How to differentiate between the Blood of the Lower Animals and of Man.—It must be clearly understood at the very outset that the present limits of scientific research do not enable observers to differentiate absolutely between the corpuscles of the blood of man and those of many of the other mammals, for although careful micrometric measurements may permit, in selected conditions, detection of differences sufficiently accurate to pronounce an opinion as to the animal from which the corpuscles have come, such conditions are rarely, if ever, met with in medico-legal practice. But while this is so, there are, at the same time, certain definite characteristics in the corpuscles of certain classes of the lower animals, and of a certain sub-class of mammals, which enable a distinction to be made by means of the microscope.

The following guiding facts, may, therefore, be set down :—

1. In man and in the large bulk of the animals of the mammalian order, the corpuscles are circular and non-nucleated. It will be well to state, however, that some observers affirm the existence of a nucleus in the corpuscles of this class, but this is contrary to the observation of most scientists.
2. In the camel tribe—the Camelidæ—of the mammalia, the corpuscles are *lanceolate-oval* in shape, and non-nucleated.
3. In birds, fishes, reptiles, and amphibians, the corpuscles are oval in shape, but contain nuclei.
4. The corpuscles of most of the domesticated animals—pig, ox, cat, horse, sheep, goat, and reindeer—are, on the average, less in size than those of man, those of the dog being about the same average size as those of man.

But although the facts stated in the last paragraph are true, they cannot be counted upon in medico-legal examinations of blood-stains, and therefore, the best positive answer which ought to be given to the question, Are the corpuscles those of man? is that they either conform

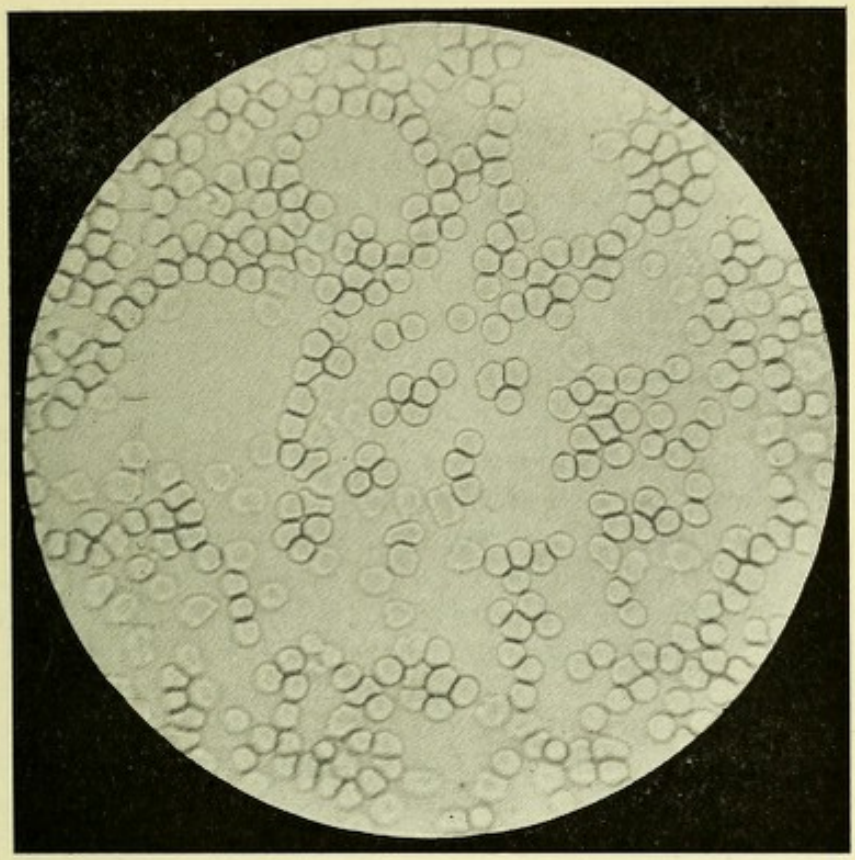


FIG. 96.—Photo-micrograph of Human Red Corpuscles—fresh, unstained specimen. The characteristic circular, bi-concave appearance is only apparent in some of the corpuscles, as pressure has distorted the others. ×500 diameters. (Author.)

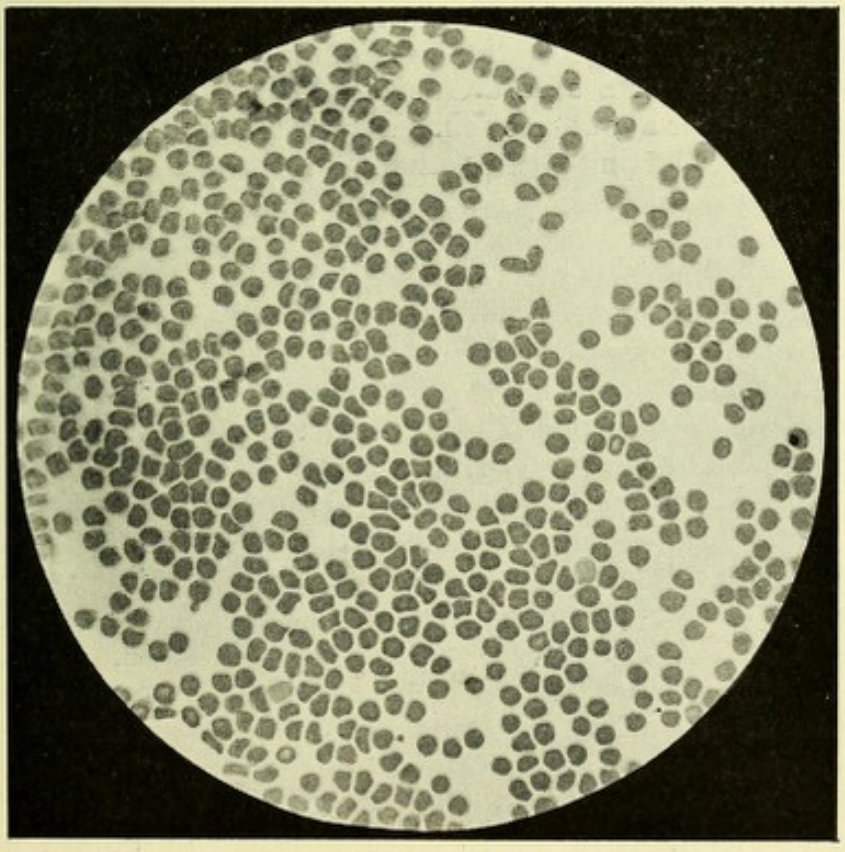


FIG. 97.—Photo-micrograph of Blood of Mouse. ×500 diameters. The field is too crowded to show uniformly the circular form; but it is observable in a few corpuscles. (Author.)

to the characters of mammalian blood, or that they do not. The answer may, however, be of great negative value where, from the corpuscular characteristics of a given stain, it can be definitely affirmed that the blood discs are not mammalian, and therefore, are not those of human blood. The question of identity of corpuscles arises frequently in medico-legal cases. We have had to give opinions in many cases, in which the blood was found to be mammalian. In a case tried at the Essex Assizes in 1851, it was pleaded of certain incriminating stains on the clothing of the accused that they were caused by killing a fowl, but microscopic examination disproved the averment by showing that the corpuscles found in them belonged to the mammalian class, and not to the class of birds.

In certain cases of alleged rape, it may become a question of importance whether the blood-stains found on the underclothing of the female alleged to have been assaulted are the result of hæmorrhage from violence to the sexual parts, or of the ordinary menstrual flow, or of menorrhagia. In our view, the answer to this question will depend more on the presence or absence of any breach of continuity of the parts from which the blood could be effused than upon the characters of the blood itself, for although menstrual blood contains no fibrin, has an acid reaction due to the vaginal mucus which keeps it fluid, and, moreover, contains squamous epithelium, these characters cannot be differentiated in the blood on fabrics, especially where urinary stains are present in addition. Should spermatozoa be found, however, considerable value would be attached to the observation.

It may happen, in certain important cases, that it is desirable to preserve specimens of the corpuscles for further examination or reference. The following is, probably, one of the most satisfactory methods of preservation:—To some of the solution containing well-marked corpuscles add a drop of a saturated solution of picric acid, which allow to stand and mix for about five minutes; withdraw the excess of picric acid with a slip of blotting-paper; then add a drop of solution of picrocarminate of ammonia and a drop of glycerine or Farrant's solution, and leave uncovered for about an hour; remove the excess of colouring matter with blotting-paper; then add another drop of glycerine or Farrant's solution, and mount in the ordinary way. Blood corpuscles so prepared will keep for several months at least.

Blood Crystals.—Some have attempted to track the identity of blood to the animal to which it belongs by the particular shapes which the blood crystals of different animals assume. It was pointed out by Preyer of Jena many years ago that the crystals of some animals differ in shape from those of man, and upon this fact the attempts named have been based; but most recent researches on the subject only emphasise the difficulties in the way of making this a positive means of identification. Among other observers, Dr Monckton Copeman has carefully worked through the subject,[1] and from his researches, partly confirmed by our own, the following points may be named:—Crystals of hæmoglobin may be easily obtained from the blood of some animals, such as the guinea-pig, rat, and squirrel, but owing to the solubility of human hæmoglobin, it is much more difficult to obtain it in the

[1] *B. M. J.*, vol. ii., p. 190, 1889.

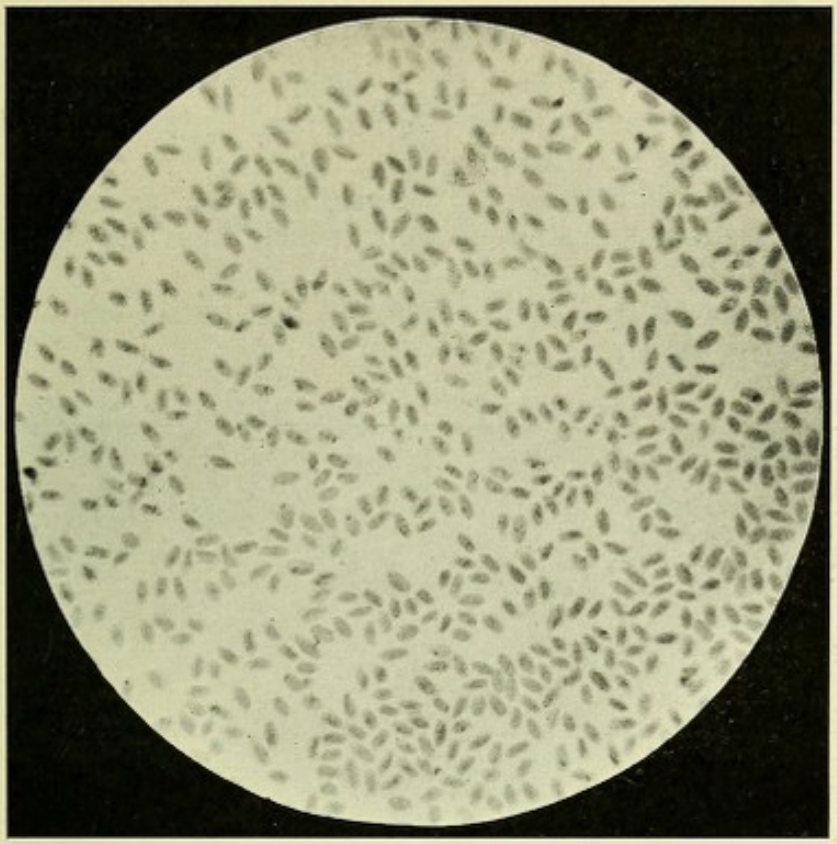


FIG. 98.—Photo-micrograph of Blood of Camel, showing lanceolate shape and non-nucleated character of corpuscles. ×500 diameters. (Author.)

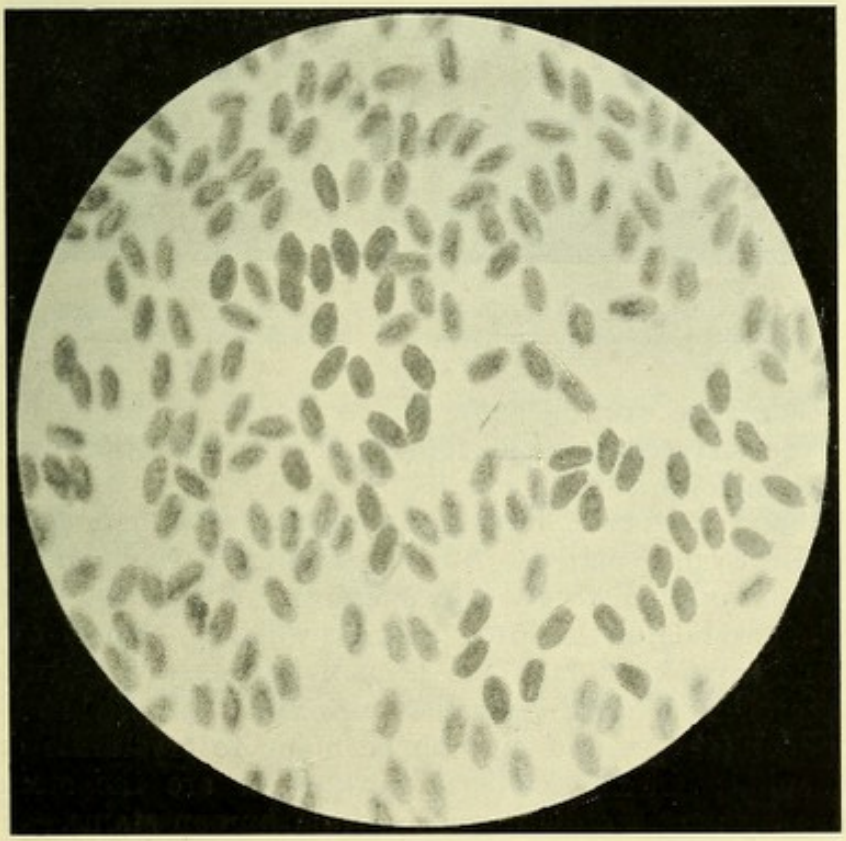


FIG. 99.—Photo-micrograph of Blood of Pigeon, showing oval-shaped and nucleated character of corpuscles. ×500 diameters. (Author.)

crystalline form. Crystals may, however, be obtained in one of the following ways :—

(*a*) By feeding leeches on human blood. After the lapse of some weeks, crystals are likely to be found in the gastric dilatation of the intestinal canal.

(*b*) By diluting human blood with serous fluid, as from hydrocele, ascites, or pleuritic effusion, which has undergone decomposition.

(*c*) By adding crystals of glycocholate and taurocholate of soda to human blood.

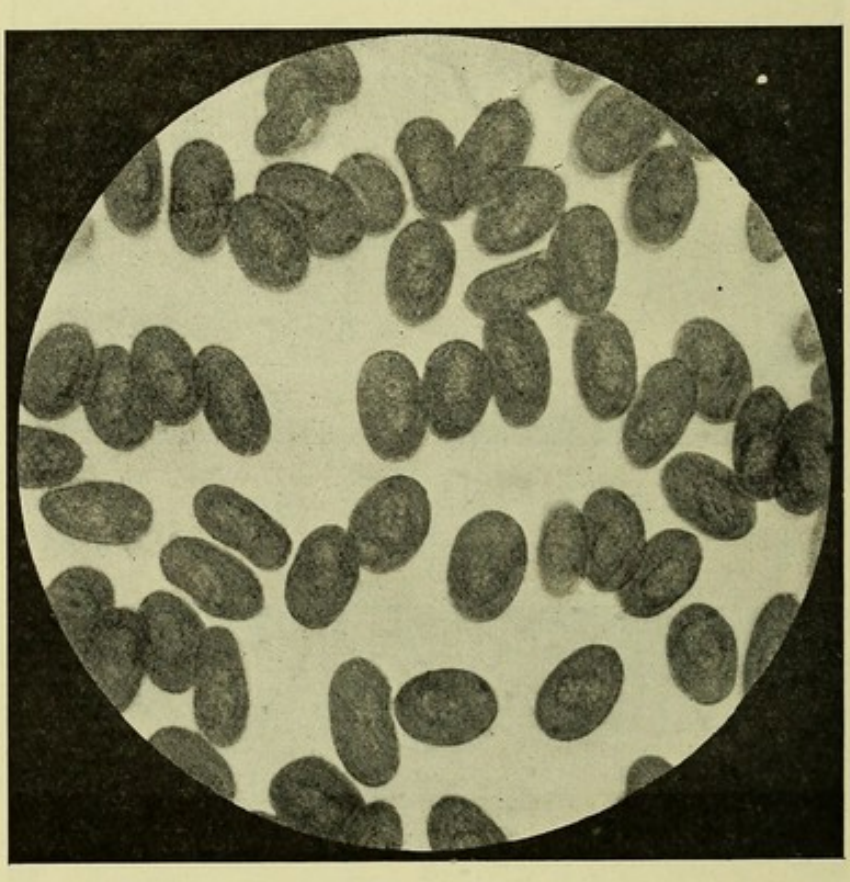


Fig. 100.—Photo-micrograph of Blood of Frog, showing oval-shaped and nucleated character of corpuscles. ×500 diameters. (Author.)

(*d*) By adding a drop of cat's bile to a drop of human blood on a slide, crystals may be found, but they are those of reduced hæmoglobin.

Their shape is that of rectangular plates, and their colour varies from greenish to pale claret. But on examining them spectroscopically, they will be found to give the spectrum of reduced hæmoglobin, whereas the crystals of the lower animals will give that of oxy-hæmoglobin. One important fact has been definitely demonstrated from recent researches in blood-crystallisation, and that is, that the blood of the bullock, sheep, and pig can be made to crystallise only with much difficulty; in medico-legal work these are the stains which most ordinarily must be distinguished from human stains. But even these may be made to crystallise by adopting Gamgee's method of treatment—viz. To add to the defibrinated blood about one-sixteenth

of its volume of ether, and shake till the mixture becomes transparent or lakey. Allow the mixture to stand in an ordinary temperature for at least 48 hours, when crystals will likely be plentifully found. In this way, blood from the following animals has been made to yield crystals :—

1. Horse.
2. Bullock.
3. Sheep.
4. Pig.
5. Dog.
6. Cat.
7. Rabbit.
8. Squirrel.
9. Guinea-pig.
10. Rat.
11. Mouse.
12. Chicken.
13. Pigeon.

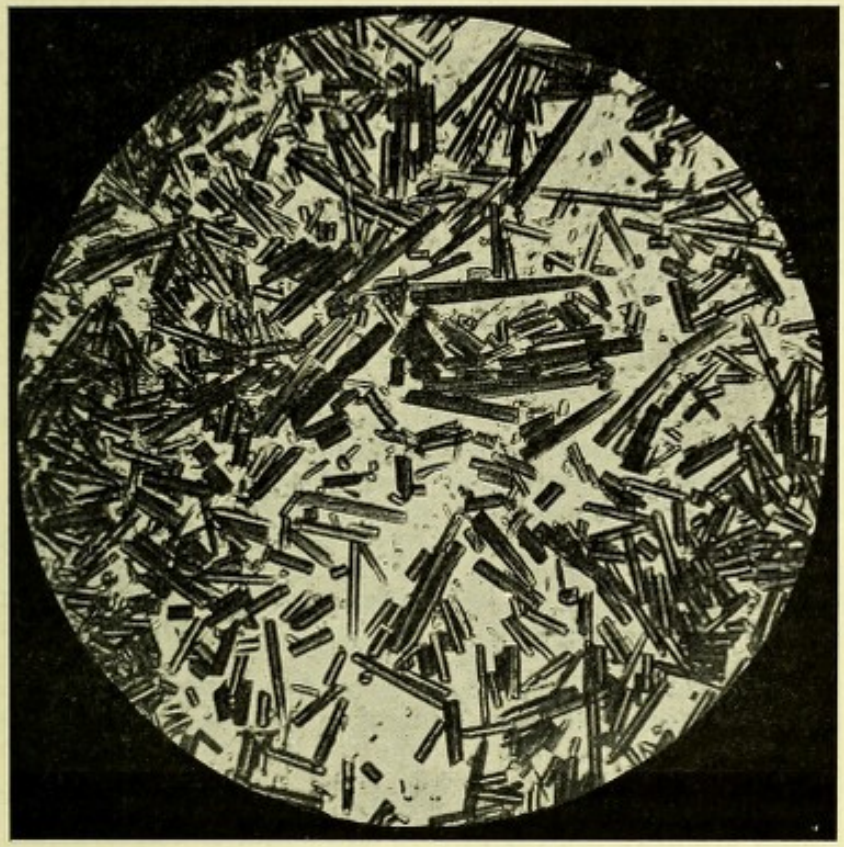


Fig. 101.—Photo-micrograph of Hæmoglobin Crystals. The crystals were obtained by Hoppe-Seyler's Method by Dr Brodie, formerly of the University of Glasgow. ×500 diameters. (Author.)

Human blood, when similarly treated, does not readily yield crystals, but when such are formed, they uniformly give the spectrum of reduced hæmoglobin, whereas those of the animals above-named give the spectrum of oxy-hæmoglobin. It is probable that this point, when further definite researches have been made, may assume important medico-legal value, but that time has not yet arrived.

SEROLOGICAL TESTS FOR BLOOD

1. *Hæmolytic Test.*—The basis of the hæmolytic test for blood is to be found in the phenomenon observed when the blood of an animal, not allied, is injected into the circulation of another animal—viz. the marked hæmoglobinuria, due to the hæmolytic action of the injected blood on the red-blood corpuscles of the animal, whereby the red corpuscles are broken up and the

hæmoglobin is liberated into the blood plasma ; and in the further observation that, if the blood introduced be that of an animal closely allied in species to the animal into which it is injected, no such solvent action on the corpuscles takes place, and no hæmoglobinuria ensues. There seems, therefore, to exist in the blood introduced in the former experiment some property which is hæmolytic (in bodies which may be called hæmolysins), which is absent in the latter. Founded on these facts, hæmolysins may be developed in the blood of an animal by injecting or otherwise introducing into its body, at short intervals, small amounts of blood of another animal, which is specific for the red corpuscles of the species of animal the blood of which has been injected or introduced. To explain the different theories propounded as to the character of these bodies and their intimate mode of action is beyond the province of a text-book of this kind, and the reader is referred to works on pathology.

Deutsch of Buda-Pesth claims priority in the suggestion of applying this principle to medico-legal investigations of blood-stains,[1] having in August 1900 read a paper at the International Medical Congress at Paris, giving the details of a test for blood based on the specific character of artificially produced hæmolysins.

The following is a brief outline of the test as proposed by him :—Defibrinated human blood, after centrifugation, containing the red corpuscles present in 10 c.c. of the original blood, was injected at short intervals of days into a rabbit, after which the animal was bled, and the serum of the blood tested as to its hæmolytic power. Serum was only to be used if it showed marked hæmolytic action in a dilution of 1:4. The suspected blood-stain was scraped into a clean watch-glass, and the scrapings dissolved in a phenol-salt solution (phenol 2 grammes, common salt 9 grammes, distilled water 1000 c.c.). The solution was then to be mixed with the rabbit antiserum to make a 1:4 dilution (3 parts being solution and one part antiserum), and some of the resulting mixed fluid was sucked up into a capillary pipette, the ends thereafter being closed in the flame. Control-tubes containing (*a*) the solution only, (*b*) the solution mixed with an antiserum known to be hæmolytic to the red corpuscles of the blood of the animal alleged to have produced the stain in question, were at the same time prepared.

These tubes were kept in the horizontal position in an incubator at 37° C. for 24 hours, and were then examined for hæmolytic action. If this action was found to be well-marked in the original test-tube and absent in the control-tube (*b*), the statement of the accused was to be held as disproved ; and *vice versa*.

Where the available stain for examination was very small, Deutsch recommended that the above treatment should be carried out in a hanging-drop preparation.

Since the reliability of this test depended entirely upon the presence in the suspected stain of entire red corpuscles, and since, as experience has shown, such is by no means always the case, the test did not command the confidence of medical jurists.

2. *Precipitin Test.*—This test is based on the well-established fact that if an animal be immunised by injections of a culture of a micro-organism, a serum may be obtained from its blood which will produce a precipitate in a clear filtered culture of the same organism, and, by extension of this observation, that if an animal be injected with the blood of another animal of different species, there is obtained in the serum of its blood a substance which will produce a precipitate in the serum of the blood of any animal of the same species as that whose blood was injected. Founded on this principle, Uhlenhuth has suggested a method by which different kinds of mammalian blood may be detected. It consists in injecting subcutaneously, or into the peritoneal cavity or venous system of a rabbit, defibrinated blood of man, for example, and obtaining from the blood of the rabbit a serum which, when dropped into a clear solution of human blood, causes a cloudiness or precipitate to form, a result which is not produced in a solution of blood from another animal.[2] In medico-legal work, the difficulty is experienced of obtaining the blood solution of such clearness to permit of the application of the test. But the test is performed on a

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[1] *Centralblatt für Bakteriologie*, May 15, 1901.

[2] *B. M. J.*, vol. i., 1901, p. 788 ; *Berl. klin. Wochenschr.*, Feb. 7, 1901.

filtered blood solution,[1] since this observer affirms that it may be applied to filtered solutions of meat, for the detection of the animal from which the meat is obtained.

This phenomenon has recently been investigated by a large number of observers, as by Uhlenhuth, Wasserman and Schutze,[2] Nuttall,[3] Tarchetti[4] and others. The principle, as proposed to be applied in medico-legal work, depends upon the fact that if into the body of an animal A the defibrinated blood of an animal B is injected, after the lapse of a short time the blood of the animal A is found to be hæmolytic or toxic to the blood of the species of the animal B. In the detection of human blood in a stain hæmolytic serum from a rabbit is used. This is obtained by injecting about 10 c.cm. of defibrinated human blood (according to the method of Uhlenhuth and Wasserman), or a similar amount of the corpuscular sediment of human blood—the serum having been decanted off (according to the method of Deutsch)—under the skin of a rabbit from three to five times in all, an interval of one week being allowed between each injection, then bleeding the rabbit from the carotid artery at the end of this time and preserving the serum of the blood so obtained in an aseptic condition. This serum now exhibits a precipitant effect upon the serum of the blood of man and the ape, but no effect whatever upon the blood of other animals. The procedure with reference to a blood-stain suggested by Tarchetti is as follows:—Dissolve the stain to be examined in a few drops of normal saline solution 0·9 per cent. of salts; filter the solution obtained; put a portion into each of two small test-tubes; to one, (*a*), add about 0·5 c.cm. of the prepared rabbit serum, and to the other, (*b*), unprepared serum from the blood of another rabbit; place both tubes in an incubator at 37° C. At the end of an hour, if the tube (*a*) contains human or anthropoid blood, its contents will have become turbid with a flocculent precipitate, whereas the contents of (*b*) will be limpid and clear. This and other observers carried out a series of experiments upon the blood-stains of man and other animals on cloth, metal, etc., and they found the method reliable. Such prepared rabbit serum, as described, containing 80 per cent. of diluting saline solution, has been shown to have no reactive effect upon the red corpuscles of the blood of a variety of domesticated animals, as the pig, calf, ox, mouse, rat, and others, but to have a marked hæmolytic action upon those of man. Metalnikoff[5] has shown that this hæmolytic property may be conferred upon the blood of the rabbit by simply feeding the animal with blood; for example, by feeding rabbits on horses' blood, the serum of the rabbits' blood causes a precipitate in the serum of the blood of the horse. Doubtless this will become a test of vital medico-legal importance in the future.[6]

Some detailed consideration of carrying out the test is, therefore, necessary.

On the assumption that in the examination of a suspected stain it has been found by microscopic examination to contain red corpuscles of the mammalian type, and that it is desired to prove or disprove that the stain is due to the blood of man, the following outline will indicate the best method of conducting the test:—The stain, or if more than one, some of the stains, should be extracted or dissolved, if possible, with normal saline solution, 0·9 per cent. Should this fail to effect solution, the stain may be treated with a solution of potassium cyanide, and the resultant solution thereafter nearly neutralised with a solution of citric acid carefully added, and then diluted with normal saline solution. Before proceeding further, it is necessary to be certain that we have succeeded in obtaining a solution containing serum. A simple method, suggested by Nuttall, is by blowing gently into the solution through a fine pipette submerged in the solution, when, if serum be present, fine air-bubbles or foam will form on the surface of the solution, which will remain for some time. This has been called the "foam test." But in order to carry through the test, much preparatory work has had to be done. The antiserum must have been prepared

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[1] *B. M. J.*, vol. ii., 1901, p. 1491; *Deut. med. Woch.*, No. 45, p. 780.
[2] *Berlin klin. Wochenschr.*, Feb. 21, 1901.
[3] *B. M. J.*, vol. ii., 1901, p. 869.
[4] *Gazz. degli Osped.*, May 19, 1901, and *B. M. J.*, vol. i., 1901, p. 104, *Sup.*
[5] *Centralblatt für Bakteriolog.*, April 18, 1901.
[6] *Vide* for further reference, McWeeney, *Jour. State Med.*, vol. ix. No. 7., p. 378.

through a rabbit (it is important to note that not the blood of every rabbit inoculated with human blood will yield a useful serum); we ought to have a 1:1000 solution of normal human serum, whereby to gauge the strength of the antiserum; and it is well to have at hand solutions of different blood-stains as a control of the specificity of the antiserum. The antiserum ought to be of such specific strength that when one part is added to twenty parts of a 1:1000 dilution of homologous blood, a cloudiness will appear within two minutes at the point of junction of the two fluids, to a dilution of 1:10,000, within three minutes, and to a dilution of 1:20,000 within five minutes. It is, perhaps, best not to exceed a dilution of 1:10,000. There must be in readiness a supply of clean, small, tapered test-tubes. Depending on the number of dilutions used will be the number of this first set or group of test-tubes. Into each of these are pipetted 2 c.c. of the solution of the stain or stains and the necessary number of c.c. of normal saline solution to make up the dilutions required. The contents of the tubes being thoroughly mixed either by shaking or by stirring with a platinum loop wire, 0·1 c.c. of the antiserum is then pipetted into each tube, the point of the pipette being placed against the side of the tube above the fluid-level, so that its contents may run slowly down into the test-tube fluid. The test-tubes are then set on one side, and their contents examined at intervals of two minutes for the appearance of cloudiness or a precipitate, the time for each tube being carefully noted.

A second set of like test-tubes, to be used as controls, are then prepared. The number may vary. Into one of these is placed (*a*) some c.c. of 1:1000 solution of human blood; into another (*b*) a like amount of solution of a stain as nearly alike as possible in appearance and age to that under examination; into a third, fourth, fifth, etc., (*c*) solutions of various blood-stains of mammalian animals other than man; into another (*d*) the solution of the suspected stain, to which has been added 0·1 c.c. of normal saline solution; into another (*e*) some of the same solution with 0·1 c.c. of normal rabbit serum added; and into another, (*f*) 2 c.c. of the normal saline solution with 0·1 c.c. of antiserum added. To (*a*), (*b*), (*c*) and (*d*), 0·1 c.c. of antiserum is added.

All the test-tubes are thus prepared, and during the whole of the test are to be kept at room temperature. Careful watch is then made of the appearances in the tubes. In (*a*) and (*b*) certainly, and also in (*d*), if the stain be of human blood, there will be formed at the junction of the solution and antiserum (the antiserum being the heavier will form the lower part of the column of fluid) within two minutes, a turbidity or pale milky cloudiness, which is most easily noted by viewing the tube contents in a good light against black paper. This turbidity is likely to increase in density and in area for the next ten or fifteen minutes. In the other tubes no reaction will be found to have developed. Nuttall has figured apparatus devised by himself for the measurement of the degree of reaction.[1] If, however, one of the control solutions (*c*) were of the blood of an anthropoid ape, there would be a certain degree of reaction exhibited, which would probably not be so rapid in development nor so marked, when present, as in the control tube (*a*). However rare the occasion when it might become necessary to differentiate absolutely between the blood of man and that of an anthropoid ape, Uhlenhuth has suggested an efficient method of determining the issue—viz. by making an antiserum from the *Macacus rhesus* (which is a monkey, not an ape) with the blood of man, which has a high precipitating action on human blood, but has none on the blood of apes, even in dilutions of 1:10 to 1:50.

In medico-legal work, the amount of stain available, and, therefore, the amount of resulting solution, is most commonly small, hence capillary tubes may have to be employed. Since such importance is attached to the reaction, and as the reaction in such small tubes is very fine, it is of the utmost importance that the tubes employed should be thoroughly clean. This may best be done by boiling the tubes in distilled water to free them from any contained minute particulate matter; in any case, they should be examined before use with a good hand-lens to prove their cleanness. Like the larger tubes, they are filled with the necessary dilutions and control fluids by capillary action; but to do this accurately requires some practice. When filled, their ends are best

[1] *B. M. J.*, vol. i., 1902, p. 825.

filled with some soft plastic material, as prepared modelling clay. Other observers use tubes of 10 cm. length and 5 mm. calibre, the relative proportions of fluids used being thereby enlarged. Where such fine tubes are used, the proportion of antiserum to stain solution does not seem to be of so much importance, provided that similar proportions are observed in control fluids.

For medico-legal work, the consensus of opinion of observers regarding the condition of the test is (1) that the tube fluids and controls should be prepared and kept at room temperature, and (2) that the reaction should be completed within twenty minutes.

The undernoted works on this subject may be consulted with profit:

Nuttall, "Blood Immunity and Blood Relationship," 1904; Uhlenhuth, "Das biologische Verfahren zur Erkennung und Unterscheidung von Menschen und Tierblut," 1905; Sutherland, "Blood-stains: Their Detection, etc.," 1907.

The precipitin test has now been employed in the criminal law-courts of Germany for over eight years.

Neisser and Sachs [1] have proposed a modification of the Uhlenhuth test. The modification depends on the fact that the hæmolytic power of a mixture of amboceptor and complement — for example, the serum of a rabbit immunised with ox blood *plus* the serum of the blood of a guinea-pig —cannot be inhibited by the addition of a human antiserum—that is, for example, the serum of a rabbit injected with human blood alone—but is inhibited if a minute trace of human serum be first added to the human antiserum. They claim for the test that it acts sensitively even with a weak human antiserum and 0·0001 c.c. of human blood.

Stains upon Weapons.—One of the most important duties of the medical jurist in connection with suspicious stains, is the detection of the nature of a given stain upon a weapon. With recent stains there is no unusual difficulty, if the procedure already suggested has been followed, but difficulty does emerge when the stain is old, because in ordinary circumstances, what blood there may have been, becomes commingled with rust. In such a case, where the examination by hand-lens shows the presence of rust, it is best (1) to scrape off a portion of the stain into a watch-glass, add a drop of alkalinised water, and treat by Ganttner's method (*q.v.*); (2) to scrape into a second glass another small portion, acidulate with dilute citric acid, or make alkaline with dilute ammonia; either solution will dissolve out the colouring matter of the blood—if such is present—and will have but little effect on the rust; then filter the solution, and examine one part of the filtrate by the Guaiacum test, and another by the spectroscope. Examine the contents of the filter-paper for iron in the ordinary way. But there are certain stains formed upon bright steel weapons by certain vegetable acids, notably citric and malic acids, which, in some measure, simulate blood-stains which have been mainly washed off. These are due to the formation of the citrate or malate of iron, salts which are soluble in water. All that requires to be done to detect their true character, therefore, is to wash the blade of the knife with as little water as possible, add a drop of strong nitric acid to oxidise the iron into the ferric state, and then a few drops of a freshly-made solution of potassium sulphocyanide, when, if the stain be due to iron, the beautiful rose-red colour of the sulpho-cyanide of iron will be formed. This is a very delicate test, and may be rendered all the more striking by adding the reagents only to a like volume of distilled water, thus making a control test of the purity of the reagents. Where very

[1] *Berl. klin. Woch.*, Oct. 30, 1905, p. 1388.

infinitesimal amounts of iron are present, the colour will be less pronounced, and it will be advantageous, in order to detect the shade of colour produced, to look down through the column of fluid in the test-tube alongside that of the parallel blank test against a white background, when the contrast will be distinct.

There are certain stains which, upon dark fabrics, may closely resemble those due to blood, such as dirty grease, tar, pitch, snuff, and paints, and which may be carelessly mistaken for blood. There are two methods by which they may be detected : either by the wet method, or the dry method. By the former method, after failure of solution by water-glycerine mixture, or normal saline solution, and after addition of citric acid or ammonia, different solvents may be employed ; for example, ether, or benzine, will dissolve the grease and the paints, and will probably have some solvent action upon the pitch ; in that case, the coloured solution should be examined by the spectroscope, when the question will be solved. By the latter method, the simplest plan is to place a piece of clean blotting-paper on a thick porcelain slab, laying upon it the cloth, stain downwards, and then to apply, with some pressure, a hot laundry smoothing-iron to the upper side of the cloth, when the stain will melt and be absorbed in the blotting-paper, if due to grease, tar, or pitch, but will not be affected, if due to paint or snuff. Upon one garment which we had to examine, stains of tar were found, and on another, stains of snuff, in addition to those of blood, due to the snuff-taking habit of the wearer of the garment examined.

Certain aniline colours, too, simulate blood-stains. Those of them which do so may be distinguished by the action of dilute nitric acid upon them, the effect being to convert the red colour into a yellowish shade.

Three questions may be asked of a medical witness regarding which the witness should frankly confess, in the present limits of scientific knowledge, his inability to answer. This is better than to guess, or offer an opinion upon inadequate data. They are as follow—viz.

(*a*) Is the blood that of a human being ?
(*b*) From what part of the body did it flow ?
(*c*) What is the age of the stain ?

Illustrative Cases.—It has been our duty for many years past in a large number of cases to make examinations of stains on articles of clothing, weapons, etc., for medico-legal purposes, but it is only necessary to cite illustrative cases to bring out points dealt with in the text.

1. At the Circuit Court, Glasgow, in the spring of 1898, a man was charged with the murder of another man. The injuries found on the body of the victim were severe fractures of the skull with escape of brain-substance. The jacket, coat and vest which accused wore when apprehended were sent for examination because of certain stains observed by the police upon them. The stains on the jacket were found to consist mainly of reddish spots of a circular or inverted soda-water-bottle shape, and to be situated on the left lapel. They varied in size from $\frac{3}{32}$ to $\frac{5}{32}$ of an inch in diameter. Stains were also found on the right sleeve of the coat near the wrist. These measured from $\frac{3}{16}$ of an inch to smaller sizes. Other stains were discovered on the inside lining of the vest, just below the opening for the right arm. Physical, chemical, microscopic and spectroscopic tests proved the stains on jacket and coat to be composed of mammalian blood, but those on the vest to be of some resinous or tarry substance. From the inverted soda-water-bottle shape of some of the stains, we reported that, in our opinion, the blood had been forcibly projected against the garments.

2. In the case described on p. 312, in which death was caused by fractured skull due to a sharp-pointed poker having been thrust into the brain through the orbital cavity, the poker said to have been used, a man's jacket, and a petticoat and cotton under-jacket belonging to the woman accused, were found by us to bear many reddish stains of different shapes and sizes. Those on the poker consisted of (*a*) blood, (*b*) rust, and (*c*) a mixture of blood and rust. Those on the man's jacket were situated on both sides of front of jacket, on right shoulder, and on right sleeve, and were round or oval in form. Twelve separate stains were found on the woman's petticoat, the largest measuring $3\frac{1}{2}$ in. $\times 2\frac{1}{2}$ in., in the centre of which was a small portion of dried, clotted blood. This stain had the appearance as if some elongated body with blood on it had been wiped on the garment. On the under-jacket or short-gown were certain ill-defined, brownish-red streaks which contained minute pieces of brownish-coloured vegetable matter. We reported that the stains on the jacket of deceased, on the petticoat of the woman, and some on the poker, consisted of mammalian blood, but that those on the under-jacket had the appearances of snuff. It was found later that the accused was addicted to the habit of using snuff.

3. In a case of stabbing, in which four persons had been apprehended, two knives were submitted for examination. Stains were observable on both knives of a faintly-reddish colour. On examination these proved to be composed of (*a*) organic matter not blood, and (*b*) to some acid fruit combination with iron.

4. A middle-aged Italian was charged with having assaulted two children and of having cut their throats with intent to murder them. He had been identified by the children. (*Vide* p. 295.) A linen collar, a white dress shirt, vest, jacket, and waterproof coat were submitted for examination and report on certain stains upon them. On the collar were reddish smears, on the left breast of the shirt, high up, were several small, circular, reddish spots, and on the right breast between the neck stud-hole and the first stud-hole of breast, was a reddish stain of inverted soda-water-bottle shape, measuring $\frac{5}{32}$ of an inch in length ; on the outside of right cuff was a reddish smear, and around it several small sputter spots ; on the outside of left cuff, a reddish smear, and on the left sleeve, at back of elbow, five reddish spots all of them small ; on the vest was a reddish stain, situated on the right lapel close to the point of the flap above the first button ; on the right shoulder-piece, a similar stain on the left lapel, in similar position almost to that on right lapel, a stain of like size to the last, and on front of vest, several stains of grease ; on the left side of collar of jacket just above junction with the lapel, were five different stains of varied sizes, on the neck edge of collar, close to lapel, another stain, all reddish in colour, on the left lapel, beginning at a point two inches below button-hole in lapel, were several stains, consisting of spots, spirts, and runlets of a reddish colour ; on the left breast, at a level with left breast pocket and extending outwards from edge of front of jacket for five inches, and downwards for nine inches, was a large series of stains, consisting of spirts or jets and runlets ; on left sleeve of jacket, on its upper half, and also in neighbourhood of wrist, were reddish spots, five in the former position, and thirteen in the latter ; on the right lapel, right breast, and right sleeve reddish stains were also found ; on the waterproof coat no stains were found on any part of the outside of it, but on its inside, on the right front below the right pocket, and twelve inches from the right edge of coat, were four reddish streaks, and on the inside of left front, at lower part of left pocket, and seven and a half inches from left edge of coat, was a small circular reddish stain.

These stains on collar, front of shirt, on right lapel of vest, on both lapels, left breast and left skirt of jacket, and on right and left insides of waterproof coat, by microscopic and spectroscopic examination, and by Teichmann's test, proved to be composed of mammalian blood, and from the shape and grouping of some of them, we gave the opinion that they were caused by spurting or forcible bespattering. For further particulars of case see p. 295.

5. In May 1904, Thomas Gunning was apprehended on a charge of having murdered his paramour. The following articles of attire, worn by the prisoner at the time, were sent to us for examination—viz. (*a*) jacket, (*b*) vest, (*c*) trousers, (*d*) boots, and (*e*) shirt.

On the jacket, on right front, behind left lapel, on outer aspect of left sleeve

close to cuff, and on lining of right front, were numerous reddish stains of varying shapes and sizes ; on outside of vest were several reddish stains, and on both legs of trousers were many reddish stains, in some of which were small clots. Attempts had been made to wipe or wash the stains on these garments. On the shirt stains were found only on left sleeve close to elbow. They consisted of reddish smears. The boots were heavy, thick soled, tacketed or nailed, and had iron toe-plates and heel-plates. They were plentifully stained on uppers, inside and outside, and the soles were more or less generally covered by reddish stains. The toes, toe-caps, and toe-plates were thickly smeared.

All these stains were examined physically, microscopically, chemically, and spectroscopically, and were found to be composed of mammalian blood. From the appearances of the stains on the trousers and boots, we reported further that the blood had been forcibly bespattered against them. For further particulars of case see p. 327.

6. John Archibald Murray was apprehended in January 1906 on a charge of having murdered his mother. Certain stains having been found on his boots, trousers, and pants, these articles were forwarded to us for examination and report. On examination of the boots, we found dark glazed stains on the outside of sole plate and behind the toe-cap of left side of left boot, and on the left side of right boot, at back part of instep, a dozen very small reddish-yellow glazed stains, mostly oval in shape, each of which measured $\frac{1}{16}$th of an inch in length ; on the left leg of trousers, at a distance of from ten to fourteen inches from the lower end of opening of pocket, and on the outside seam, was a series of reddish-coloured stains, each of which was more or less rounded in shape. They were four in number. They measured respectively, $\frac{3}{8}$rds of an inch in diameter, $\frac{1}{2}$ in. $\times$ $\frac{3}{16}$ in., $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in., and 1 in. $\times$ $\frac{1}{2}$ in. This series was called (*a*). On same leg, beginning at a point 18 inches below lowest point of opening of pocket and five inches to the right side of outside seam, was a diffused reddish stain of irregular shape, measuring $5\frac{1}{2}$ in. $\times$ 4 in., and at the bottom of it another stain, oval in shape, measuring $1\frac{1}{2}$ in. $\times$ $\frac{5}{8}$ in. These two stains were situated below the level of the knee of the trouser, and somewhat to the inside. These were called (*b*). On examining the inside of the cloth of the trouser, it was found that none of the stains in group (*a*) had gone through the cloth, but that the stains in group (*b*) had passed through, the larger stain measuring on the inside 4 in. $\times$ 2 in., and the smaller the same on the inside as outside. On the pants 12 inches from the bottom edge, on left leg, began a larger stain, dullish black in colour, which terminated 5 inches from the same point, and above the upper part of this stain was a second stain, rusty-red in colour, which measured $2\frac{3}{4}$ in. $\times$ $1\frac{1}{2}$ in. On examining the inner surface of the pants, it was found that the blackish stain was of same dimensions inside and out, but that the rusty-red stain inside measured only about 1 inch square, and that the staining was not uniform throughout that area.

Microscopic, chemical, and spectroscopic examination showed that the stains in the groups (*a*) and (*b*) on the trousers, the stains on both boots, and the rusty-red stain on pants, were all composed of mammalian blood, but that the blackish stain on pants was not so composed. We reported further that the blood which formed the stains on the trousers and pants had passed from without inwards and not from within outwards, because of the differences of measurements inside and outside. For further history of this case see p. 170.

7. In July 1907 there were transmitted for examination and report the following articles—viz. : (1) a pocket-knife, (2) a pocket-handkerchief, (3) a neck-muffler, (4) a shirt, (5) an under-shirt, (6) a pair of under-pants, and (7) a jacket. On No. 1 were small stains of a brownish colour on both sides of the blade and a very small faint reddish stain on each side of handle. We were unable after examination to affirm positively that they were due to blood. No. 2 was more or less covered with dried reddish material, and had the appearance as if it had been dipped or partly washed in water. No. 3 bore certain small reddish stains. No. 4 showed stains on wrist-bands, varying in size from $1\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. to $\frac{1}{2}$ in. $\times$ $\frac{1}{4}$ in. No. 5 showed on margin of right wrist-band a reddish stain $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in. No. 6 showed on front of lower left body portion, on left side of fork, and on upper two-thirds of left thigh, a series of dark red stains of varying size. On No. 7 the only stains found were present near margin of cuff of right sleeve and on inner aspect of cuff, the largest of

these measuring 2 in. × ½ in., the others, seven in number, being smaller in size and of the form of circular and elongated spots. By chemical and other tests, all the stains on the articles, other than No. 1, were found to be composed of mammalian blood. (*Vide* p. 306.)

8. In November 1907 there was transmitted to us a vest upon which there were certain coloured stains for examination and report. Examination showed small reddish stains on left side of breast of circular and elongated shapes, which measured ⅜ in. × ¼ in. and 1 in. × ⅜ in., and a series of whitish-grey stains. After preparation and the application of chemical, microscopic and spectroscopic tests, the former were found to be composed of mammalian blood ; the others were not of blood. (*See* case, p. 300.)

9. In December of same year we examined (1) a jacket, and (2) the blade of a knife belonging to a man in custody on a charge of having stabbed a lady typist. On the jacket two reddish stains were found on back of wrist-band of left sleeve, and two similar stains on back of right sleeve, close to back seam. All the stains were small, the largest measuring ½ in. × ¼ in. After the usual examination, the stains on left sleeve were proved to be not composed of blood, while those on the right were of mammalian blood. The stains on the knife-blade were in the form of reddish streaks along the axis of the blade, but they were proved to be composed of rust. (*Vide* p. 306.)

In another case in the same month, the articles sent comprised (1) a jacket, (2) an old breakfast table-knife, and (3) a man's shirt. The stains on the jacket were found to be due to mud and grease and not to blood, those on the knife were composed of mammalian blood, and two stains on the wrist-bands were also so composed. (*Vide* case, p. 287.)

CHAPTER XII

MEDICO-LEGAL RELATIONS OF THE SEXUAL FUNCTIONS

THE following are the heads of subjects under which the different relations of the sexual functions may be grouped, and the order in which they will be treated :—

I. Impotence in the Male.
II. Sterility in the Female.
III. Pregnancy, including :
  (*a*) Criminal Abortion, or Fœticide ;
  (*b*) Infanticide, and Concealment of Pregnancy.
IV. Rape, or Defloration.
V. Sodomy and other Unnatural Sexual Crimes.

I. Impotence in the Male.—This question may be referred to the medical jurist arising out of cases such as the following :—(*a*) where the legitimacy or paternity of a child is disputed on the ground of age, or impotency, of the reputed father ; (*b*) nullity of marriage ; (*c*) rape.

It is but seldom that cases arise under the first head, but where they do arise, it is usually because of the alleged impotency of the male by reason of premature or advanced age, or by reason of bodily infirmities which usually produce the condition—both physiological causes. Below the age of puberty, the male is reckoned to be sexually impotent, although this does not preclude the existence of the power of coitus ; hence a male before the age of puberty is, by the law of England, incapable of contracting a legal marriage. In France and Germany the law enacts this age to be eighteen years. Puberty is generally held to be attained at the age of fourteen years, and by the term " puberty " ought to be meant the attainment of virility, not merely that of power of coitus, for this latter power begins, as has been said, earlier than puberty or virility, and continues for some time after—which is a variable period—the procreative power has ceased. But although the law fixes the age of the attainment of virility, it places no limit upon the period of age above puberty when a male ceases to be sexually competent. Cases of virile power in elderly men are well known and authenticated. This point was raised in the famous Banbury peerage case, because the putative father was 80 years of age at the date of the birth of the claimant, but the judge there ruled that there was no legal limit to the age when the procreative power ceased.

The facts of this case, briefly put, were these : In 1632, Lord Banbury died, aged 85. In 1627, Lady Banbury had a son, and in 1630, another. Both husband and wife lived at the house of Lord Vaux, with whom the wife was adulterous. An inquisition was held after the death of Lord Banbury, in which it was declared that he died without heirs male of his body. In 1646, the son

claimed the title, and from time to time, his descendants, but the House of Lords either denied the claim, or ignored it. However, in 1806, the lineal descendant of the son got it adjudicated upon by the Peers, the famous Lord Erskine being his advocate, and it was proved in evidence that at the time Lord Banbury died, he was a hale and hearty man. Nevertheless, the House of Lords decided in 1813 that the claim had not been established. Lord Erskine in his statement advocating the claimant's case quoted the case of Sir Stephen Fox, who married at the age of 77, had four children born to him, the last when he was 81 years of age.

That the procreative power in old men is possible, is shown by the fact that Casper records a case in which spermatozoa were found in a man 96 years of age,[1] and that he himself had found them in a person of 69.[2]

Certain bodily infirmities, as hemiplegia, paraplegia, and locomotor ataxia, are generally considered as causing impotency, but this must be taken with caution with reference to cases of the first and last-named affections, for hemiplegics and ataxics have been known to be able to procreate, while it may be taken as conclusive, in the bulk of cases of the second. But even of paraplegics, Curling[3] quotes from Brachet's "Recherches Experimentales sur le Systême Nerveux," 2nd edit., p. 280, a case in which a male, paraplegic for some years, retained such sexual power as to have prolific intercourse. This person after a fall from his horse became paraplegic, and for eight years the paralysis remained stationary. Whilst in this state his wife bore him two children. While there can be no doubt that as the degenerative changes in the cord in locomotor ataxia advance the procreative power becomes weakened and, latterly, is destroyed, there are well-authenticated cases in which, in the earlier stages at least, the procreative power remains. In Bagot *v.* Bagot, which was tried in the Irish Probate Court in 1878, this very question of impotency from locomotor ataxia was raised. The tendency to impotency is also produced by certain vicious habits, such as excessive indulgence in alcohol, opium, and tobacco, as also by the prolonged use of such drugs as iodine and the iodides, and bromides. From the medico-legal point of view mental causes do not rank as causes of impotency for reasons which will be pointed out later.

Krause has drawn attention to the effect of X-rays upon the seminal secretion. He states that the testes of rabbits and guinea-pigs are rendered sterile after an exposure for 370 minutes, while azoospermia followed an exposure of 195 minutes. He declares, further, that the testes of man may be similarly affected, instancing the cases of attendants in a Rœntgen-ray laboratory, in whom azoospermia, and in some cases, oligonecrospermia, were observed after employment for periods of over three years, although there was no sexual impotence in coitus or other subjective or objective sign. In a patient who had been under treatment for pruritus by X-rays, the spermatozoa were found to be necrotic after two exposures of from ten to fifteen minutes' duration at a distance of 15 cm. After twenty days he was again exposed, and azoospermia

[1] "Forensic Med.," Syd. Soc. Ed., vol. iii., p. 291.
[2] *Op. cit. ibid.*, p. 258.
[3] "Diseases of the Testes," 4th edit., p. 443.

was found to be present. Five months later, however, living spermatozoa had returned.[1]

The physical causes of impotency are, probably, the most important from our point of view; they certainly offer the safest bases upon which to found an opinion. Those which cause absolute impotence are the following:—

(*a*) *Absence of the Penis.*—Obviously the absence of the organ of intromission is proof of impotency. The late Professor Ogston[2] gives the facts of a case in which a man, on a hunting expedition in Greenland, fell on his knife, causing a large penetrating wound of the abdomen and the total severance of the penis; and he states that this man confessed to him, that though he had sexual desires, he was unable to fulfil the act.

(*b*) *Absence of the Testes.*—There can equally be no doubt that the congenital absence, or misplacement, or artificial removal, of both testes produces absolute impotency. In certain cases where the testes have either not descended initially, or in which having been replaced in the abdomen by accident during the early part of male life while the spermatic canal is still patent, they have become fixed internally by inflammatory lesions—cases of crypsorchidism or cryptorchidism, as they are termed—the testes may be present, although not found in the scrotum. But in all such cases, their absence causes sooner or later the development of physical changes, or want of development, in the male body. Generally speaking, where this is congenital, the changes which occur at puberty in the ordinarily-equipped male do not take place; therefore, the body partakes more of a feminine build, the voice is like that of a woman by reason of the absence of development of the thyroid cartilages, and the development of the hair upon the face is either entirely arrested, or is but little in evidence. Cryptorchides may, therefore, be reckoned as sexually impotent. Artificial removal of the testes accounts for the official eunuch, the keeper of the seraglio. But the same is not true of the monorchides. Physically, they are usually as other men, and the procreative function is active. We know of two cases of fruitful monorchides. Eccles has expressed the opinion that after surgical replacement of the imperfectly-descended testes, there is little likelihood that it will produce spermatozoa.[3] But in the case of a male who by accident or otherwise after puberty is reached loses both testes, the procreative power and the power of coitus do not cease at once, although both are gradually lost, and the procreative power before the other. Sir Astley Cooper[4] relates the case of a man whom he had castrated, who, for twelve months after, had regular emissions of semen and for two years after, but rarely and very imperfectly; and Otto, of a man who had castrated himself, but whose *vesiculæ seminales*, at his death nine months later, were found filled with semen.

(c) *Malformations of the external Genital Organs.*—In such conditions as hermaphroditism, hypospadias, epispadias, fistula in perineo, advanced disease of penis or testes, impotency is the rule. Another interesting cause is that of double penis. Dr Ballantyne of Edinburgh, whose researches in teratology are so well known, contributes an interesting article on this subject and its literature.[5] But there may be impotency from causes which are not apparent externally. Dr Rushton Parker has recorded a very unusual case.[6] This man had married a wife, but all attempts at coition on his part were futile. Six months after the wedding, the marriage had not been consummated. Both himself and his wife observed that he had periodic monthly dis-

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[1] *Munch. med. Woch.*, Sept. 4, 1906.
[2] *Op. cit.* p. 77.
[3] *B. M. J.*, vol. ii., 1902, p. 1316.
[4] *Med. Chir. Review*, vol. xviii., p. 390.
[5] *B. M. J.*, vol. i., 1896, p. 1392.
[6] *Ibid.*, 1899, p. 272.

charges of blood *per urethram*, which, on each occasion, usually lasted for three days, and they noted their occurrence monthly from April to November inclusive. On physical examination, there was nothing unusual found in his general appearance, and his external genital apparatus seemed normal, although the testes felt decidedly small and soft. He stated that he had never experienced any sexual feeling, and had never practised self-abuse. Dr Parker was of opinion that although rudimentary testes had descended into the scrotum the man likely had a uterus and Fallopian tubes.

Another remarkable case is recorded by Ströbe in Zeigler's "Beiträge zur pathologischen Anatomie," vol. xxii., p. 1898 (with plates).[1] This person, supposed to be a male, and who had married a wife but had begotten no children, died at the age of 63 of a cancerous stricture of the gullet. He looked like a man, but had scanty hair upon his face. The penis was normal, as was also the urinary meatus, but the scrotum was empty. On dissection of the abdomen, a well-formed uterus was discovered, its fundus being 2¼ inches broad, the Fallopian tubes and the round and broad ligaments being also present. The left Fallopian tube was like the right furnished with a testis and epididymis at its other extremity, as proved by microscopic examination. The cavity of the uterus was found to open into the *caput gallinaginis* of a normal prostate gland. No history of his sexual life was obtainable.

Another case is related by Berthold [2] of a person, aged 22, dressed as a woman—she, however, had to shave on account of the growth of hair on the face—who came to consult him on account of hoarseness and sore throat. On examining the vocal cords, he observed that they were developed as in a male. He concluded that the hoarseness was nothing more than a normal man's voice. On examination of the external genitals, he found that they were concealed by a large left inguinal hernia, which, however, on being reduced, revealed extreme hypospadias, and a bifurcated scrotum, not unlike the female *labia majora*. Berthold, thereupon, pronounced the sex to be male. Having had opportunities later, from time to time, of watching the progress of this person, he found that the timid, coy person who first consulted him had merged into one bold and brave, and had actually engaged himself to marry a young woman. Although sexual desire was now present, and the semen contained spermatozoa, coitus was impossible.

Like cases are recorded by Chiarleino [3] and others, but the foregoing will suffice to indicate the strange anomalies which give rise to incompetency in the male.

Relative impotency, though rare, is not unknown. Apart from those cases in which a man, though virile, is impotent relatively to a wife—to which condition the term relative impotency is sometimes erroneously applied—there are, undoubtedly, cases in which men, although normal as to their external genitals so far as medical examination can detect, have failed to consummate their marriage.

Within recent years, two actions of declarator of nullity of marriage by wives against husbands on this ground have been heard in the Court of Session, and in each case, after evidence by the spouses and by medical witnesses, decree of nullity was pronounced.[4]

The facts of these cases were briefly as follows :—

1. M. *v.* G.

The pursuer, M., went through a ceremony of marriage with the defender, G., who was a farmer, in April 1898. Although repeated attempts were made

[1] See also *B. M. J.*, vol. ii., 1898, *Sup.*, p. 78.
[2] *Archiv für Laryngologie und Rhinologie*, vol. ix., part i., February 1899.
[3] *La Gynécologie*, February 15, 1900.
[4] *Scots Law Times Reports*, vol. x., 1902, p. 264, ; *ibid.* p. 266.

thereafter by the defender to consummate the marriage, they were unsuccessful. Pursuer left her husband's house in September 1898, and did not see him or have any communication with him after that date. In 1902 she raised this action of declarator of nullity of marriage on the ground of his impotency. The action was undefended ; but at the proof counsel watched the case for the defender, who had submitted himself to examination by medical men some days before the proof was to be heard. Pursuer gave details in her evidence of the circumstances between herself and her husband after marriage. The medical witnesses stated that they had examined both pursuer and defender, that pursuer was a perfectly healthy woman in all respects, that her hymen was ruptured in four places, but that the appearance of her private parts showed that if she had ever had connection with a man, it could not have been frequently. They saw no reason to doubt her statement that she had never had connection with a man, and the condition of her hymen might have been due to disease or to defender having hurt her with his fingers when attempting coitus. There was no evidence of sexual nervousness or vaginismus on the part of pursuer.

Their examination of defender showed that he was quite healthy, that there was no anatomical or visible defect in his private parts, nor any evidence of disease or malpractices to account for this failure in coitus. Defender had stated to them that he had never had coitus with a woman before his marriage. From his appearance, they were of opinion that the defender had some slight mental peculiarity which affected that part of his brain which regulated his sexual functions. Another woman might have excited his passions, and he might be impotent only *quoad* his wife.

Lord Stormonth Darling gave decree of nullity, as asked, the terms of which will be found in the decree of the succeeding case, which, although reported later, preceded this case in point of time of trial.

2. A. B. *v.* C. D.

A. B., a wife, raised an action of declarator of nullity of her marriage with C. D. on the ground of his impotency. Prior to the raising of this action, her husband, C. D., raised a similar action against her on the ground of her impotency, which had prevented the consummation of the marriage.

Both parties averred in the actions that though the marriage had subsisted for nearly three years, it had never been consummated. C. D., in his action, alleged that A. B. was impotent owing to the contracted condition of her private parts, and owing to the fact that she suffered from nervous spasms of the vagina, which rendered consummation impossible. A. B. on the other hand, alleged that C. D. was impotent either from malformation or from functional or nervous defects in his constitution, or from other causes to her more particularly unknown. Defences were lodged to both actions, and before the records were closed it was arranged that each of the parties should submit to examination by the medical advisers of the other party. After A. B. had been examined by the medical advisers of C. D., C. D. intimated that he did not intend to proceed with his action or to defend further the action at the instance of A. B. Accordingly, A. B. was assoilzied from the conclusions of the action against her, and proof was allowed in her action against C. D. At the hearing of the proof, A. B. stated that although she had lived with C. D. for over two and a half years, occupying the same bed with him, the marriage had never been consummated, notwithstanding attempts had been frequently made. That was not due to any hindrance or unwillingness on her part. The medical witnesses stated that A. B. was a perfectly healthy and normal woman sexually. There was neither physical nor nervous obstruction of coitus, nor was there vaginismus. They had also examined C. D., the defender, and had found his external genital organs normal. They were of opinion that consummation must have been prevented by some nervous or functional disorder operating during the attempt at coitus. They believed that a man might be perfectly competent to have intercourse with one woman, and perfectly incompetent with another, that the defender was impotent *quoad* his wife, but that they could not negative the possibility of his being able to have intercourse with other women.

At the close of the proof, counsel for defender intervened, and argued that there was no evidence of impotency on the part of the defender except *quoad* the pursuer, and he craved that the decree should not be pronounced in terms of the conclusions of the summons, but should be as follows, the words in italics

being inserted:—" finds and declares that the defender was, at the time when the pretended marriage between him and the pursuer was entered into, and still is, impotent and unable to consummate the marriage *with the pursuer* by carnal copulation."

Lord Stormonth Darling, in giving judgment, said that this case was exceptional owing to the fact that the pursuer was only twenty-one and the defender thirty-one years of age, and that both were proved to have no malformation of any kind which medical inspection could detect; that it was also a relevant fact that there was no trace in the husband of former malpractices which might diminish his virile power; that it was a very exceptional case, and it was difficult to account for what had happened, but that he was not called upon to speculate on that subject; and that it was sufficient to entitle the Court to nullify the marriage if it appeared on the evidence that the marriage had not been consummated, although there had been repeated opportunities of doing so, and willingness on the part of the spouse who was seeking to annul. Accordingly, he annulled the marriage; and he thought that the addition of the words suggested by defender's counsel were perfectly proper, and indeed they were really exegetical of what alone he could do in a summons of this sort, and he would, therefore, insert them.

Other reported cases of relative impotency will be found as follows:—For D. *v.* D., 4 Shwabe and Tristram, 86; F. *v.* P., 1896, 75 *Law Times*, 193; L. *v.* L., 7 P. D. 16; H. *v.* B., P. (1901) 39; A. *v.* B., 38 S. L. R. 559; C. B. *v.* A. B., 12 R. (H. L.) 52; M. *v.* M., 2 Robertson, 625, A. *v.* B., 1 Spinks, 12; and Fraser, "On Husband and Wife," vol. i. 92.

II. Sterility or Impotency in the Female.—In the consideration of this aspect of the subject from the medico-legal point of view, it is essential, at the very outset, that the difference between the legal and medical views or interpretations of sterility and impotency in the female should be understood, especially with relation to the matrimonial state. The legal definition may be considered to be: such physical and irremediable conformation of the sexual organs as prevents the act of coition; the medical, as the inability of a woman to become pregnant while in the married state, from any cause whatever, or as Taylor[1] puts it, "the inability to procreate, or a want of aptitude in the female for impregnation." The law of England lays down that no woman under the canonical age of twelve can legally marry, owing, doubtless, to the average time of attainment of puberty, the law of France, 15 years, and that of Germany, 14 years. The first factor, therefore, from the medical point of view, in sterility, is—

Age. Generally speaking, females who have not yet menstruated, and those who have ceased to menstruate at the other extreme of age, are sterile or impotent; from the legal point of view, those females who have not reached the canonical age. But this disability only attaches to legal matrimony; it does not predicate legal impotency, as shall be shown in the discussion of the subject of pregnancy. However interesting may be the questions of precocious menstruation, of the average period of the onset of puberty in females under different climatic environments, and other kindred topics, they have but little direct medico-legal bearing, and, therefore, must be passed over. The only question upon which menstruation may have a bearing in civil cases is that which may arise in the case of women who

[1] *Op. cit.* vol. ii., p. 303.

have ceased to menstruate at or about the usual age when this function normally fails, with respect to the possibility of their further bearing children, in relation to the provisions of a will. But the age at which the average woman ceases to menstruate can have only indirect bearing upon the determination of the answer in the case of any given woman, since the problem must be satisfied with specific relation to the given case.

We are shut up, then, to the sole consideration of the above subject from the legal point of view—viz. those causes of physical and irremediable conformation of the sexual organs which preclude the act of coitus. The causes may, therefore, be divided into those which are :

1. Absolute and Irremediable ;
2. Temporary and Remediable ; but the possibility of remedy may only be discovered after an action of nullity has been laid.

I. *Absolute Causes*.—These include,

(*a*) Complete absence of the Vulva ;

(*b*) Absence of the Vagina.

Where both of these conditions are congenital, the impotency must be looked upon as absolute. The former condition, however, usually resolves itself into some form of hermaphroditism of which the varieties are very great, but in all of which the common feature is the absence of a vaginal canal of such a kind as to enable normal coitus to take place. The dividing line between the sexes in certain cases of hermaphroditism is so narrow that it is extremely difficult to decide whether the individual be a female or a male, either from the point of view of anatomical relation of parts, general physical conformation, or physiological desires. But the vulva may be normal, and yet there may be congenital absence of the vagina. Lawrence records a case of imperforate vagina, without uterus, but otherwise, with complete external manifestation of sex.[1] Latouche [2] narrates the case of a woman of 19 years of age, who was well formed in other particulars, but in whom there had never been any ovarian or menstrual flux, owing to the absence of ovaries and uterus ; and Miller,[3] of a girl, aged 16, who was robust and well developed, in whom the vulva was well developed, but in whom the vagina was absent. On abdominal section, an anomalous mass was found in the normal site of the uterus which weighed six ounces and was of uterine shape, the bulk of which was as hard as bone, indeed presented all the histological appearances of bone. Dr Cotterill [4] gives particulars of a case of complete atresia of the vagina in a young married lady of 28, in whom the physical appearances were feminine, the mammæ being above the average in size, and the external genitals in the main normal, but in whose case coitus obviously had never taken place. She was operated upon, and some time afterwards she informed Dr Cotterill that marital relations were satisfactory. Other cases, also operated upon, have been recorded of this kind by Ballantyne,[5] in whose paper a case operated upon by Walton [6] is mentioned. Gooding gives the details of a case of the absence of the vagina in a married woman in whom the urethra discharged the function of the vagina. She had been married for two years, and in the early months of her marriage suffered intensely during coitus. On examination, the urethra was found widely dilated. From the age of sixteen, after an attack of inability to pass urine, which was drawn off by catheter, she felt something suddenly snap, and a dark treacley fluid came away for some days ; thereafter she menstruated regularly. She was operated upon, and a satisfactory connection with the uterus, which

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[1] *B. M. J.*, vol. i., 1900, p. 140 ; *ibid.*, vol. i., 1902, s. p. 74.
[2] *Arch. Provinc. de Chirurgie*, Ap. 1897.
[3] *New York Med. Jour.*, March 3, 1900.
[4] *B. M. J.*, vol. i., 1900, p. 837.
[5] *Scot. Med. and Surg. Jour.*, June 1899.
[6] *Belgique Méd., Ann.* 5 (1898), p. 354.

was normal, was established.[1] A case is reported of complete vaginal atresia with dilated urethra, but with no uterus.

II. *Temporary or Remediable Causes.*

(*a*) Excessive constriction of the vagina. In view of what has been said of complete *atresia vaginæ*, it is easy to conceive of this condition whether as an imperfect development of the parts, or as a stage of atresia. Such a case is recorded in [2] which the vagina was small in lumen but admitted a sound for a length of 2½ inches, at the upper extremity of which no internal generative organs could, however, be detected by examination.

(*b*) Excessive hyperæthesia of external genitals. Most authors deem this condition apocryphal, and we were of like opinion until we saw a case in which the woman, about 40 years of age, although married for 18 months, had never been able to consummate the marriage because of this. Attempts at vaginal examination threw the woman into a state of convulsive excitement. She was put under chloroform, and the parts were stretched manually upon three occasions, and, thereafter, by the use of cocaine ointment, ordinary marital relations were established.

(*c*) Imperforate hymen. These cases are by no means so infrequent as is commonly believed. We have operated on two cases, at periods of 1½ and 2 years respectively after the menstrual function had commenced. Attention to the condition in each case had been drawn by the gradual increase in size of what was thought to be a tumour, but which was due to the retention of the treacley menses.[3]

(*d*) Tumours of vagina; prolapse of the uterus, or of bladder; or malignant growths of vulva.

Declarator of Nullity of Marriage.—From the medico-legal point of view, an action of declarator will only lie against a husband, if he, by reason of impotency arising from imperfect conformation of congenital origin, or from malformation of the external genitals of an irremediable kind, is prevented absolutely from consummating the marriage; and against a wife, if she be of such congenital conformation as prevents her from permitting the consummation. These definitions are incomplete, inasmuch as they do not include all the facts, but they form a basis from which to begin consideration of the question.

Marriage is legally a contract between two persons of opposite sex, which presupposes on the part of each the lawful use of the body, or in other words, capability of the fulfilment of the act of physical union by coitus, and any cause whatever originating on the part of either of them which creates a barrier to coitus would, according to civil law, enable declarator of nullity of marriage. From the legal point of view, the impediment may simply consist in the deliberate and persistent refusal on the part of either of the parties to consummate the marriage, although both parties may be normally built. But from the medico-legal point of view, the point to be considered primarily is, Does there exist such physical deformity or deficiency in the body of the party against whom the action of divorce is laid, as to prevent and as is likely to continue to prevent, the consummation? According to English law, if a man and woman be joined in lawful wedlock, if some time afterwards the woman shall declare that the husband

[1] *The Lancet*, vol. i., 1879, p. 430; *B. M. J.*, vol. ii., 1901, p. 981.

[2] *B. M. J.*, vol. i., 1900, p. 762.

[3] *Glasg. Med. Jour.*, vol. xiv., p. 382; *B. M. J.*, vol. i., 1900, p. 65; *Lancet*, vol. i., 1902, p. 20.

has not been able to effect coitus, and if she be able to prove her statement by her own condition, the marriage shall be null, because marriage was not only instituted to prevent fornication, but for fruitful procreation. Where a lawful marriage has taken place between a man and woman either of whom is entirely inept, not on account of age, but by reason of some natural impediment to the propagation of children, as for example impotency or like causes, the law shall make the marriage null. Such natural impediments shall equally apply to the woman as to the man.

The General Common Law of Germany practically conforms to that of England, and is to the effect that " any married person who at or after cohabitation by their conduct shall intentionally obstruct the attainment of the legitimate object thereof, gives thereby to the other party a lawful occasion of divorce. Any incurable cause of complete inability to discharge the matrimonial duty, even though it have first originated after marriage, also gives occasion for divorce. The like is the case with any incurable bodily infirmity, which excites loathing and disgust, or wholly prevents the attainment of the object of marriage." But this law differs from that of England in that it permits a suit of divorce to lie in the case where an incurable cause of complete inability to discharge the matrimonial duty originates after marriage. Blackstone[1] puts the matter very clearly thus : " A total divorce is given whenever it is proved that corporeal imbecility existed before the marriage. In this case, the connection is declared to have been null and void *ab initio*. Imbecility may, however, arise after marriage ; but it will not vacate it, because there was no fraud in the original contract, and one of the ends of marriage, the procreation of children, may have been answered." Based upon this principle, therefore, in cases in which cohabitation has existed for variable periods after marriage, and in which suits of divorce have been raised by one of the parties, decisions of the judges have been against granting the divorce. Many judgments of this kind may be found in Phillimore's " Ecclesiastical Reports." [2]

By the law of England, marriage is both a religious and civil contract ; by the law of Scotland solely a civil contract, *consensus non concubitus facit matrimonium* being a maxim of Scottish law. Divorce is of two forms : (1) *a vinculo matrimonii*, which can only be granted where one of the canonical causes of impediment exist, and for medico-legal purposes may be deemed to be particular corporeal infirmities ; or, (2) *a mensâ et thoro*, with which, medico-legally, medical men have little to do, except in those cases in which the alleged cruelty consists in imparting to the wife or husband, as the case may be, a specific disease as syphilis, as in Campbell *v.* Campbell,[3] and in other cases.

When an allegation is made by the wife against the husband that impotency giving rise to impediment exists, it is the duty of the Court to call in medical evidence. Two or more medical men are appointed to examine the husband in some private place, where the defendant must submit to such an examination as the medical men

[1] " Commentaries," vol. i., p. 440 (Notes by Christian).
[2] Vol. iii., p. 425 ; *ibid.* p. 147.
[3] The Campbell Divorce Case, 1886.

think necessary, in order to verify the existence of the alleged impediment which causes the impotency. In order, however, to establish the averments of the wife, it is necessary she should show evidence, by a medical examination of her own body, that she is not only *virgo intacta*, but also *apta viro*. The medical evidence will, therefore, include the result of the examination of both parties.

In the case where the husband sues for declarator of nullity against the wife on the same grounds of impediment to consummation of marriage, if she defend the action, medical evidence must be given to show whether or not the allegation is true by the present condition of the woman.

The likely difference in character of the medical evidence in these cases will be that, in the former case, the evidence is *negative*, and in the latter, positive. Since in the former the examination can only apply to the physical conformation of the genitals of the husband, and since any opinion as to his virility must depend upon his being like, or unlike, to other men, and upon the existence of virginity in the wife, which is evidence tantamount to the non-accomplishment of a given and required act, it is clear that the evidence must be of this negative character, for unless there be in the husband marked deficiency or departure from normal of his external sexual parts, no opinion implying inability may be offered. No examiner can positively state, where the usual complement of parts is present in a man, that the virile and procreative powers do not exist; and all that can be stated is that no good reason exists why both powers should not be present. In the case of the female, however, in the latter case, assuming the husband to be normal, the impediment is likely to be obvious, and will probably consist of such defect of the vaginal section of the external genitals as will establish the inability to permit coition; hence the evidence is positive. But the law requires more than this. It is not enough to say that impotency exists in the case of a male or female by reason of impediment; it must, indeed, be shown that the impeding cause is irremediable. For example, where the impediment consisted only of an unduly thick and tough hymen in the female, it would not be considered as a good ground for declarator of nullity, since it may be remedied by surgical operative procedure. But in cases where there is, admittedly, defect of parts in the female, such as absence of the vagina, or imperfection of vagina which may not permit of natural and complete coitus, then a suit of declarator of nullity would lie. Questions, however, may arise in respect of this latter condition which can only be solved by medical examination and opinion. All that the plaintiff can demand is reasonable and natural access. Should this be possible, even though the other sexual parts necessary to fruitful procreation be entirely absent, the suit will not prevail; but should this be impossible on the other hand, and no operative procedure which the defendant was willing to undergo would be of any avail, then divorce would follow. Contingent upon the view that marriage is a contract, there are certain points which the law would decide from this point of view only. Should, for example, an admittedly defective man or woman—defective in the divorce sense—marry a normal woman or man, and the healthy

contracting party be made aware of the condition of the other prior to marriage, no suit of divorce could be established after the union, because of consenting knowledge on the part of the healthy contracting party. In like manner, the development or production of any condition, preventive of cohabitation, some time after the marriage had been consummated, will afford no legal ground for declarator of nullity, since the contracting parties by the act of union in marriage do not bind themselves to maintain for all time the physiological bodily conditions in which they were at the time of the union.

To sum up the conditions which would enable a suit declarator of nullity to lie, we would mention the following—viz.

(*a*) The existence of an evident and irremediable bodily defect or infirmity which offers complete impediment to the consummation of the marriage ;

(*b*) That the said defect or infirmity existed at the time of marriage, and was not revealed before marriage ;

(*c*) That the defect or deformity did not arise or develop after cohabitation in the legal sense.

PREGNANCY IN ITS MEDICO-LEGAL ASPECTS

The question of pregnancy may come before the medico-legal examiner in many various ways and for diverse reasons. Of some of these, the following may be named :—

(*a*) As a reason why a woman should be excused attendance at a trial as a witness.

(*b*) In a case of slander : in which, of an unmarried woman, a widow, or a wife living apart from her husband, it has been said that she is pregnant.

(*c*) To declare whether or not a woman who has raised an action of damages for breach of promise of marriage and seduction, is pregnant, or whether she has really been delivered of a child.

(*d*) To say whether or not a woman is with child, the possible heir to an estate, her husband having but shortly before died, in order that in the disposition of the estate the law of succession be duly satisfied.

(*e*) In cases of supposed imposture of pregnancy, to say whether or not the woman has been pregnant, and has been recently delivered of a child.

(*f*) To form an opinion whether or not a woman, at or about the age of the menstrual climacteric, is likely to become pregnant either for the first time, or in continuation of a series of pregnancies, with relation to the question of wills or adjudication of estate.

(*g*) To say, of a given woman who has been sentenced to death and who pleads in bar of execution of sentence that she is pregnant of a quick child, whether she is or not.

(*h*) To declare in cases of alleged criminal abortion whether or not the woman has been actually pregnant.

(*i*) In cases of alleged concealment of birth or pregnancy and infanticide, to affirm whether the woman has or has not been pregnant, and, if she has been pregnant, to say whether or not she has been recently delivered of a child.

There are other contingencies besides these, but the foregoing will serve as illustrations.

Generally speaking, the possibility of pregnancy must depend upon the function of ovulation with which menstruation is closely

associated; therefore, we must take cognisance of the ages when the function of ovulation commonly begins and ends. Leaving on one side cases of precocious menstruation in infants and young children, which is most usually an index of ill-health, there are abundant records to show that the average ages between which girls in this country attain puberty are 14 to 16 years.[1] But as is well known, climatic conditions affect the periods of onset; it is much earlier, for example, in warm climates as India, and later in rigorous countries as Northern Europe. Engelmann[2] has pointed out from statistics collected from his own observations and from those of others, that of 5000 girls in the United States—Boston and St Louis—the average period of onset was between 13½ and 14½ years, and he affirms the general principle that birthplace and parentage less affect the period than do the surroundings and mode of upbringing. But while it is the rule that a woman usually becomes pregnant only after the *known* establishment of menstruation, as exhibited by the usual signs, cases are far from being rare in which impregnation has occurred where the usual signs of menstruation had never appeared. In such cases, we are shut up to one of two conclusions—viz. either that the process of ovulation must not necessarily be accompanied by such uterine excitement as produces the menstrual flow, or that the stimulus of marriage has awakened the hitherto comparatively inactive process of ovulation. There can be little doubt that both conditions are to be found. For apart from the cases in which a woman marries before the usual external signs of menstruation have appeared and in which condition she becomes pregnant, and where besides, the external signs only appear after her first pregnancy, there are cases within the range of experience of all practitioners, in which a woman may, from the time the menses cease on her first impregnation, pass through two, three, or more rapidly successive impregnations without any external sign whatever that the process of ovulation had been resumed. One writer records a case within his own experience in which he attended a lady in several confinements, who was in fact the mother of twelve children, and who had never menstruated.[3] But there are good grounds for believing that in some women, certainly, the process of ovulation goes on regularly without any external manifestation of menstrual flux, at least of a sanguineous character, and it is not unreasonable to believe that, in such cases, the flux may only be of a mucous character. But the fecundity of married women cannot in any way be based upon the regularity and normal character of the menstrual flux, as too many factors embarrass and disturb the calculation. Instances are numerous of women who have been sterile to one husband and fruitful to a second. While, in the general case, the bodily health of the woman affects the process of ovulation, and, therefore, the likelihood of impregnation, we have to reckon with those women who in wretched health, even in phthisis, conceive readily. Indeed, certain writers on this subject have asserted that the cycle of the reproductive function is an autonomy within the body of the female, and, to some extent, independent of the

[1] *B. M. J.*, vol. i., 1901, p. 640.
[2] *Ibid.* vol. i., 1900, p. 1374.
[3] *Ibid.* vol. i., 1897, p. 1071.

general bodily condition; and they adduce as reasons for that opinion, the foregoing fact of apt pregnancy, and also the other that some women during their earlier pregnancies have a periodic menstrual flux. Whether this latter fact is solely to be accounted for by a bicornate uterus, it is impossible, however, to assert. Fecundity would appear to be influenced, in certain instances, by heredity. Various writers have drawn attention to this, of whom we shall only quote three: Valenta[1] narrates an extraordinary case of hereditary fertility. The woman who was married at the age of 14 years, during a married life of twenty years gave birth to 32 children in eleven pregnancies; there were twice quadruplets, six times triplets, and thrice twins, twenty-six were boys, six were girls, of whom twenty-eight were born alive, and four, dead. Her first essay in parturition was at the age of 14, and yielded quadruplets. Her mother was one of quadruplets, and she had borne 38 children. There was, likewise, a history of plurality of births on the father's side. Macphail[2] also gives an account of a case in which he traces the tendency to plurality of births through five generations, but in no single instance in all the generations was the plurality greater than triplets.

Da Cruz reported to the Lisbon Medical Society another remarkable case of a woman who in four pregnancies bore eleven children; twins in the first pregnancy, triplets in the second, quintuplets in the third, and a single child in the last. Most of these children, however, were either still-born or died shortly after birth. The factor of heredity in this case is shown in the fact that two sisters and an aunt of the woman had also had multiple pregnancies.[3]

As bearing upon the duration of pregnancy, the variability among women of the interval between the menstrual periods must not be lost sight of, as certain writers do not hesitate to assert that it has the most important bearing in cases of abnormal duration, either on the side of brevity or length. To this question, however, we shall return. At the other end of female life, the time when impregnation becomes impossible through cessation of the function of ovulation is equally difficult to determine, for while the average age may be stated to be any age between 40 and 60, any conclusions of a special case based upon such an average would be very fallacious and misleading. In this, as in the period of onset of the function, there are marked individual differences. In medico-legal practice, reasoning from the general case to the special may be permissible in certain circumstances, but in this contingency an opinion should be based upon the individual case only, and even then, with caution. Anomalies in age at which ovulation ceases happen too frequently to be ignored. When it is recollected that in well-established cases the function has ceased so early as the age of 23, and has continued so late as 75,[4] the importance of considering each case upon its individual merits becomes apparent. If it be true, therefore, that the regularity of menstruation is an index of the continuity of the process of ovulation, the period at

[1] *Wien. med. Wochenschrift*, No. 3, 1897.
[2] *The Lancet*, vol. ii., 1895, p. 1429.
[3] *Ibid.* vol. i., 1889, p. 392; *B. M. J.*, vol. i., 1902, p. 669.
[4] Whitehead, "On Abortion and Sterility," 1847, p. 145.

which a woman may become pregnant becomes a wider one than might, at first sight, be supposed. This subject will be considered, however, in the discussion of legitimacy. As it is possible for a woman to conceive before the external signs of menstruation have appeared, so also must it be reckoned as possible in a woman within a limited time after these manifestations have disappeared.

Within recent years we became acquainted with the following case. A woman, aged 47, who had ceased to menstruate for over a year, began to experience discomfort by reason of abdominal swelling, which was diagnosed by a practitioner as a uterine tumour, which tumour, however, some months later made its appearance in the world as a fine healthy boy.

From these preliminary considerations, we return to deal with the circumstances enumerated at the beginning of this chapter in which an examination regarding pregnancy may have to be made.

Regarding the first-named—viz. the relation of pregnancy as an excuse for the attendance of a woman as a witness, it ought to be definitely understood that the mere fact of a woman being pregnant is not of itself a sufficient excuse, except when she is so far advanced in that condition that her delivery is imminent. At the same time, a valid excuse of non-attendance may be offered, and will probably be accepted, if, owing to any intercurrent condition arising out of the pregnant state, she would suffer risk or prejudice to herself or the product of conception by such attendance, such as risk of abortion, hæmorrhage, etc., in which case a legal medical certificate would cover.

The next two named contingencies, *b* and *c*, which depend upon the simple diagnosis of pregnancy, will fall under the discussion of the signs of pregnancy.

Where the succession to an estate depends upon the possible existence and live-birth of a posthumous child, the fact of pregnancy becomes of greater importance, since in that case, and in the event of the husband and father having died intestate, the estate will have to be tied up until the question is solved, in the event of the pregnancy of the widow being established, by the birth of the infant. Besides, a legacy, or an estate, may be left to a child *in utero*, and it may have a guardian or trustee appointed to administer its affairs, contingent on the expectation that it shall survive the perils of birth. Then there is the position known in English law as *in possessio fratris*, which may be illustrated by the following supposititious case :—A man, who has been married twice, dies : his second wife, surviving him, is pregnant. From each union there has been one female child. The posthumous child proves to be a male, who only survives his birth a few minutes. By his birth, the disposition of the father's estate becomes entirely changed. Had the posthumous child not existed, the estate would have been divided equally between the two daughters ; but his birth has the effect of transferring the whole of the estate to the daughter of the second wife, because she is the nearest relative to the male heir, while the daughter of the first wife becomes only half-blood. Again in English law, the writ of *De ventre inspiciendo* may be issued under the following circumstances :—A husband dies without as yet any issue by his wife who survives him, and the succession to his estate falls to his heir-at-law.

But the wife declares that she is pregnant. To verify this fact, or to disprove it, becomes a matter of importance to the heir-at-law, who asks the court to issue the above writ for medical inspection, upon which the answer to the issues depends.

Imposture of pregnancy is but rare, but that it may have been practised in earlier times is postulated by the fact that the births occurring in royal families must be attended by a Minister of State. One of the most remarkable cases, as indicating what a woman will do to achieve her purpose, fell within our experience a few years ago in police practice. A woman who was in the habit of "farming" children, and to whom the attention of the police had been called, was observed by her female neighbours to have suddenly increased in bulk, and she gave it to be understood that the cause was pregnancy, and that in two and a half or three months later she expected to be confined. The neighbours' suspicion was aroused; her bulk increased, until one morning about the time named it was announced to the neighbourhood that she had been confined. The women were indignant at her attempts to deceive them, and they gave a hint to the policeman that he should get the doctor to examine this woman, who, they said, had never borne the child, but had tried this method of realising her object. When we went to her house, she was in bed, and lying beside her was an infant. The "binder" was applied, and the lower parts of the underclothing bore evidences of bloody discharge. The infant was trying to extract milk from the nipple of a withered breast in which there was no milk, nor likely to be any. Examination *per vaginam* revealed the fact that she had not been recently delivered and had not been pregnant. In this case, it will be noticed that both imposture of pregnancy and pretended delivery were attempted. Most usually, however, it happens that higher stakes are at issue when these attempts at deception are practised; indeed, to introduce a supposititious child into the world as the heir to a property. Although several cases might be cited, the following which was recorded by Dr Balfour—the translator of the Sydenham Society Edition of Casper's "Forensic Medicine"—is very typical.[1]

The following is a summary of the facts: about two months before the end of December 1879, Dr B. attended a Mr X. in his last illness, during which he observed the extremely assiduous attention of the wife to her husband. On December 29, Dr B. received a note from Mrs X. requesting him to call some time during that day. He did so, late in the afternoon, and was not a little astonished to find a nurse in the lady's room seated before the fire with an infant in her hands. He apologised for having been late, as he did not think it could be a case of that kind since he had not been engaged to attend; besides, there was no mention of the nature of the illness in the note, and he did not even know that she was pregnant. Mrs X., however, received his explanation in a "kindly spirit." Thereupon, he made inquiry respecting the time of the birth, and was surprised to learn that it had taken place, as she told him, at 5 P.M. of the previous day. She also informed him that the child had been born before the arrival of the nurse, and that a neighbour had assisted her during her labour. She was a primipara. Up to this point Dr B.'s suspicion was not aroused, but gradually as he sat in the room he began to suspect the probability of some deception being practised. To find this out, he sent the nurse into an adjoining room, while he, under the pretence of looking that everything was right, proceeded to make an investigation of the person of the patient She, being

[1] *B. M. J.*, vol. i., 1880, p. 241.

generally of an anæmic condition, could reveal nothing to him from that point of view. He found the binder properly applied, and her chemise well stained with blood ; but on making a vaginal examination, he was at once convinced that she had never borne the child, and at once told her so. She, on solemn oath, declared that the child was hers. The nurse was now brought in, and the remains of the child's umbilical cord were examined : the appearance of it and the alleged time of the birth did not tally. The nurse was again sent out of the room. He then repeated the assertion that the child was not hers, and that she was not the mother of it. She, modifying her tone, said, "Do you say it is not mine ?" He replied, "Certainly not." Thereupon, she attempted to bind Dr B. to secrecy, which, however, he refused to listen to, adding that if she did not give a true account of the matter he would call in the aid of the authorities. She then told him that she got the child from an unmarried woman in Leith who had been delivered of it the day before she took to her bed, and that, although she had said that she had been delivered of it at 5 P.M. the night previous, the child did not actually arrive at her house till between 7 and 8 P.M. The cause of her conduct, according to her own statement, was her great maternal affection ; the true cause was, probably, the fact that, as her husband had died intestate, she was only entitled to one-third of the property he had left, while the child would have received the other two-thirds, had her deceit proved successful, and she would, also, have been placed in receipt of an allowance as the natural guardian of her child. Her plot had, evidently, been well laid. She had informed a male friend of her husband, and his lawyer, at the time of the death of her husband, that she expected to be confined in about two months after that time, and the property had been tied up in expectation of the event. She had previously expressed the hope to friends, on several occasions, that her baby would have blue eyes, like those of her late husband. This feigned child did actually possess eyes of that colour, a fact which might have gone far to prove the heirship had she been successful in her fraudulent plans. The nurse was entirely innocent of connivance in the attempt to defraud.

The next condition to be considered is that in which a pregnant woman is sentenced to death, who declares that, being quick with child, the execution of her sentence should be delayed until the child is born. As we have elsewhere pointed out,[1] the judge who has tried the case must appoint under the writ *De ventre inspiciendo* a jury of matrons to examine the woman, and, according to the law of England as it stands at present, such jury is to be composed of married women taken from those who may be present in Court at the time. This was done by Mr Justice Grantham, at the Lancashire Assizes in 1889, in the case of a female domestic servant who was sentenced to death for the wilful murder of her child by drowning. The jury of matrons found that the woman was *enceinte*.[2] It need hardly be pointed out that this is an anachronism. Indeed, some judges under such circumstances ignore the law and either appoint a medical man to act along with the jury of matrons, or two medical men without said jury. In 1882, the Parliamentary Bills Committee of the British Medical Association made a representation to the Crown "that the practice of empannelling a jury of matrons in cases in which pregnancy is pleaded in bar of execution is not in accordance with medical science, and that the law on the subject requires alteration." Moreover, in the draft code of the Criminal Code Commission of 1879, the same view is given effect to in clause 531, in the following terms :—"If sentence of death is passed upon any woman, she may move in arrest of execution on the ground that she is pregnant. If such a motion is made, the Court shall direct one or

[1] *Edin. Med. Jour.*, July 1895.
[2] *B. M. J.*, vol. ii., 1889, p. 1131.

more registered practitioners to be sworn, to examine the woman in some private place, either together or successively, and to inquire whether she is with child of a quick child or not. If upon the report of any of them it appears to the Court that she is so with child, execution shall be arrested till she is delivered of a child, or until it is no longer possible in the course of nature that she should be so delivered. After the commencement of this Act, no jury *De ventre inspiciendo* shall be empannelled or sworn." It will be observed that in the law as it stands, and as is proposed in the new Criminal Code, the stay of execution will only be successful should the woman prove to be *quick* with child—that is, where the movements of the child in the mother's body can make themselves perceived by an experienced observer, or by the sound of the fœtal heart as heard by the physician. This is based upon the statement of the law of England which " considers life not to commence before the infant is able to stir in its mother's womb," [1] and, also, according to canon law, " *non est homicida, quæ abortum procurat, antequam anima corporis sit infusa.*" In older statutes, accordingly, it was deemed a graver offence if the attempt to procure abortion were made after the quickening of the child, than before. But although the law has moved forward, and now considers the crime of abortion, *qua* the act itself, to be equally grave at whatever time produced between conception and the natural onset of labour, it has left certain anomalies behind, of which the foregoing is one. Much might be said against the view which the law takes of the product of conception within the body of a sentenced woman, but it is, perhaps, sufficient to say that there is no difference substantially between the fœtus one week before quickening is perceived and one week after, except the mere accident of time, since physiological life is present all the time ; and if the law is to be logical it ought to be held, in the conditions under discussion, either that the product of conception at no period of its intra-uterine growth is sacred, or that during the whole period it is sacred and worthy the jealous care of the State, as it is deemed to be in civil law. The law of Scotland takes a more logical view—viz. that in respect that a woman pleads she is pregnant, and is, therefore, unfit to undergo sentence of death, her plea, if substantiated, entitles her to have sentence delayed until her child is born, irrespective of its stage of intra-uterine growth.[2] In France, also, the pregnancy of a woman, irrespective of the age of the fœtus, compels the postponement of execution.

Having, then, dealt with the occasions upon which the question of pregnancy may arise, apart from the crimes of criminal abortion and concealment of birth or pregnancy, which will be considered by themselves, the signs of pregnancy next fall to be considered.

Signs of Pregnancy.

The signs of pregnancy consist of the following :—

1. Cessation of the Menses.
2. Morning Sickness.
3. Mammary Changes ; which consist chiefly of gradual enlargement of the mammary glands, and the formation of a pigmented areola round the nipples, and, in the later months

[1] Blackstone, " Commentaries," vol. i., p. 129.
[2] Hume, vol. ii., p. 471.

in primipara, of the presence of colostrum or milky secretion, which may be expressed from the nipples.

4. Abdominal Changes; which consist in (*a*) gradual enlargement, developing to hyper-distension; (*b*) pigmentation; (*c*) signs of hyper-distension of skin of abdominal wall; (*d*) the discovery, by palpation, of a more or less solid body by the sense of touch, and, it may be, of fœtal movements.
5. Changes in the Uterus and Vagina. In the former, (*a*) by enlargement in size, as discovered by bi-manual palpation; (*b*) by the velvety feel of the mucous membrane of the os; (*c*) by the soft cushion-like feeling of the uterine neck; and (*d*) by the port-wine colour of the mucous membrane of vulva and surface of vagina, which is called *Jacquemier's test.*
6. Quickening. This is perceived by women themselves at variable periods depending upon their individual experience of the sensation, for it can hardly be expected that a primiparous woman will detect it so soon as a multiparous, and upon the progress of fœtal development, since the development of the fœtus at equal ages varies. It is, probably, for this latter reason that the term of pregnancy at which different women discover quickening differs so much, for although it is usually reckoned to be perceivable by the average woman about the 17th week, it may be perceived one or more weeks earlier or later.
7. Fœtal Heart Sounds. These can only be perceived by an experienced observer after the uterine and abdominal walls are sufficiently in juxtaposition that by conduction through fœtal body, uterine and abdominal walls, and stethoscope, the sounds of the heart movements of the fœtus are conveyed to the ear of the observer. When such are heard it is unequivocal evidence of the pregnancy and of the life of the child. They sound to the ear of the listener like the muffled ticks of a watch under a pillow, and the number of beats per minute varies as the uterine age, being from six months onwards from about 160 to 120 per minute. The situation on the abdomen in which they may be perceived depends upon the posture of the fœtus *in utero.* Their absence does not exclude pregnancy, since the child may be dead, nor even negative fœtal life, since if a column of *liquor amnii* interpose between the fœtal body and uterine wall, the conduction of the sound may be so interrupted that no vibrations reach the ear of the listener. There are, in addition, other sounds which are perceivable by the stethoscope from the pregnant uterus, which are due to the fœtal circulation. These are called, collectively, the Uterine or Placental Souffle. It would appear as if they were caused by the waves of blood rushing into the sinuses of the uterus.
8. Ballottement. When a movable solid body of heavier specific gravity than water is surrounded more or less by fluid in a practically closed cavity, it falls by gravity to the lowest part of the cavity; if, then, the finger suddenly tilts or tips up the solid body by an upward movement, it will momentarily leave the finger, ascend into the fluid, and then fall back into its original

position, and in doing so, will impart to the finger the sensation of a falling body, if the finger be retained *in situ* during the experiment. This constitutes the phenomenon known as ballottement. It is most easily and readily perceived between the fifth and seventh or eighth months, owing to the ratio between amount of *liquor amnii* and size of fœtal body which obtains during this interval, and which, earlier or later than the months named, is different—that is, the liquid is of greater bulk than the fœtal body .

But of the foregoing signs, some are certain and some uncertain. Of the certainty of the signs in the earlier months it is difficult to speak, since an opinion at this stage must depend more upon the combination of signs than upon the distinctive character of any individual sign. Thus cessation of the menses and morning sickness, of themselves, are very uncertain signs, since the menses may disappear temporarily from causes other than pregnancy, and a flux of blood may periodically recur even after conception for a variable number of months, if not, indeed, throughout the whole duration of pregnancy; in like manner, the latter symptom may not be present at all, or at such comparatively rare intervals only, that no stress can be laid upon it as indicative of pregnancy. But, on the other hand, should cessation of the menses, morning sickness, gradual pigmentation of nipples, and enlargement of mammary glands, exist together along with a visibly increasing abdominal bulk and a port-wine coloration of the mucous membrane of vagina, it may reasonably be concluded that pregnancy exists. In the later months—the latter half of the period—there are signs, however, which are absolutely certain: if the fœtus be alive, the fœtal heart sounds, fœtal movements, and ballottement will indicate the fact with certainty; if the child be dead, however, palpation of the contour of the fœtal body, when such is possible, with ballottement, but with none of the specified signs of life will point to the presence of a dead fœtus *in utero*.

Certain diseased conditions of the abdominal cavity and of the internal generative organs themselves may simulate very closely the normal pregnant state. Of these, probably the chief are: (*a*) ascites; (*b*) fibroid tumours; (*c*) ovarian cysts; (*d*) extra-uterine pregnancy; (*e*) retention of the menses from imperforate hymen; (*f*) phantom tumours. It is not, however, necessary to discuss the differential diagnosis of these in any detail, because the student will likely have had opportunities of seeing some, if not most, of these diseased states during his clinical studies. The greatest difficulty in differential diagnosis will be experienced with the four first-named, as examination *per vaginam* would at once reveal the imperforate hymen and the normal condition of the uterus in the case of phantom tumour, verification of which latter diagnosis can be made by putting the patient under chloroform. While ovarian cysts most frequently develop toward the later period of menstrual life, they are of sufficiently frequent occurrence during the active menstrual period to compel attention. The history of the development, the absence of other signs of pregnancy, which are sure to develop if the case is one of pregnancy, and the initial unilateral development of the abdominal enlargement with clearness of percussion

at the flanks, would probably tend to clear up the diagnosis. Fibroid tumours of the uterus of such a size as to be mistaken for pregnancy are likely to have a history of slow development and of very gradual abdominal enlargement, and local uterine examination, in addition to bi-manual manipulation, are likely to reveal such facts as solidity of tumour, absence of the evidence afforded by ballottement, and absence of change in mucous membrane of os and cervix uteri, as will establish a diagnosis. In like manner, ascites may be distinguished from pregnancy by the uniform development of the abdominal swelling, by the wave-like motion of the fluid on percussion either in the sitting or recumbent posture when any measure of distension has been reached, and by the dulness in the flanks in the lying position. The greatest difficulty is likely to be experienced in the differential diagnosis of extra-uterine pregnancy from normal pregnancy, since in both the same early signs are likely to be present—viz. sympathetic changes in the mammæ, as shown by the pigmentation and gradual enlargement and fulness of the mammary glands, and gradual development of abdominal enlargement. In the former, however, menstruation is more likely to be continued, and the local uterine changes do not develop in the former as in the latter. The student should consult treatises of midwifery for fuller information on this subject. The question has been canvassed from time to time whether or not in a virgin female such substances as simulate very closely products of conception may not be expelled from the uterus. It has been asserted by Jacob and others that a hydatidiform mole, for example, may develop independently of impregnation. Whether this is correct or not, it would be impossible to affirm with certainty, because there are too few cases on record upon which to base judgment of a definite kind. At the same time, cases of a striking kind appear from time to time.

Bock [1] gives particulars of the case of a girl, aged 12½ years, living under conditions which rendered the question of virginity beyond doubt, who menstruated for the first time at the age of 12 years and two months, and during which period clots were painlessly passed. At the following period there was, however, pain, and a clot was passed, which consisted of a complete cast of the endometrium, with uterine glands and ciliated epithelium. The same thing was repeated at the next illness. At the fourth period there was slight flux for three days, and then a typical hydatid mole was expelled, which was made up of vesicles like rows of beads, each of which was full of a serous fluid and varied in size from the head of a pin to a pea. After this, her periods were normal up till four years after, when the facts of her case were published. The only apparent difference between the foregoing case and hydatidiform degeneration of the villi of the chorion (the product of a blighted ovum), is that of size, for the physical appearances of the hydatids seem very identical. Assuming that the question of virginity is beyond cavil, then it is obvious that another source of hydatidiform degeneration than that of the villi of the chorion must be reckoned with. Bock is inclined to connect the membranous dysmenorrhœa and hydatidiform mole closely together, and to view the origin of the latter as a pseudo-placental change of a part of the retained menstrual decidua. While this raises a very important and novel point in uterine pathology, it likewise opens up grave medico-legal issues, which, however, must be left unconsidered at present.

The Signs of Pregnancy in the Dead Body.—From the external appearances of the body alone, the chief signs will be those which are

[1] *Bull. de la Soc. Belge de Gyn. et d'Obst.*, vol. x., No. 3, 1899.

present at the stage of the pregnancy at which the woman died, and are likely to consist of (*a*) mammary changes; (*b*) abdominal enlargement; (*c*) changes in os and cervix uteri. But if the body may be dissected, no special importance need be attached to these, since by simply opening the uterus the fact may at once be discovered. In the older books on this subject, great importance was attached to the presence or absence of a true *corpus luteum* as indicating whether pregnancy had been present or not. It appears to us, however, that too much importance was attached to this, in view of the fact that dissection of the uterus would reveal far more truly than any other kind of examination whether or not uterine products of conception were present, or had been present. Whatever importance this may once have had is, however, completely destroyed by the discovery that true *corpora lutea* have been found in the bodies of women who were neither pregnant nor even menstruating. In a paper by Popoff of Pensa, read before the Obstetrical Society of London in May 1882,[1] the following facts were recorded:—A prostitute, aged 21, died from poisoning by prussic acid. In one of her ovaries a fully ripe *corpus luteum* was found, although she was neither pregnant nor menstruating. A woman, aged 41, died from gangrene of a uterine fibro-myoma: her ovary contained a true *corpus luteum*, and, in other respects, resembled the ovary of a pregnant woman, which the narrator accounted for by the increased determination of blood to the part, owing to the presence of the tumour. The late Dr Matthews Duncan, in commenting on this paper, stated that he had seen such a *corpus luteum* in an aged woman, and that he had dissected a case of pregnancy in which there was complete absence of a *corpus luteum*. Where, therefore, the body is at disposal for dissection, reliance must be confined to the internal appearances of the uterus in the determination of pregnancy.

Pregnancy with Reference to Female Age.—The only points of medico-legal interest arising in this connection are: (1) What is the earliest age at which a girl may conceive? (2) What is the latest age at which women have been delivered of children?

Precocious pregnancy exists comparatively rarely, but several cases have been recorded from time to time. Leaving on one side those cases where in warm climates, by reason of early menstruation appearing normally in girls, earlier pregnancies are apt to occur, and confining our attention to cases within the temperate zone, some are recorded where conception has occurred so early as *eleven years and ten months*. This particular case is recorded by Taylor[2] as having been discovered in the trial of a charge against a man (R. *v.* Chattaway, Coventry Summer Assizes, 1838) of misdemeanour, in that he had carnal knowledge of a girl between the ages of ten and twelve years, from which the girl became pregnant and was delivered of a child at the age of twelve years and seven months. We have notes of a case which was attended by a student while acting as an assistant, in which a girl, aged *twelve years and two months*, was delivered by him of a child at full time with the aid of forceps. She must have conceived, therefore, at the age of *eleven years and five months*. Another case is recorded[3] by the

[1] *B. M. J.*, vol. i., 1882, p. 778. [2] *Op. cit.* vol. ii., p. 307.
[3] *Edin. Med. Journ.*, vol. vii., p. 332.

late Dr J. G. Wilson of Glasgow, in which a girl was delivered of a child at the age of 13½ years. Probably one of the earliest cases on record is that reported by Roberton of Manchester,[1] in which a girl, a factory-worker, conceived some months after her eleventh birthday, and was delivered of a full-grown child a few months after she had reached her twelfth year of age.

Robertson relates the facts of the case of a Colonial girl aged 13 years, who, when she consulted him in September, was seven months pregnant. She was delivered of a female child, weighing 7½ lbs., on November 22 following.[2]

Boldt [3] reports the case of a girl, 12 years of age, whom he examined and found to be in the fifth month of pregnancy. Labour was expected to come on in the third week of August 1905. Owing to a generally contracted pelvis, the conjugate diameter of which only measured 2½ inches, she was taken into hospital on August 9. She was there seized with puerperal eclampsia, and Cæsarean section was performed, but she died fourteen hours afterwards. The infant lived. The mother was only twelve years and eight months old at the time of operation.

Greater importance, probably, is associated with the second query, since arising out of the age of certain women at the time of their delivery late in life, important legal issues, as in the Douglas Peerage Case, have emerged. Many cases have been recorded of the delivery of women at ages usually considered to be long after the fecund age. While it is generally true that the fecundity of women lessens the nearer the age of the climacteric period is approached, and that impregnation does not usually happen after 45 years of age, it is rather with the exceptions that medico-legal science has to deal. Women have conceived and borne children when they were past 50; therefore, it would be foolish to try to fix the age in women below 55 at which pregnancy may not happen. It is, however, in this series of cases that legal issues arise. In the Douglas Peerage Case, which arose out of the legitimacy of the claimant being contested, tried at Edinburgh in July 1767, before the Lords of Council and Session, fifteen judges sitting, the question of legitimacy or illegitimacy centred round the question whether Lady Jane Douglas at the age of 49 could have conceived and brought forth a son. Each judge gave a judgment, and on the vote being taken, seven judges voted in favour of the legitimacy of Archibald Douglas and seven against, whereupon the Lord President gave his casting-vote against the claimant, and thus the Court declared against his legitimacy. The case was, however, appealed to the House of Lords, and there the judgment of the Court of Session was reversed in 1769.

The only cases of this kind which have fallen within our personal experience are the following:—

1. Mrs D. was delivered on Jan. 16, 1882, of a very large female child, in the 51st year of her age. This was her thirteenth child, and a lapse of many years had occurred since her previous confinement.
2. Mrs W. was delivered of her first child, a large male, when she was of the age of 44, on April 23, 1881, and of her second and last, also a male, on July 22, 1882, when in her 46th year.

[1] "Midwifery," p. 30. [2] *B. M. J.*, vol. i., 1902, p. 142.
[3] *Monatschr. f. Geb. u. Gyn.*, May 1906, p. 612.

Duration of Pregnancy : or Period of Gestation.—Popularly, the period of gestation is reckoned as nine calendar months ; scientifically, it is said to be an average period of 10 lunar months, 40 weeks, or 280 days ; and legally, of 40 weeks or 280 days ; but counsel is permitted to lead evidence in any given case as to the possible extension of that period. While the scientific or medical estimation of the period of gestation may be shortly stated as 280 days or thereby on the average, it would probably be still more correct to say that as labour comes on at the date when the tenth menstrual flow would, if it had continued, have begun, the duration of pregnancy must be reckoned from the date of conception as including ten menstrual cycles of any individual woman. So that while it is correct to say that in the large bulk of cases the period is that of 280 days, because of the menstrual cycle of the bulk of women being 28 days, it must be considered as possible that the period of gestation may be longer where the individual menstrual cycle is longer, or may be shorter where it is shorter. Thus a woman whose cycle was 28 days might be expected to be delivered at the onset of the tenth cycle—viz. $28 \times 10 = 280$ days ; where the cycle was 29, 290 days, and in a rapidly diminishing ratio of cases where it was 30 days, 300. So, also, on the other side of the average, the duration of the cycle might be 27, therefore, the duration of pregnancy would be 270 days, or 26 days and 260 respectively. By the formulation of the foregoing principle, which appears to be probable, we are bound, within physiological limits, by its logical issues. This doctrine, therefore, which was first laid down by Cederschjöld, Schuster,[1] and others,[2] may be considered as the opinion of the advanced gynæcologists of our time. Schuster, indeed, has shown of four cases how the duration of pregnancy must be reckoned on the length of the menstrual cycle ; in one, where it was 29 or 30 days, the first pregnancy lasted 296 days, the second, 300 days. These are but illustrative of many other recorded cases. Taussig[3] has made a valuable contribution to this subject. He gives a narrative of the facts of a case in one of his patients. Her menses ceased on Dec. 7, 1897, and a male child was born on Oct. 26, 1898, which weighed over 11 lbs., and measured nearly 22 inches in length. According to his calculation, her pregnancy lasted 323 days. In her next pregnancy the duration was 285 days. He further gives a report of 61 cases in which the period of gestation varied between 300 and 348 days, which have been recorded by other observers. The reader who desires to pursue the subject further is referred to his contribution for further details. It is now well established that pregnancy may be prolonged till the 300th day. Casper's propositions[4] on this subject are so apt that we quote them in full :—

(*a*) The usual duration of pregnancy is from 275 to 280 days.

(*b*) Pregnancy may, however, indubitably be protracted beyond this, and that even as far as the 300th day.

(*c*) Cases in which pregnancy is alleged to have been protracted

[1] Henke's "Zeitschrift," Bd. 57, s. 1.
[2] Spiegelberg, "Text-Book of Midwifery," vol. i., p. 65 (Syd. Soc. Ed.).
[3] *Amer. Jour. of Obstet.*, Sept. 1901.
[4] *Op. cit.* vol. iii., 370.

considerably beyond this, even to the eleventh, twelfth, and thirteenth months, have never been determined by accurate observations, and allegations of this kind in any individual case are, therefore, completely inadmissible.

The great difficulty in establishing the actual period of gestation is probably due, in large measure, to the absence of accurately observed data over a sufficiently large series of cases. Even in those cases which, so far as the physician is concerned, have been carefully observed, the possible error of the personal reckoning of the woman herself cannot be computed. Therefore any scientific data can only be founded upon rare isolated cases, in which, by reason of a single coitus with resulting impregnation, the duration of pregnancy may be reckoned. But even in that case, coitus is not necessarily contemporaneous with conception; indeed, a number of days may elapse between the two occurrences sufficient to completely invalidate the conclusion. So far as we can see, therefore, the foregoing propositions state the case with considerable accuracy. The following may be considered as typical of recorded cases of protracted gestation :—

1. Rea [1] attended a woman in her fourth confinement whose last menstrual illness was September 4, 1896, but she did not have sexual intercourse till September 30, two days before her next expected illness. There had been no intercourse during the previous two months, and there was none after the above date till her confinement. She, therefore, expected to be delivered on July 6, 1897, but although she had on two occasions severe hæmorrhage, labour did not come on till August 5, the fœtus being anencephalic. If the patient's statement is correct, then her pregnancy lasted 305 days.

2. Wigodsky [2] records a case of protracted gestation which lasted eleven months in a woman, a 3-para, aged 28. Her last period was dated September 7, fœtal movements were felt at end of January, and delivery took place on August 13. The fœtus was anencephalic. It is evident that the narrator reckons the period of gestation as dating from the cessation of the menses to the date of delivery.

3. The following case may be reckoned as a case of prolonged gestation, but differs from the two former in that labour did not come on naturally, in fact, did not come on at all, and abdominal operation had to be resorted to. It is, therefore, very properly denominated a case of "missed labour." The case is recorded by Dr Mary Scharlieb,[3] and the main facts are as follows :—Mrs W., aged 29, had been married eight years, and had a normal easy labour with her first and only child, about seven years before her admission to hospital in September 1894. Her last menstrual period was in October 1893, and she thought she was pregnant, but was ill for some time with abdominal pain and fever, after which, till May 1894, she was fairly well. At this time, however, when she believed herself pregnant six months, she became so ill with cramp-like pains that she could neither lie down nor sleep, which confined her to her room for six weeks. After a short interval she had another attack of pain and fever, and she passed a shapeless mass of pink jelly about 2 inches in diameter, succeeded by blood clots. Her illness continued until the time of her expected confinement in July, but no labour came on. Early in September, she had hæmorrhage *per vaginam* which lasted for a week, this being followed by a thick yellow discharge, during which time she had a few sharp pains as of the first stage of labour. She was seen by a medical man who advised her admission into hospital. Her condition on admission was as follows :—she looked very ill and worn, her temperature 102° F., pulse 120, respirations 26; the legs were swollen, the abdomen tense and œdematous, and enlarged beyond the ordinary size of pregnancy. Neither fœtal heart-sounds nor fœtal movements could be per-

[1] *Journ. Amer. Med. Assoc.*, May 14, 1898.
[2] *Medicinsk Obosrenie*, No. 2, 1896; and *B. M. J.*, vol. i., May 29, 1897.
[3] *B. M. J.*, vol. ii., 1898, p. 785.

ceived. On being put under chloroform, the outlines of the fœtus *in utero* could be detected through her abdominal wall, but on examination *per vaginam* no sign of cervix or os uteri could be discovered at first, although, later, behind and above the symphysis pubis, a narrow slit was found. Abdominal section was performed, when the pregnancy was found to be uterine, and the uterus to be adherent to intestines and abdominal parietes. On opening the uterus, an intensely fœtid purulent fluid poured out, and the fœtus was then extracted. It was large, well developed, and weighed about 12 lbs. It had been evidently dead for some time, from its macerated appearance. The placenta was disorganised. The woman died on October 25.

This case is unique in that a fœtus had fully developed *in utero* without the natural onset of labour. It is probably unique in literature, inasmuch as the pregnancy was verified by operation.

The following case, bearing upon this question, but from the opposite point of view, presents some points of great interest. The facts had to be reviewed by reason of an action of affiliation or paternity in the Glasgow law-courts against the reputed father. The facts were these: a young woman—a servant-maid—was delivered of a male child on January 14, 1886, which, upon examination, bore all the marks of maturity. The infant was plump, the finger and toe nails were well developed. Her statement was that intercourse between her and the defender took place only on one occasion, and that on May 28, 1885. She was able to fix this date because she had come into Glasgow on that day from her place in the country to be re-engaged at the hiring-fair held on that day, and it was at the fair she met the defender. That was not denied by the defender either as to date or the intimacy. The question for consideration was: Could a child, the result of fruitful intercourse on May 28, 1885, be born mature on January 14, 1886. The number of days between and inclusive of these dates is 231, and, *primâ facie*, the answer would be in the negative. On inquiry, the girl declared that she felt life at three months—a somewhat unusual circumstance—and on further inquiry as to her menstrual cycle, it came out that her menstrual periods had always been shorter than those of other girls—a fact that was corroborated by her mother. The interval was sometimes only 14, sometimes 17, and, occasionally, 21 days, and the menstrual flow usually lasted for 4 days. If the average of these cycles be taken—viz. $18+21+25\div3$ we arrive at an average cycle of 21 days, and multiplying that figure by ten, 210 days. But if an allowance be made for the likelihood of there being more of the longer intervals than the shorter, we must conclude that the figure actually found is quite compatible, *in her case*, with the birth of a mature child. The Sheriff decided the case in her favour, and gave decree as craved.

Velpeau [1] remarks that the menstrual interval may be only 22, 20, 18, or even 15 days, and he adds that he knew one woman who was never more than twelve days free from the flow, and, on the other hand, others who were regular every 32, 35, or even 40 days; and Davis [2] avers that many women menstruate at intervals of from 24 to 20 days. Other observers, also, record like odd cases.

Taussig has made a valuable contribution to this subject. He narrates the facts of a case in one of his patients, in which the menses ceased on Dec. 7, 1897, and a male child was born on Oct. 26, 1898, which weighed over 11 lbs., and measured nearly 22 inches in length. According to his calculation, the pregnancy lasted 323 days. In the next pregnancy of the same woman, the duration was 285 days. He reports 17 other cases recorded by different observers, in all of which the period of gestation exceeded 310 days, the periods varying from 311 to 339 days.[3]

Blackstone [4] remarks "that all children born before matrimony are bastards by our law; and so it is of all children born so long after the death of the husband, that by the *usual course of gestation* they could not be begotten by him. But this being a matter of

[1] "Midwifery," p. 87.
[2] *Amer. Jour. of Obstetrics*, Sept. 1901; *B. M. J.*, vol. i., 1902, p. 659.
[3] "Obstetric Medicine," p. 252.
[4] "Commentaries," vol. i., p. 456.

some uncertainty, the law is not exact as to a few days." It may be taken, therefore, that while the law considers about 280 days to be the normal period of gestation, evidence may be led to show reason why, in a given case, the period may be protracted beyond it. If we turn to the law of other countries, however, we shall find that those limitations are more strictly defined. The Common Law of Prussia, for example, recognises " no pregnancy as of longer duration than three hundred and two days," [1] and the Rhenish Civil Code restricts the limit to 300 days. In France, 300 days is reckoned as the outside limit of the duration of pregnancy. According to the Civil Code of France, sections 312, 314, and 315, a child born in wedlock has the husband for its father, unless the father disavows it and can prove that from the 300th to the 180th day before its birth, he had not been able, either by reason of absence or physical impossibility, to have connection with his wife. Further, the legitimacy of a child born 300 days after dissolution of marriage may be contested.

Legitimacy and Illegitimacy.—Every child born in lawful wedlock or within a given period after the death of the husband has the husband for its father, unless such can be disproved in a court of law. A child born of an unwedded mother becomes legitimised in Scotland on the marriage of the mother to its father, but it is not legitimised by the same circumstances in England. This difference is markedly defined in such cases as those in which a male child, so legitimated by the law of Scotland, becomes legal heir to the estates of his father in Scotland, but cannot be recognised and served as heir to any estates in England. This was the decision of the House of Lords in 1840 in the case of Birtwhistle *v.* Vardell. In this connection, also, the case of Dalhousie *v.* McDonall, tried in the House of Lords in 1840, may be studied. According to Erskine,[2] in the law of Scotland, " to fix bastardy on a child, the husband's absence must continue till within six lunar months of the birth, and a child born after the tenth month is accounted a bastard." But there is a much narrower aspect of the subject than this—viz. where a child is born of a married woman and during the subsistence of wedlock, under such circumstances of inability of access of the husband that it may be presumed, *a priori*, that he cannot be its father.

Further it is the law of England that a child conceived in wedlock, but born after the death of the mother, is the legitimate offspring of the union. While, technically, the death of the mother dissolves the marriage, in practice, the living child, extracted from her body by Cæsarean section, it may be, or by manual operation, after she has ceased to live, is as legitimately the product of the union as if she had given birth to it while alive.

In many cases of legitimacy, judgment is arrived at from the moral evidence and without medical evidence being necessary. But medical evidence is usually required in cases where, for example, the condition of the husband from physical disability is presumptive of his inability to procreate, or where, by reason of the impossibility of access, a child

[1] Casper, *op. cit.* vol. iii., p. 361.
[2] *Institutes* ; and *Ed. Med. and Surg. Jour.*, vol. i., p. 334.

was born at such an interval of time after the last possible opportunity, that he denies paternity. Thus the questions of impotency and of duration of pregnancy, which have already been discussed, are involved. Most usually, however, cases centre round the latter question; therefore the subject will be better elucidated by giving the facts of a concrete case which was tried in the Law Courts of England, and in which evidence on the possible protraction of gestation was led.

The following is a short summary of the Gardner Peerage Case. In March 1796, Alan Hyde Gardner, afterwards Lord Gardner, a naval captin, married a Miss Adderley, at Fort St George, in the East Indies. They lived together as man and wife till January 1802. On or about the 30th of that month the husband took leave of his wife, a few days later sailed for the West Indies, and did not return till July 10 of the same year. It appears that about the end of 1801 his wife was suspected of adultery with one Henry Jadis, but it was not discovered by Captain Gardner till June 1803, after which he ceased to have intercourse with his wife. On December 8, 1802, Mrs Gardner was delivered of a male child, unknown to her husband, the child being named Henry Fenton Gardner. In 1804, Captain Gardner prosecuted Jadis for criminal intercourse with his wife, and obtained damages of £1000 against him. He also got decree of divorce from his wife. Mr Jadis thereupon married Mrs Gardner in 1805, and the child, who had formerly received the name already given, was now acknowledged by them as their offspring, and took the name of Henry Fenton Jadis. In 1808, the father of Captain Gardner—Baron Gardner—died, and Captain Gardner succeeded to the title. In 1809, he married the Hon. Miss Smith, and of issue there was one son who was named Alan Legge Gardner, and a daughter, the former being born on January 29, 1810. Lord Gardner died in London on January 5, 1816. The son of the divorced wife of Captain Gardner and Jadis attained his majority in 1823. The legitimate son of Lord Gardner and his second wife, now a lad of 14 years of age, petitioned the King for recognition of his right to his father's title. This was opposed by Henry Fenton Jadis, who again resumed the surname of Gardner, on the ground that he was the true heir. Apart from the question of the adulterous conduct of Mrs Gardner, the mother of Jadis, the question for the consideration of the Committee of the House of Lords wholly turned upon the duration of pregnancy. On this point, the evidence of seventeen medical witnesses was tendered to the Committee. During the hearing of the case it was proved that, between the late Lord Gardner and his first wife, there was a possibility of access on the day he left her, January 30, 1802, and from that day till the day upon which he sailed, February 7, but not from the last date until after July 11, the date of his return: consequently the following questions had to be considered by the Committee—viz. Could a child, born on December 8, have been the result of sexual intercourse on January 30 previously—a period of 311 days; or, from February 7 to December 8, a period of 304 days: or, was a child begotten on July 11, viable on December 8, a period of 150 days? The principal question, however, put before the medical witnesses for their consideration, had special reference to the possibility of protracted gestation to such an interval of days, as 311, or 304. Unfortunately, the medical evidence given was of no assistance to the Committee. Of the seventeen witnesses, five—Drs Gooch, Blegborough, Davis, Pennington, and Sir Charles M. Clarke—stated that the duration of pregnancy lasted between 39 and 40 weeks; and twelve—Drs Granville, Conquest, Blundell, Merriman, Power, Hopkins, Dennison, H. Davis, Elliotson, and Messrs Sabine, Channocks, and Hawkes—were of opinion that while the usual period was about 40 weeks, it might be protracted beyond that period. Dr Granville, in his evidence, instanced the case of his own wife. She passed her menstrual period on April 7, quickened on August 15, and although labour was expected early in January and pains then came on but subsided, she was not delivered until February 7—that is, a period of 306 days if the day before the expected period in April is reckoned, or 318 days if the time from the middle of the period in March and that of April which did not come is calculated. He further said that he had seen other cases of 290, 300, and 310 days' duration. Dr Merriman deponed

that he had seen cases of 285, 287, 296, 303, and 309 days, respectively. Mr Sabine spoke to the case of his own wife. She menstruated last on September 14, quickened in second week of January, and was not delivered till August 14. Of this last case, it is quite clear that if the pregnancy be reckoned as from the period succeeding that of September, the period would only work out as about ten calendar months, and even from the middle of the time, as ten and a half months. One of the witnesses who was there to depone to his belief in the protraction of the period of pregnancy, distinguished himself by expressing somewhat novel views on the subject. He said he was of opinion that the normal period for male children was 290 days, and for females, 280 ; and when the Solicitor-General asked him : What of a hermaphrodite ? he replied : "*that* I should take between the two."

It does not require to be said that the Committee ignored the medical evidence, and decided against Jadis on the ground of the well-established adultery of his mother.

For fuller accounts of the medical evidence, the reader who desires to pursue this subject ought to consult the following writings :—Lyall's "Medical Evidence relative to the Duration of Human Pregnancy, as given in the Gardner Peerage Case" ; *Edinburgh Med. and Surg. Journal*, vol. xxvii., p. 109 ; and *Med. Chirurg. Review*, vol. ix., p. 170.

In America, cases have been decided in which children born after a pregnancy of 313 and 317 days respectively were deemed to be legitimate.

One of the most interesting cases of short pregnancy which has been tried in Scotland was one in which, for ecclesiastical purposes, the Reverend Fergus Jardine sought to establish the legitimacy of a female child which was born to him and his wife, 174 days after their marriage.

Lord Fraser, in his Treatise on Parent and Child, 2nd edit., p. 14, remarking evidently upon this case, says :—"The question came before the Church Courts in the celebrated Kinghorn Case, where the child was born without any signs of immaturity, one hundred and seventy-four days after the marriage, but the libel was found not proven" (*Med. Gaz.*, xvii., p. 92; *Med. and Chir. Rev.*, xxxi., p. 424; *Assembly Papers*, 1840).

Signs of Recent Delivery.—Although this subject might have been discussed under Concealment of Birth or Pregnancy, it is, perhaps, more fitting that it should be considered as a part of the general subject of Pregnancy.

It is frequently required of the medical practitioner in such charges as the above-named to examine an accused woman as to whether or not she has been recently delivered. The following, therefore, may be taken as the signs of recent delivery within eight or ten days thereafter :—

In the Living Subject.

(*a*) Symptoms of general indisposition. These include an anæmic condition of body, a soft, quickened, and compressible pulse, and sunken eyes, with dark areolæ.

(*b*) Enlargement of the Mammæ. These are found to be more or less full, firm, turgid, and knotty, and a milky fluid or colostrum may be expressed from the nipples. The surface veins are dilated and marked, and there is a more or less dark-coloured pigmentation round the nipples. The colour-tone of the pigmentation varies; in blond women, it is usually light in colour, in brunettes, it is almost blackish.

(*c*) Altered Conditions of Abdomen. In multiparæ, the skin of the abdominal parietes is flaccid or flabby, and may even be thrown into folds. In primiparæ, this condition of flaccidity may not be so marked, due in large measure to the better tone of the abdominal structures, and the extent of distension. There are usually *lineæ albicantes* present —although the colour will likely be pinkish, not white— due to the distension, and there is likely to be some degree of pigmentation, chiefly in the neighbourhood of the umbilicus and median abdominal line. At the lower end of abdomen—usually just a little above, or behind, the symphysis pubis—the uterus may be felt on palpation like a fœtal head, or an enlarged cricket ball.

(*d*) Changes in Vagina and Os and Cervix Uteri. The following conditions are likely to be found :—

1. There will be a bloody, serous, or muco-purulent lochial discharge which will soil the examining finger.
2. Appearances of bruising or laceration of external genitals, usually consisting of rupture of the fourchette, swelling of the vulva, and, perhaps, some degree of laceration of perinæum.
3. The os uteri will be more or less patent, usually to an extent sufficient to enable one or two fingers to be passed into it for a short distance ; its lips are likely to be swollen, and one or both of them may be lacerated or torn. By bimanual manipulation, the organ will be found increased above normal size.

Where these appearances and conditions, or most of them, are found in any case, we may safely conclude that the woman has been recently delivered of a child, since no other like set of conditions are found from any other cause. But while these may be considered as the average conditions and appearances, it is necessary to state respecting some of them, that there may be a departure from the average rule. In cases of concealment of birth, for example, where it is the object of the woman to hide the occurrence, she usually goes about her ordinary work as usual. In such cases the woman is usually of robust health, and, therefore, the general signs of indisposition are likely to be awanting. Owing to the same fact, also, there is likely to be a longer continuation of the sanguineous lochial discharge, because of the woman continuing her duties while the uterus is of increased size, and as the result of gravity. Therefore it is necessary to review together the signs found, before pronouncing an opinion.

Signs of Recent Delivery in the Dead.—In an examination conducted upon the dead body of a woman, the examiner will not only discover such evidence as has already been given, but he has all the advantages which a dissection of the body may afford. In addition to the foregoing examination, therefore, his duty will be to make a careful examination of the uterus and vaginal tract, more especially in cases where criminal abortion is believed to have been practised by instrumental interference (in which case it is absolutely necessary that the whole of the utero-genital tract should be removed entire for the pur-

pose of a complete examination of the parts, in a good light, after a careful vaginal examination has been made), for the purpose of discovering any wounds. The uterus will be found enlarged, its cavity, depending upon the stage of pregnancy, to be from 2 to 10 inches in length and to contain coagula, and the site of the placenta will be marked by a darker colour. The interior of the organ, especially in the neighbourhood of cervix and of the pouch of Douglas, should be carefully inspected for punctured wounds. We have had to make post-mortem examinations on the bodies of two women, recently delivered, owing to charges of mala-praxis, in one case against a medical practitioner, in the other, against a midwife. In the first case, there was a rupture of the perinæum, which did not, however, open into the rectum. The torn edges were in a sloughing condition. The uterus was several times larger than normal, the whole of its posterior and lateral aspects showed inflammatory action, and general peritonitis was present. On removing the uterus and vaginal tract entire from the body, no wounds of a penetrating character were found, but there was a ragged condition of the cervix. Section of the uterus revealed a cavity of 9½ inches, and the placental site was well marked. The death was evidently due to septic metro-peritonitis. In the second case, death was evidently due to apoplexy occurring during labour. On the surface and in the substance of the upper and back part of the brain was a considerable apoplectic extravasation of blood, and on section of the brain itself at this part, the brain-substance was filled by a clot about the size of a walnut. The uterus was found of large size, and on section after removal from the body, two placentæ were found *in situ*. There was no unusual appearance about the neck of the uterus, or in the vagina, other than those consequent upon an ordinary labour. The body, generally, was œdematous. This girl, who was a domestic servant, died in the house of a midwife, whither she had gone to be confined.

Signs of Previous Pregnancy.—The signs found will depend upon whether the woman has been primiparous or multiparous. Especially in the latter, but also in most cases of the former, the following signs, or some of them, are likely to be found :—

(*a*) *Lineæ albicantes* on abdomen and mammæ, the result of the hyper-distension;
(*b*) Persistent dark areolæ around the nipples;
(*c*) Rupture of fourchette or perinæum, or both;
(*d*) Perhaps, a ragged, or notched condition of os uteri;
(*e*) Absence of signs of virginity, and non-rugose condition of vaginal walls.

The examiner, however, must be prepared in exceptional instances to meet with cases where a woman who has borne more than one child may exhibit on her body none of the above signs, or but little evidence of them. Montgomery [1] narrates a case in which he examined a lady who had borne five children and nursed three of them, and he found that "her breasts were small, but neither flaccid nor pendulous; the nipple short, with not the least shade of brown colour in the areolæ, which exhibited only the delicate rose colour so often observed in that part of the virgin breast; there were neither lines nor spots of any kind

[1] "Cyclop. Pract. Med.," vol. iv., p. 504.

on the abdomen; the *os uteri* was small and natural; the vagina contracted, and the fourchette perfectly entire." This lady, however, never carried her children beyond the end of the eighth month. In 1887, we examined a married woman, aged 30, who was brought to the Police Station for a lacerated wound of the back of the head which she had got by falling, and for threatened miscarriage. Her breasts were in a virgin condition; there was a total absence of *lineæ albicantes*, and of pigmentary deposit around the nipples. The woman had borne four children, and had nursed each of them for nine months, her youngest child being three years of age.

Superfœtation.—This is one of the questions which is a legacy from ancient medico-legal writers. By the term itself is meant the comception of a second fœtus during the currency of an already existing pregnancy. Originally it was thought that such second conception could take place almost at any time during the currency of pregnancy. That notion was based upon the fact that, occasionally, at the birth of a full-time child, a second fœtus was shed from the uterus, but in a much less advanced state of development, and it was concluded, therefore, that the conception of the second had taken place during the currency of the uterine development of the first. Further, there were certain rare cases in which, one child being born at, or nearly at, full time, a second was born at some period subsequently, and short of the time necessary for a fresh conception to have occurred in the interval. But both class of cases are open to a different explanation; those of the former, as cases of twin conceptions in which the life of one had ceased at some period in the earlier stages of development. On one occasion, we delivered a woman of a healthy full-term child, and along with it a second fœtus which was pressed perfectly flat, and which, from its appearance, was judged to be about the fourth month of development. It appeared on inquiry that, at the time the woman was at this stage of her pregnancy, she fell down a steep, long, spiral, iron stairway, and received severe injuries, accompanied by serious vaginal hæmorrhage, which, however, ceased after a few days. There could be no reasonable doubt, therefore, that the second fœtus had been then killed, or that it died from separation of that part of placenta by which it was nourished. The latter class of cases may arise where the woman has a bi-locular, or bi-cornate uterus, a condition which is by no means uncommon, and of which many cases have been recorded. Pruvost [1] reports the case of a woman in whom, at her first labour, a double uterus with double os was detected. At her second pregnancy which came on at the eighth month she was delivered of a child, and the pains recurring a few hours later, the other half of the uterus discharged some decidua. In her three following pregnancies, the halves of the uterus alternately became pregnant, and from the opposite half followed some decidua. Roberts [2] reports an interesting case of *uterus bicornis unicollis*, in which, from the one half of the uterus a 4½ months' fœtus was discharged, and from the other, a decidual cast. This woman had already been delivered of three full-time children before the condition was suspected. In such cases as the foregoing, therefore, superfecunda-

[1] *Progrès Médical*, May 1, 1897.
[2] *B. M. J.*, vol. i., 1900, p. 1282.

tion is quite possible. Many other cases have been recorded, but a paper by Jardine on "Labour in a Bicornate Uterus (uterus didelphys) and Double Vagina," is well worth perusal.[1] Scott Macgregor, in a paper on double uterus, gives a table of 100 collected cases.[2]

The following propositions may be laid down as substantially established :—

Of Superfœtation :—

1. That, setting aside the element of self-deception on the part of a woman, the great bulk of supposed cases are but twin pregnancies, in which the development of one fœtus has been arrested.
2. That, in a mono-locular uterus, from a few days after conception, it is physically impossible for a second ovum to become impregnated, except where the impregnation of an extra-uterine and of a uterine ovum simultaneously occurs.[3]
3. That of the cases published, there is no evidence to clearly demonstrate that, after a woman has been pregnant for some weeks, a second conception has occurred in a mono-locular uterus.

Of Superfecundation :—

1. That this is a possible contingency in a bi-locular uterus.
2. That a double conception may take place in a bi-locular uterus at varying intervals of time, or, one conception in one half of a bi-cornate uterus, and the other, extra-uterine.

Post-Mortem Delivery.—The question may be raised some day in a court of law whether, in the case of a child which has been extracted alive from the mother's uterus after her apparent death, the husband would be entitled to be put in possession of the estate of his wife during the minority of the child, assuming that it lived through all that period. According to a very ancient decision, he would not be entitled. Such a case would undoubtedly raise important issues as (1) whether or not the mother was actually and legally dead at the moment of birth, some of the signs of apparent death being present, and (2) whether or not, the physical appearances of extinction of life being present, there was not physiological life still present in her body sufficient to permit of her child being born alive. The question of the life or death of the mother would legally hinge on these two points. Since the existence of the child *in utero* is held to depend upon the existence of the mother, the question may be pertinently put, Does not the very fact of the live birth of the child involve the fact of the existence of life in the mother ? That live children have been born by Cæsarean section after the apparent death of the mother is unquestionable. It therefore becomes a serious question for a medical practitioner to consider whether, when a mother dies near the full term of her pregnancy, he should give a child the chance of living by this method, or let it die with the mother. The following cases show the possibility of extracting a live child under these circumstances :—

The late Dr Harley in 1850, in the Royal Maternity Hospital, Edinburgh, performed Cæsarean section in the case of a young woman who had died suddenly from spasm of the glottis while anasarcous from cardiac disease. The child, which was a male, measuring 18½ inches and weighing 6 lbs. 12 ozs., lived and grew up to manhood.[4] Under the same reference, is narrated a case re-

[1] *Glasg. Med. Jour.*, vol. lvii., p. 447 ; Russell, *ibid.* p. 452.
[2] *Jour. Obstét.*, May 1906.
[3] *B. M. J.*, vol. i., 1896, p. 1323.
[4] *Ibid.* vol. ii., 1896, p. 1596.

ported by Sandberg of Christiania, in which he operated on a woman who died on August 18, in eclampsia, and delivered her of a child under 4 lbs. in weight and not 16 inches in length. It was placed in a *couveuse*, and it was living in October when he published his report of the case. Kirch [1] relates the following remarkable case. He was called by the friends of a woman, who, they said, had died suddenly about three-quarters of an hour after giving birth to a child. The woman was 40 years of age, and was the subject of mitral disease. Kirch went at once. He found her quite dead. The first child, which was born alive, was being attended to by a nurse. On making an examination of the woman, he found a fœtal leg projecting from the vulva, and he at once extracted the entire fœtus, which was born asphyxiated, but which revived, however, although it only lived for a few hours. From a consideration of the whole facts of the case, Kirch concluded that this second child was delivered 19 minutes after the death of the mother. Brotherston [2] relates a case in which he performed the Cæsarean operation on the body of a woman, and extracted 23 minutes after her death a large, healthy, female child in a state of asphyxia, but which survived, and was, as he writes, " as fine and healthy a child as I have seen." Blattner [3] states that he delivered a living asphyxiated child, *one hour* after the death of the mother, which, however, only breathed for ten minutes, and then died.

Whatever might be the judgment of our law on this point to-day, it is worthy of note that in the days of Numa Pompilius, the law of Rome was that the body of no pregnant woman was allowed to be interred, whether she died in labour or not, until the child had been extracted from her womb.

Criminal Abortion.—The law does not recognise any difference between what is known in medicine as an abortion or miscarriage and a premature labour, nor does it now take any cognisance of the fact whether the criminal expulsion of the product of conception was produced before or after the period of quickening. The law is set down in 24 & 25 Vict. cap. 100, sections 58 and 59.

" 58. Every woman, being with child, who with intent to procure her own miscarriage, shall unlawfully administer to herself any poison, or *other noxious thing*, or shall unlawfully use any instrument or other means whatsoever, with like intent, and whosoever, with intent to procure the miscarriage of any woman, *whether she be, or be not with child*, shall unlawfully administer to her, or cause to be taken by her, any poison or other noxious thing, or shall unlawfully use any instrument, or other means whatsoever, with the like intent, shall be guilty of felony, and being convicted thereof, shall be liable at the discretion of the Court, to be kept in penal servitude for life, or for any term not less than 5 years, or to be imprisoned for any term not exceeding 2 years, with or without hard labour, and with or without solitary confinement.

" 59. Whosoever shall unlawfully supply or procure any poison or other noxious thing, or any instrument or thing whatsoever, *knowing that the same is intended to be unlawfully used, or employed, with intent to procure the miscarriage of any woman, whether she be with child or not*, shall be guilty of a misdemeanour, and being convicted thereof, shall be liable, at the discretion of the Court, to be kept in penal servitude for the term of three years, or to be imprisoned for any term not exceeding two years."

It is also the law of Great Britain and Ireland that anyone who

[1] *Centralblatt für Gynäk.*, No. 25, 1900.

[2] *Edin. Med. Jour.*, April 1868.

[3] *American Jour. of Obstet.*, vol. viii., p. 160 ; *vide* also : Bauer, *Monatschr. f. Geb. u. Gyn.*, Oct. 1902, p. 811 ; Lindquist, *B. M. J.*, vol. ii., 1901, s. p. 103.

produces criminally the abortion of any woman from the effects of which she dies, is guilty of murder. Mr Justice Phillimore, in his charge to the jury in the Whitmarsh case (*vide post*), stated the law clearly as follows:—" If the unfortunate woman caused her own miscarriage, then, so far as she was concerned, it was in law a case of suicide, or *felo de se*. If the prisoner were her accomplice in that, if he were present aiding and abetting an illegal operation which caused her death, though he did not actually use the instrument, he was equally responsible for her death. If he were there, or encouraged or assisted her by getting a room, he would be what the law called a principal in the second degree. If he merely urged or counselled, and was not himself present at the illegal operation, he would be what the law called an accessory before the fact, and would still be guilty of murder." Mr Justice Darling, in referring a case to the Grand Jury, Chester Assizes, March 6, 1899, in which a prisoner was charged with the murder of a woman, whose death, it was alleged, was caused by an illegal operation to procure abortion, pointed out that, though the law as it stood considered such a person, after conviction, guilty of murder, in view of recent cases in which sentences of death had been passed on persons in like position to the prisoner, but which had been commuted, he would advise them to put an end to such an unsatisfactory state of the law by telling them that, if they found from the evidence that the object and intention of the prisoner in this case was not to kill the woman, but simply to produce abortion, they should not return a true bill for murder. The theory of " constructive murder," as it is termed, requires remodelling and further delimitation. The foregoing judgment of Mr Justice Darling was evidently due to the fact that, although Heap was hanged in 1875 for this crime, Whitmarsh, who was also sentenced to death, had his sentence commuted by the Home Secretary to a term of twelve years' penal servitude, and Collins, although he was found guilty of manslaughter, to a term of seven years' penal servitude only.

It will be observed from the previous statement of the law that the criminality or *culpa* of the act lies in the *intent* to procure abortion, and it, therefore, follows that the person upon whom the intentional procedure has been practised need not even be pregnant. Neither do the provisions of the statute in terms make any allowance for the medical practitioner, who, with intent, brings about premature labour, from the effects of which a woman may die, with the object of saving the life of the mother from some concurrent condition or disease. It is quite true that the act must be performed with distinct felonious intent, for the law in practice recognises that the operation may be required in certain justifiable circumstances. But in order to protect himself, the medical practitioner, when he deems such an operation urgently required, ought to ask and obtain, after consultation, the concurrence of another medical man, and, if possible, the consent also of the husband, after explaining to him the situation. These are precautions absolutely essential, since prosecutions have arisen under circumstances in which no such care was exercised, as the following cases will show:—

1. Dr Wallace was tried at the Kent Assizes, in 1898, for the alleged performance of an illegal operation on a girl. It was alleged that the accused had

taken advantage of the unconscious condition of the girl at his surgery some two and a half months before, and that this was the motive cause of the above operation. It was shown in evidence, (1) that the said operation was performed while the mother of the girl was present, and (2) that she suffered from a uterine ailment, for the rectification of which the accused used the uterine sound, in ignorance of the girl's pregnancy. Mr Justice Hawkins, in his summing-up of the case said, " No man would be safe if he depended for his liberty or character upon evidence which was not absolutely conclusive against him, particularly when his record was a good one." The accused was found not guilty.[1]

2. A medical man in Edinburgh was apprehended, kept in gaol for two weeks, and liberated without further proceedings being taken against him, under the following circumstances. At the end of February, he was asked to visit a young girl who was unknown to him. She confessed to him that, having discovered that she was pregnant, she had taken drugs to procure abortion. At his visit, the miscarriage was proceeding, and on account of severe hæmorrhage, presumably, he felt it to be his duty to prescribe ergot. The girl not getting relief, he considered it necessary, in order to save her life, to perform an operation. Through indiscretion on the part of the girl herself, who got up and drank spirits, she took peritonitis of which she died. It was subsequently found out that prior to the accused being called, the girl had been visited by two men, described as medical students, who, it appears, had in some way treated her, and, it was declared, even performed an operation. No word of apology or explanation was offered to the accused by the authorities.[2]

3. Dr Harris along with a woman named Espelby was charged with conspiring to use an instrument with intent to procure abortion. A true bill was found by the Grand Jury, but after trial by the Petty Jury, he was found not guilty.

Modes of Producing Abortion Illegally.—From the terms of the statute, it will be apparent, that though the illegal employment of a poison, other noxious thing, or an instrument is condescended upon, " any other means whatsoever " will embrace any other mode which might not be comprehended under any of the named causes.

From the medico-legal point of view, the methods may be divided into two main classes—viz.

I. The use of Drugs;

II. The use of Instruments.

I. *The Use of Drugs.*—Among quacks and other illegal practitioners, the employment of drugs is the favourite way of producing abortion, mainly because the sale or supply may be effected under circumstances incapable of legal proof, such as, for example, where the drug is handed by the seller to the buyer in the absence of witnesses, and where there is nothing on the packet or bottle indicative of its source. Among the ignorant many methods are employed, such as the free use of cathartic medicines, diachylon (see p. 400), savin, pennyroyal and steel, aloes, tansy, and other drugs, such as cantharides and oil of absinthe.[3] Of all of these, lead in the form of diachylon, obtained from lead plaster and made up as small pills, is the most commonly used at the present day. Certain other drugs are employed by those who have obtained some imperfect knowledge of medicine by reading or otherwise, such as cantharides, ergot, the free use of quinine, an extract of cottonwood, or *actæa racemosa* or squaw-root. The better informed practitioner who has fallen into devious ways, and who knows

[1] *B. M. J.*, vol. ii., Dec. 1898.
[2] *Ibid.* vol. i., 1896, p. 987.
[3] *Ibid.* vol. ii., 1902, p. 504.

the comparative valuelessness of drugs for this purpose, usually resorts to mechanical interference by the use of instruments.

Of late years, under disguised names, such as " female remedies for obstructions," " The Lady Montrose Miraculous Female Tabules," etc., an enormous traffic in abortifacient drugs has been discovered. This was revealed in the trial of the brothers Chrimes before Mr Justice Hawkins at the Old Bailey, in January 1899; that of " Madame Gray," before the High Court of Justiciary at Edinburgh, 1897, and others. The trial of R. *v.* William Brown and others for the sale of abortifacient drugs, based on the sections of the Act quoted, may be profitably consulted for certain legal aspects of the crime, and particularly for Mr Justice Darling's judgment.[1]

All drugs having an abortifacient effect act in one or other of the three following ways—viz. (*a*) by acting on the bodily system generally as a poison; (*b*) by acting locally and directly upon the muscular structure of the uterus; (*c*) by acting locally and indirectly upon the uterus through the gastro-intestinal or genito-urinary tract. It is likely that it is in the first way that savin and lead [2] act; in the second, ergot and quinine; and in the third, drastic purgatives, cantharides, and others. The wife of a labourer at Runcorn took over 100 grains of oil of absinthe for the purpose of procuring abortion, from the effects of which she died three-quarters of an hour after.

In December 1908, a man, who had been a chemist's assistant, was tried at the Sheriff Court, Glasgow, on the charge of having given to a girl, with whom he had been keeping company, and who had become pregnant, a bottle containing a drug for the purpose of producing abortion. The bottle and contents had been sent to us for analysis. It proved to contain liquid extract of ergot. The mother of the girl discovered that her daughter had obtained this drug, and succeeded in dissuading her from taking more than the one dose she had already taken. The girl was delivered at the normal time of a healthy child.

In another case, but of divorce, the allegation by the wife, against whom the action was raised, was that she had been supplied with medicines consisting of aloes and myrrh pills and an iron mixture containing magnesia sulphate, for the purpose of inducing abortion, and that their operation had been successful. It was contended by the medical witnesses for the pursuer that aloes was not an abortifacient.

Cushny [3] in investigating the actions of drugs on the uterus of animals found that pilocarpine, quinine hydrochlorate, aloes, and ergot all act upon the muscular structure of the organ and induce uterine contractions. He found that pilocarpine acts through some structure or mechanism which is counteracted by the previous hypodermic injection of atropine, since contraction will not follow the injection of pilocarpine if preceded by an injection of atropine, or if induced by pilocarpine will cease on injection of atropine; that quinine produces contractions despite the precedent injection of atropine, showing a direct action on the uterine muscular fibre; that aloes acts in a similar manner to quinine; and that of all these drugs ergot acts the most powerfully.

[1] *B. M. J.*, vol. ii., 1899, p. 1583.
[2] *Ibid.* vol. i. 1900, p. 1590.
[3] *Ibid.* vol. ii. 1906, p. 1460.

Vahlen claims to have isolated from ergot of rye a substance which does not produce either gangrene or convulsions, but which acts energetically on the pregnant uterus. He calls the substance *clavin*. It has been tried by Bumm in four cases and by Vahlen himself in two cases with positive results, the doses of 0·01 and 0·02 gram. being administered subcutaneously.[1]

The most commonly used drug at the present day for abortifacient purposes is diachylon. It is the preparation employed in diachylon plaster and exists as oleate of lead, being a mixture of lead oxide and olive oil. Pills are surreptitiously made of this compound, and have been found to weigh from 1½ to 5 grains, or 8 grains, either alone, or mixed with a certain proportion of aloes. Those produced in the Nottingham prosecution weighed from 1½ to 5 grains, and contained, in addition, aloes, with a coating of boric acid, while those in the Leicester case weighed 8½ grains, the amount of lead oxide in each being one grain. In the Sheffield prosecution, the amount of lead in terms of metallic lead varied from 0·82 to 0·85 of a grain.

The attention of the profession was first directed to the use of this drug for this purpose by Dr Pope of Leicester in 1893. Cases came to be reported from Birmingham in 1898, from Nottingham in 1899, and in 1900–1901 from Sheffield, Leeds, and other parts of England. It is not known to be used in Scotland.

A very large number of cases have been reported since 1893 by different observers. We adduce a list of many of these references.[2] In some of these cases there has been a fatal result.

Symptoms. The symptoms are those of chronic lead poisoning. (*Vide*

[1] *Deut. med. Woch.*, Aug. 10, 1905.

[2]
Pope . . . . *B. M. J.*, vol. ii., 1903, p. 9.
Crooke . . . . *Lancet*, vol. ii., 1898, p. 255.
Bell Taylor . . . ,, ,, 1898, p. 742.
Branson . . . . *B. M. J.*, ,, 1899.
Ransom . . . . ,, vol. i., 1900, p. 1500.
Wrangham . . . ,, ,, 1901, p. 72.
Scharzwæller, *Berl. klin. Woch.*, Feb. 18, 1901.
Scott, *Quart. Med. Jour.*, Feb. 1902.
Jacob and Trotman . . *B. M. J.*, vol. i., 1903, p. 242.
Layton . . . . ,, ,, 1903, p. 849.
Hall . . . . ,, ,, 1905, p. 584.
Bell . . . . ,, vol. ii., ,, p. 1642.
Bell . . . . ,, ,, ,, p. 90.
Heelis, Jacob and Trotman ,, vol. i., 1906, p. 257.
St Lawrance-Burke . . ,, ,, ,, p. 259.
Hall and Ransom . . ,, ,, ,, p. 428.
Little . . . . ,, ,, ,, p. 499.
Wrangham . . . ,, ,, ,, p. 556.
Inquest, Sheffield . . ,, ,, ,, p. 764.
Prosecution, Nottingham . ,, vol. ii., ,, p. 334; *Lancet*, vol. ii., 1906, p. 387.
Prosecution, Sheffield . ,, ,, ,, p. 1337; *Lancet*, vol. ii., 1906, p. 1681.
St Bartholomew's . . ,, ,, ,, p. 778.
Hope Robson . . . ,, ,, ,, p. 1394.
Hay . . . . ,, vol. i., 1909, p. 214.
Hall . . . . ,, ,, ,, p. 277.
Heaney . . . . ,, ,, ,, p. 1062.

p. 624.) The question has been raised by some observers,[1] whether, diachylon having been taken by the mother, and having failed to produce abortion, the drug has an injurious effect on the infant after its birth. In the case to which the reference is given, the infant only survived its birth twelve hours. The head was decidedly hydrocephalic, measuring 16½ inches round its largest circumference. Chemical examination of the liver showed lead to be present in the proportion of 0·002 per cent. We think it can hardly be doubted that in such cases a prejudicial effect will be produced upon the child, if not directly, at least indirectly, and that the effect will in great measure depend upon the length of time which elapses between the restoration to health of the mother from the effects of the plumbism and the time of birth.

Attempts, in some cases successful, have been made to discover the makers and vendors of these lead pills. Three successful prosecutions, at least, have been carried through by local authorities, two in Sheffield and one in Nottingham. In the former a certified midwife named Carford was tried at the Sheffield Quarter Sessions, she being indicted on a charge of having supplied noxious pills containing lead. Certain women were employed to obtain the necessary evidence. They deponed that they had purchased the pills in question from the defendant who told one of the witnesses "to keep it quiet." The city analyst stated that the first lot of pills which he analysed contained lead in the proportion of 0·82 grain per pill in terms of metallic lead, the lead being in the form of diachylon or *emplastrum plumbi*, and the second lot, 0·85 grain per pill. The prisoner was found guilty, and she was sentenced to six months' imprisonment.

A similar case was tried on the following day, the woman being also found guilty, and sentenced to six months' imprisonment.[2]

For some time before 1906, it was suspected that lead pills were being made and sold in Nottingham for this nefarious purpose. It was discovered that in a certain district of the town the pills were spoken of as "Mrs Seagrave's pills." A box of the pills was procured by an agent of the Health Department, and on analysis were found to consist of diachylon and aloes (the former amounting to from 50 per cent. to 70 per cent.) and a coating of boric acid. They varied in weight from 1½ grains to 5 grains. The police arrested Mrs Seagrave *alias* Wardle, and, on searching her house, found a large quantity of similar pills. She was committed for trial after inquiry before the magistrates, and at the Nottingham Assizes, July 17 and 18, 1906, she was tried and found guilty and was sentenced to 18 months' hard labour.[3]

At Leicester December Assizes in the same year, a woman was sentenced for a similar offence, and was awarded a like sentence. The pills she sold weighed 8½ grains each. It was shown in evidence that she gave her victims from 60 to 80 pills at a time, with instructions to take four at night and the same number in the morning.[4]

Quinine seems to be increasing in its use as an ecbolic. Eales [5]

[1] *B. M. J.*, vol. i., 1906, p. 257.
[2] *Ibid.* vol. ii., 1906, p. 1337.
[3] *Ibid.* vol. ii., 1906, p. 334.
[4] *Lancet*, vol. ii., 1906, p. 1613.
[5] *B. M. J.*, vol. i., 1905, p. 312.

records the case of a woman, a multipara, aged 30, who having missed six weeks, was recommended to use quinine. She took 15 grains, and about four hours after severe pains came on with vomiting which lasted for several hours, and giddiness and deafness which lasted for twelve hours. She aborted. This observer says that this drug is in common use for this purpose amongst certain classes.

Phosphorus, while not used in this country, so far as known, for abortifacient purposes, would seem, according to Hitschmann and Lindenthal, to be the commonest drug employed in Vienna in criminal abortion. These observers state that they have examined nine cases of death by phosphorus in which pregnancy could be excluded.[1]

Siefert records a fatal result in a case in which corrosive sublimate injection (two soloids dissolved in about a litre of water) was used to produce abortion. Death occurred four days after, the abortion having taken place in the interval.[2]

A stem of parsley, "queue de persil," is extensively employed in Algiers and elsewhere for procuring abortion. Scherb of Algiers[3] reports a case in which this was used and was followed by fatal tetanus.

The following references to cases tried in which drugs were used are important. In England, R. *v.* Calder, Exeter Lent Assizes, 1844 ;[4] R. *v.* Brown, Lewis Assizes, June 1878. In Scotland, 3 Hume, 1, 186, —case of Robertson and Kempt ; Alison, 1, 629—case of Munn ; More, II. 373.

II. *By the Use of Instruments, or by Mechanical Violence.*—Violence may either be applied generally to the abdomen, or locally to the uterus. Cases are comparatively rare under the former head, and, therefore, the following attempted case from Tardieu is of some interest.[5] A peasant seduced his servant, in consequence of which she became pregnant. Desirous of producing abortion, he mounted on a strong horse taking the girl with him, and galloped wildly to and fro, throwing the girl to the ground on repeated occasions while the horse was in full gallop. This did not succeed. Thereafter he applied to her stomach bread just taken from a very hot oven. But this proved equally unavailing ; and eventually, the girl gave birth to a living and well-formed child at full time. In these days, interference takes the form of horse or bicycle exercise, dancing, tight-lacing, etc.

The criminal aspect of instrumental interference most usually takes the form of local uterine violence. The variety of instruments used is of wide range, such as hooks, knitting or crotchet needles, scissors, wooden skewers, sponges, syringing, intra-uterine injections, catheters, and the uterine sound.

The following cases may be taken as typical :—

1. Dr Wherry of Cambridge[6] reports the following case, which is of interest in respect that the abortion is traced from commencement to finish. A young

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[1] *Arch. f. Gynæk.*, vol. lxix., part 3, 1903.

[2] *Centralb. f. Gynæk.*, 4, 1906, p. 124.

[3] *Jour. de Méd. et de Chir. pratiques*, June 10, 1908, p. 417 ; *B. M. J.*, vol. ii., 1908, p. 1036.

[4] *Provincial Med. Journ.*, April 10, 1844.

[5] *Étude Médico-légale sur l'Avortement*, p. 27.

[6] *B. M. J.*, vol. i., 1881, p. 880.

woman, aged 19, consulted a chemist in Cambridge named Ransome, and his wife, a professed midwife, and took medicines with intent to procure abortion, but without the desired effect. On Sunday, Dec. 5, 1880, she was induced by these persons to submit to an operation at the hands of a man named Lepper, who came from London for the purpose. After payment of £10, Lepper passed up "a silver hook"—as the girl described the instrument—which hurt her very much, and blood came away. No witnesses were present. A few hours later, a second operation was performed, which caused great pain and loss of blood. On both of these occasions, she walked a distance of more than a mile to the chemist's shop where the operations were performed. On the following day, Dr Wherry was called, when he found that peritonitis had developed. On Dec. 11 she was so ill that her deposition was taken. She, however, ultimately recovered. The prisoners were apprehended, tried, convicted, and sentenced to five years' penal servitude. It is evident, in this case, from the symptoms induced, that the instrument had at least severely injured, if, indeed, it did not actually penetrate, some part of the vaginal wall, or uterus itself.

2. Dr Collins was convicted on July 2, 1898,[1] on the charge of manslaughter for procuring abortion with a fatal result upon a married lady who did not want any more children. The evidence for the prosecution may be summed up in the following points—viz. (1) That the woman died from septic peritonitis; (2) that there was a wound, situated about an inch and a quarter on the inner side of the anterior lip of the *os internum* caused by some blunt-pointed instrument, which was distant 5 inches from the mouth of the vagina, and which measured $\frac{1}{4}$ inch in diameter and $\frac{1}{8}$ inch deep. It was a ragged, punctured wound, as if it had been made by a blunt, probe-pointed instrument of some kind, not by a sharp instrument; (3) that the condition of the womb corresponded to a pregnancy of seven to eight weeks, and showed evidence of recent abortion; (4) that the deceased knew she was pregnant, and was desirous to be rid of the product of conception; (5) that during the time Collins attended her —Collins being previously a stranger to her—she aborted. Collins was found guilty, and was sentenced by Mr Justice Grantham to seven years' penal servitude.

3. Madame Gray was tried before the High Court of Justiciary at Edinburgh, in 1897, for having performed an illegal operation on a widow. She was found guilty, and was sentenced by the Lord Justice-Clerk to five years' penal servitude.

4. Alfred Thomas Heap, in 1875, was convicted of having criminally produced abortion, from which the woman died. He had produced the result by transfixing the uterus with a Manchester spindle, the woman dying shortly after the operation. He had been previously convicted of the same crime. He was convicted, and hanged for this offence.

5. Jane White, aged 67, a nurse, was found guilty of a like crime at the Central Criminal Court, London. The woman upon whom she operated died of peritonitis. At the post-mortem examination, a lacerated wound was found in the uterine region, which, in the opinion of the examiners, had been caused by some hard or blunt instrument, probably a catheter. White was sentenced to death, but was reprieved afterwards.[2]

6. Sarah Ann Eden was convicted at the Warwick Assizes on Dec. 10, 1895, for having caused the death of a married woman by procuring abortion. She was condemned to death. The dead woman was the mother of six children, and it was shown in evidence that she had first tried to persuade her usual medical attendant to bring on abortion, but having failed to do so, she had recourse to this midwife, who in doing the operation caused her death.[3]

7. Dr Whitmarsh was convicted of having caused the death of a young woman, aged 26, by performing upon her an illegal operation with the object of procuring abortion. It would appear from the evidence of the dying declaration of the woman that the accused passed an instrument, and then injected some fluid. Symptoms of mercurial poisoning supervened. The post-mortem examination by Mr Bond showed that the whole of the mucous membrane of

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[1] *B. M. J.*, vol. ii., 1898, pp. 59, 122.
[2] *Ibid.* vol. i., 1899, p. 448.
[3] *The Lancet*, vol. ii., 1895, p. 1518.

vagina and uterus was found to be in a sloughing condition ; the uterus was enlarged to a condition corresponding to the period of gestation reached at the date of the alleged abortion ; the breasts were found to contain a little milk ; the lower gum was found to have sloughed and the alveolus of the lower jaw was bare. On analysis of the liver by Dr Stevenson, mercury was found. Whitmarsh was found guilty of murder, was sentenced to death by Mr Justice Bigham, but the sentence was afterwards commuted to penal servitude for life.

8. Drs La Jarrige and Boisleux were convicted at Paris in 1897, for having caused the death of Miss Thomson by performing an illegal operation, the effect of which was to produce abortion. Rupture of the uterus was found by Prof. Brouardel on post-mortem examination of the body. This case is peculiar in respect that the accused had performed laparotomy on the deceased. It does not appear perfectly clear from the evidence that there was any allegation made that the accused performed the operation with the object of criminally procuring abortion, although they were distinctly charged with not having used sufficient care in ascertaining whether or not the woman was pregnant ; and one of the witnesses stated that the fact that the woman was pregnant was known to the first-named accused. The jury found them guilty, and they were sentenced to five years' imprisonment.

Other cases might be cited, but the preceding are sufficiently illustrative.

For Scottish cases, consult Hume, i. 187, case of Robertson and Bachelor ; Alison, i. 628, case of Aitken ; and 3 Irvine, 235.

The practical point to be considered now is : Upon what must medical evidence of criminal abortion depend ? The following must be taken into full and careful consideration before an opinion is offered —viz.

(*a*) The history of the woman ;
(*b*) The examination of her body, living or dead ;
(*c*) Inspection of the aborted material, when available.

It is important at the very outset of this inquiry to remember that, although criminal abortion is most usually practised at or about the fifth month of pregnancy, since it is then that the woman becomes certain of her pregnant condition by feeling the movements of the fœtus *in utero*, it may be induced at earlier periods, especially in the case of married women, whose experience leads them to an earlier knowledge of their state, than in the case of a woman who is pregnant for the first time ; further, that an attempt to procure abortion may be made upon a woman who is not pregnant at all, but who fears that she is because her menses have ceased.

1. The History of the Woman.—In many instances, this may not come within the purview of the medical examiner. But where there is a history of the use of distinctly abortifacient drugs, or of other drugs used inordinately, such as drastic purgatives or cathartics which would not ordinarily be used in such quantities or so repetitively, and which when so lavishly used may produce abortion by sympathetic or reflex action through exalted peristalsis, suspicion at least ought to be awakened.

2. The Examination of the Woman's Body.—(A) *During Life.*—When opportunity offers, the examination must be made early, owing to the comparative rapidity with which signs of delivery in the earlier months of pregnancy may disappear. In abortion, however, it very often happens that the ovum and decidua are not evacuated from the uterus in a state of entirety, and, therefore, signs of this will be left. The examination ought to be both tactual and visual.

The finger may not be able to detect small breaches of continuity, but it will probably discover such changes in the "feel" of the mucous membrane of the os, and of patency of the os, as to indicate whether or not something may have recently passed by that route. Visual examination *per speculum* is of great value, for careful exploration of the vaginal tract is then likely to reveal any wounding if such be present. There are two prominent lines of symptoms which should awaken suspicion of criminal abortion—viz. (*a*) those of septic poisoning associated with metritis, or peritonitis, or partly with both conditions; and (*b*) those of traumatic peritonitis. Either of these may be found after abortion where no criminal attempt has been practised, but there is usually some preceding history to illumine the point at issue. Such symptoms and signs as the foregoing, therefore, might be found where there has been an attempt to procure abortion, and in which there has been no pregnancy. Where the woman has been pregnant, or is still pregnant, the examiner must carefully look for the signs of it; as pigmentary areolæ round the nipples, enlargement of the breasts, milk in the breasts, absence of the hymen, bloody discharge from vagina, and patulous condition of os. (B) *After Death.*—Death may result where abortion has been criminally produced from the following causes—viz. (*a*) Shock, directly consequent upon the internal injuries produced by the operation; (*b*) Hæmorrhage from the uterus and parts injured; (*c*) Septic poisoning, which may take the form of septic peritonitis, metro-peritonitis, or septicæmia; (*d*) Traumatic peritonitis; (*e*) Effects of poison, generally, on the system; and (*f*) in rare cases, Tetanus.

The examiner having noted the presence or absence of the signs of pregnancy externally visible upon the body, and having inspected the utero-vaginal tract both visually and tactually, should next proceed to the internal dissection of the body as in an ordinary case, but with special attention directed to the condition of the abdominal cavity and its organs. The first thing to note will be the presence or absence of inflammatory mischief in this cavity, and, if present, its incidence and extent of area and particularly if it be centred round special points. Before removing any of the parts from the cavity, careful search must be made for the presence or absence of any penetrating wounds of the peritoneum, and if present, their position and character with relation to the uterus and the parts penetrated must be noted. Thereafter, it will be well to scoop out of the body the entire soft contents of the pelvic cavity, by making incisions close to the bones, or better, to throw open the parts by sawing through the pubic bones, and then to proceed in a good light to the detailed examination of the whole parts—viz.

(*a*) The urinary tract, for the presence or absence of signs of irritant mischief, such as might be produced by cantharides or turpentine;

(*b*) The utero-vaginal tract, for evidences of internal wounding, the condition of the os and cervix, the uterine dimensions, and of the signs of pregnancy.

It is advisable, in those cases where there are no signs of local violence, that the condition of the gastro-intestinal tract should undergo strict

examination for evidence of irritant poisoning, and where such is found, that the whole tract and its contents, along with the other organs of the body, should be placed in clean jars, which should then be sealed and kept as already indicated (*vide* p. 27), lest an analysis should have to be made.

3. The Examination of the Aborted Material.—From what has been said of the law on this subject—that the criminality consists in



Fig. 102.—Abortion at Fourth Week. (From Hunterian Collection, University of Glasgow.)



Fig. 103.—Abortion at Tenth Week. (From Hunterian Collection.)

the intent to procure abortion whether the woman be or be not with child—it is generally sufficient to prove by dissection, where death has been caused, that the uterus has been recently evacuated of pregnant contents, or by local examination, where the woman is living, for evidence of such uterine evacuation, and by general examination for the external signs of pregnancy. At the same time, any remanent parts of the product of conception and of aborted material should be noted when found.



Fig. 104.—Abortion between Sixth and Eighth Weeks. (From Hunterian Collection.)

The very practical question, however, arises at this stage : Allowing that abortion has been produced, has it been caused criminally ?

It must be kept prominently in mind that abortion may be produced accidentally, from natural causes, or from disease. It is not necessary to discuss in detail the natural causes of abortion. As a general principle, liable however to exceptions, it may be stated that whatever cause tends to debilitate generally a pregnant woman thereby causes increased liability to abortion. Suddenly occurring febrile diseases, especially of the exanthematous type, such as small-pox, scarlet fever, influenza, enteric fever, typhus, etc., and specific diseases, especially syphilis, provoke miscarriage. Reflex irritation of the uterus from whatever cause arising, especially in connection with the gastro-intestinal and genito-urinary tracts ; degenerative changes in the villi of the chorion, or in the placenta, especially of the fatty type ; and

accidental hæmorrhage between uterine wall and placenta, are all well-known provocative causes, in addition to malpositions of the uterus itself, not to speak of the effect in some women of explosions of the emotions, as anger, grief, or joy.

Abortion may also be produced by apparently trifling accidents. This is true of many women. A false or miscalculated step from a height, a marked and sudden jar to the body, an accidental knock against the abdomen, may all produce it. At the same time, in other women, even serious abdominal injuries may fail to precipitate the expulsion of the ovum, even near the natural termination of pregnancy. We once attended a woman who in the last few days of her last month of pregnancy fell from a height on the comparatively sharp edge of a trunk. When the child was born a few days after—healthy and strong—an ecchymosed mark, the size of an ordinary medal, was found on the abdomen of the child, which disappeared, as such marks usually do, about ten days after birth. Women have frequently been known to carry their children to full time even after serious accidents. (*Vide ante.*)

Cases however arise from time to time in which, from attendant circumstances, medical practitioners may be compromised, but in which the abortion has been brought on by the woman herself, either by the self-administration of drugs, or by instrumental interference.

During the time the Collins case was occupying the attention of the medical press, various correspondents adduced evidence of cases in which self-induced instrumental abortion had been practised. In one case, a woman confessed to her medical man that she had brought on miscarriage on herself 35 times, by squatting herself down and passing a thick knitting-needle into the uterus.[1] In a second, where it was self-induced by means of a catheter, the practitioner found the patient bleeding profusely and some placental material projecting through the *os uteri*, as the result of the instrumental treatment.[2] In a third, where the woman, who had invited her medical attendant to perform this operation upon her but was refused, effected her object by means of a thick bone crochet needle. In a fourth, a young midwife pupil provoked abortion on herself by introducing a uterine sound into the uterus, followed by an intra-uterine injection, and died in 9 days from tetanus.[3] In a fifth, a woman who was acquainted to some extent with gynæcological methods of treatment, injected into her uterus a few drachms of glycerine (Pelzer's method), thus producing abortion, of which she died on the sixth day after.[4] In a sixth, a woman who believed herself to be two months pregnant, passed a glass penholder with a sharp grooved point into her uterus. She lost hold of it during the operation, and it disappeared entirely within the uterus. Some days later, she was seized with intense pain in the abdomen ; the abdomen was opened and explored, and the penholder was found, point forward, nearly touching the central part of the diaphragm. The penholder measured 5⅞ inches in length.[5] These cases need not be multiplied, but others have been recorded where a long hair-pin had been used.[6]

Schönbek has recorded the case of a midwife, aged 35, who living apart from her husband, and being three months pregnant, so injured herself in inducing abortion that, under other circumstances, the injury produced might well have been supposed to be the act of another person. On admission to

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[1] *B. M. J.*, vol. ii., 1898, p. 749.
[2] *Ibid.* p. 657.
[3] *Ann. de Gynéc. et d'Obstét.*, June 1899.
[4] *Brooklyn Med. Journ.*, July 1899.
[5] *B. M. J.*, vol. i., 1900, p. 1221.
[6] *Ibid.*, vol. ii., 1899, p. 187.

hospital she had vaginal hæmorrhage and was suffering from rigors. Being very ill, the os was dilated and the uterus emptied of a fœtus and a placenta which was neither abnormal nor decomposed. Three days later she became partly delirious, and in her delirium said that she had dipped a catheter in lysol and passed it into the external os, when it slipped out of reach. She died on the following day. Post-mortem examination of the body revealed purulent peritonitis, and among the intestines a broken-off piece of bougie, measuring five inches long and a little over one-tenth of an inch thick, which lay a hand's breadth below the liver. A perforation was found in the uterus, commencing in the cervical canal half-an-inch above the *os externum* and running obliquely upwards, opening on the peritoneal surface of the uterus at the level of the internal os. Schönbek thought there were reasons for doubting the truthfulness of the confession.[1]

While from the medico-legal point of view, it makes no difference with respect to the commission of the crime whether it has been provoked by the woman herself or by someone else, such cases as the foregoing ought to compel consideration in circumstances in which a practitioner is accused, because, as the history of many cases but too clearly reveals, a medical practitioner may be called in when the process has been initiated by the woman herself, to save the life of the woman from the consequences of her own illegal act. Should the woman chance to die without any confession or explanation that she herself had done this, and should a post-mortem examination be conducted upon her body, it is not difficult to apprehend the ease with which the medical attendant will be compromised in the eyes of the law, and how serious consequences to him may follow. Moreover, it is not compatible with the ordinary mode of conducting practice that a medical practitioner can always protect himself, since he cannot call for the services of a brother practitioner in cases of miscarriage on the off chance that one may be a case of criminally-induced abortion. It is, however, advisable that the practitioner should see that he is protected, by quietly arranging that a female neighbour or nurse should be called in so that she may be able to speak to the facts of the onset of the abortion, should, perchance, it prove a self-induced case. This is one of the undoubted risks to which members of the medical profession are exposed, as we have pointed out elsewhere.[2]

In a case tried in Belgium, in which a medical man was charged with having by instrumental means procured abortion in a prostitute, the doctor was convicted by the Court of First Instance. On appeal, however, the conviction was quashed on the ground that the medico-legal expert employed by the authorities, instead of limiting himself to facts and inferences to be fairly drawn from the facts, overstepped his province and constituted himself a *juge d'instruction* or prosecutor. It was ultimately discovered that the woman, having failed to persuade the doctor to operate on her, went to a midwife, who used a sharp instrument which had penetrated the dorsal region of the fœtus, thus producing the abortion.[3]

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[1] *Centralb. f. Gynäk.*, 49, 1905, p. 1497.
[2] *Glas. Med. Journal*, Sept. 1886.
[3] *Lancet*, vol. i., 1889, p. 34.

CHAPTER XIII

INFANTICIDE

THE crime of infanticide consists legally in the murder of a live-born, newly-born child. The law distinguishes the crime to be either by Omission, or by Commission.

Infanticide by Omission means the neglecting to do such things connected with the continuance of the life of a newly-born child as may cause its death; as for example, neglecting to tie the umbilical cord after severance, since by omitting to do this the infant may bleed to death; or by neglecting to clothe it in a reasonable way so as to protect it from the cold; or by omitting to remove such obstacles as would prevent it from breathing.

Infanticide by Commission is the performance of any act against a live-born child which prevents it from living or which destroys its life.

The law on the subject has undergone many changes during the past three and a half centuries. By the 27 Jac. I. cap. 27, it was laid down that any unmarried woman who concealed her pregnancy, and the infant dying, was to be condemned to death. In the event of the dead body of a child having been found and the maternity traced to a particular woman, the burden of proof that the child was born dead lay upon her. In 1690, an Act of William and Mary, cap. 21,—which applied only to Scotland, however,—enacted, in a charge of child-murder, a series of presumptions which the jury, in the absence of direct proof, were to consider as evidence of the commission of the crime. These presumptions were founded upon the following premises:—(1) That the person charged had concealed her condition from everyone during the whole currency of her pregnancy; (2) that she was without, and did not call for, any assistance at her delivery; (3) the discovery of a dead child; or the absence of a child, dead or alive. Many women were executed under this Act. From 1690, no new legislation on the subject was passed until 1803, when the Act known as Lord Ellenborough's Act—43 Geo. III. cap. 58—was passed. It arose because of certain doubts which had arisen respecting the true sense and meaning of the 27 Jac. I. cap. 27, and also of an Act of Parliament for Ireland made in the sixth year of the reign of Queen Anne, entitled "An Act to prevent the Destroying and Murthering of Bastard Children." This Act of George III. enacted that the "rules of evidence and of presumption as are by law used and allowed to take place in respect to other trials for murder" should prevail in a charge of child-murder. It also empowered the jury to find on the lesser charge of concealment of birth. The Act only applied to England and Ireland. In 1808, the 49 Geo. III. cap. 14 was passed. It repealed the Act of 1690 of William and Mary, and was applicable only to Scotland. It constitutes the present law in Scotland with respect to this crime.

It enacted "that if from and after the passing of this Act any woman in that part of Great Britain called Scotland shall conceal her being with child during the whole period of her pregnancy, and shall not call for and make use of help or assistance in the birth, and if the child be found dead, or amissing, the mother being lawfully convicted thereof, shall be imprisoned for a period not exceeding two years, in such common gaol or prison as the Court before which she is tried shall direct and appoint."

In 1828, by the passing of the Lansdowne Act—9 Geo. IV. cap. 31, sec. 14—the prosecutor was relieved from the necessity of proving in a charge of concealment of birth whether the child died before, at, or after its birth. The Consolidation Act—24 & 25 Vict. cap. 100—adopted and extended the above provisions.

Section 60 reads: "If any woman shall be delivered of a child, every person who shall by any secret disposition of the dead body of the said child, whether such child died before, at, or after its birth, endeavour to conceal the birth thereof, shall be guilty of a misdemeanour . . . provided that if any person tried for the murder of any child shall be acquitted thereof, it shall be lawful for the jury by whose verdict such person shall be acquitted, to find, in case it shall so appear on evidence, that the child had been recently born, and that such person did, by some secret disposition of the dead body of such child, endeavour to conceal the birth thereof, and thereupon the Court may pass such sentence as if such person had been convicted upon an indictment for the concealment of the birth."

This Act is the basis of indictments for infanticide in England and Ireland.

It will be apparent from the foregoing, therefore, that in England the alternative charge to infanticide is concealment of birth, whereas in Scotland, it is concealment of pregnancy. In every charge of infanticide, the law starts from the presumption that every child is born dead till proof of the opposite is adduced, the *onus probandi* falling upon the prosecutor.

It will be well at this stage to clear away certain terms by giving their legal definitions. The term "live-birth" in law has been in the past a great stumbling-block in the successful prosecution of cases of this crime. It ought to be said at once that its definition is judge-made and not statutory, but that it has equal force as if it had been made by Act of Parliament. Live-birth legally means the entire delivery of the child from the parts of the mother, and the maintenance of a circulation or life of its own independent of the mother.[1] This definition obtains although the child may still be attached by the umbilical cord to the placenta which may yet be within the uterus of the mother. In other words, the child must be living an independent existence before it can come "under the King's peace." For this reason, it has been decided that it is no murder to kill a child *in utero*, but should the child only be injured from the violence offered, be born alive, and should then die from the effects of the injuries, the person who caused such injuries is chargeable with murder.[2]

It has also been decided in the Supreme Court of Illinois that an infant which had been born with a deformity alleged to have been caused by injury to the mother while it was within the uterus of its

[1] R. *v.* Enoch, 5 C. and P. 539. R. *v.* Poulton, 5 C. and P. 329.
[2] R. *v.* Senior, 1 Mood. C. C. 346.

mother, could not raise a suit of damages against the causer, because at the time of the infliction of the injury it could not be credited as a separate being capable of sustaining an action independent of the mother.[1]

It will thus be seen that the legal definition of live-birth differs from the medical definition in respect that the latter considers evidence of respiratory action of the child whether initiated partly within or wholly without the maternal parts, as indicative of live-birth. And it is precisely because of the difficulty, in this secret crime, of determining by physical appearances of the body whether the respiratory function was carried on while part of the child was within the maternal parts, or while it was wholly without, that in so many cases the minor charge of concealment of birth, or of pregnancy, is returned as the verdict of the jury respecting the guilt of the accused. A child is held to be " newly-born " in law within fifteen days after its birth.

When may a child be declared to be still-born ? The answer to this must be determined by the civil law as to live-birth, apart from a charge of infanticide or concealment of birth. It is quite clear from the evidence given before the Committee on Certification of Deaths that very loose notions prevail in certain quarters as to when a child is to be deemed still-born. But the question has arisen in a Court of Law in connection with a charge against a practitioner of alleged falsification of a birth certificate.

At the Sheffield City Sessions, January 11, 1901, a medical practitioner was charged under Section 40, sub-section 2, of 37 & 38 Vict. cap. 88, with the above offence. A number of witnesses stated that the child was born alive, about half-an-hour after the doctor left the house of the mother, who was then in labour, on the night of March 31, that they heard it cry, or make a whining noise, and that it died between three and six o'clock next morning. The accused gave a certificate stating that the woman had been delivered of a still-born child. The accused stated in his defence that the child was a six months' child, and that he inferred from that fact it could not be born alive. The jury gave the accused the benefit of the doubt, but stated that they believed he was guilty of gross carelessness in giving such a certificate. A verdict of " not guilty " was accordingly entered. It ought to be clearly understood that a child, whether at six months or nine months of uterine age, which manifests such signs of independent existence as would entitle it to succeed to an estate—for example, attempts at respiration, or the continuous action of the heart even for some minutes after birth, much more the act of crying—must be reckoned as born alive for the purposes of the civil law.

The following practical medico-legal questions are bound to emerge in the medical examination of a woman charged with the crime of child-murder—viz.

1. Has the woman charged been recently delivered ?
2. Is the body of the child found that of a viable child ?
3. Is the child found that of the person accused ?
4. Was the child born alive ?
5. If the child was born alive, what caused its death ?

Having already discussed the first two queries (*vide* pp. 102, 391), it is not now necessary to deal with them. The only point that need be made clear now is, that unless the child born has reached such a stage in its development as made a living birth possible, no charge of

[1] *New York Med. Record*, March 1900 ; *B. M. J.*, vol. i., 1900, p. 659.

infanticide, or of the minor charge, would lie against the accused.[1] In the theory of the law, a fœtus which has not attained the completion of the seventh month of intra-uterine life is held to be incapable of maintaining a separate existence, and is, therefore, non-viable. Viability (*vitæ habilitas*) means, therefore, the capability of a fœtus to maintain a separate existence after birth. The presumption of the law, concerning the body of a child found dead which bears evidences of less than seven months' intra-uterine age, is that it had failed to live by reason of its immaturity. But should there happen to be evidence that this immature fœtus lived after its birth, and that it had been deprived of its life by the act of another, a charge of infanticide would lie against such person. An interesting side of the subject of viability from the point of view of the civil law of succession has come under the consideration of the French Law Courts. Before the Tribunal de la Seine in 1902, a plaintiff sought to recover the *dot* which he had paid on the marriage of his daughter, on the ground that the daughter had died without leaving a child to inherit the dowry from her. His daughter, whose *dot* amounted to £2000, died in giving birth to a child of six and a half months of intra-uterine age. The premature infant, at birth, was placed in an incubator, or *couveuse*, where it lived for 25 days, when it died. The question for the Court to determine was whether or not the child was viable. It seems, according to French law, that if the child was not viable, the father of its mother, who gave the dowry to the mother at her marriage, could claim the return of the dowry on the ground that a non-viable child cannot inherit, but if it was a viable child, and if it survived the death of its mother, one-half of the dowry would go to the child's father, and the other half to its maternal grandfather, The Court granted leave to the plaintiff to lead evidence on the following three points :—(1) that the child was born after a period of gestation of 6½ months ; (2) that at birth it weighed 1 kilo. 200 grammes, and that it continued to lose weight thereafter ; and (3) that it did not have fully-formed finger-nails. The Court appointed a jury of experts to consider the evidence. *The British Medical Journal*, in noting the foregoing particulars of the case, remarks : " this is said to be the first time a legal tribunal has been called upon to decide whether an infant which lived 25 days after its birth, and was not the subject of any disease or constitutional taint other than extreme weakness, was or was not viable." [2] Therefore the question of viability is of great importance.

3. Is the child found that of the person accused ?

Proof on this point is most usually established from lay evidence, by persons of the prisoner's own sex, with whom she has been more or less intimately associated in work or social life. The medical examiner may assist in this matter by a careful examination of the wrappings which envelop the body of the child, as happened in a case in Glasgow in 1898, in which on the brown-paper wrapping of the body was a nearly obliterated name and address which gave the necessary clue to the discovery of the mother, or of the nature of the ligature with which the umbilical cord is tied. The child's body, on the other hand, may never be found, in which case the death cannot be proved.

[1] Hume, i. 298 ; Alison, i. 153.
[2] *B. M. J.*, vol. i., 1902, p. 1227.

In odd cases, where the body is found and in which the child has lived for two or three days after its birth before being murdered, some evidence relative to identification may be obtained from observation of the condition of inflammatory area of separation of cord from abdomen. But such cases are very rare, as the deed is done usually at the time of the birth of the child, the object being to prevent it making its arrival into the world known.



FIG. 105.—Case of Monstrosity. The child was born on November 20, 1888, and lived till December 12; thus the child lived for a period of 22 days. The illustration gives a posterior view and shows that the monster possessed two heads, three arms, two legs with very deformed feet, and a curious caudal appendage. For the use of this and the other illustrations of the monster we are indebted to a former student who attended at the birth.

4. Was the child born alive ?

Proof of the child being dead before birth, or of being incapable of maintaining a separate existence, may be adduced from the following facts :—

(*a*) Evidence of immaturity or non-viability. Children less than the age of seven months of uterine development are medically

considered, in the great majority of cases, to be incapable of maintaining a separate existence. And while there have been children successfully reared at less ages than the above, such has only been accomplished in exceptional cases and under exceptional precautions, and therefore need not be considered in this connection.

(*b*) A monstrous birth. Such is generally considered to be incapable of living a separate existence. But we must discriminate even in this, as it will entirely depend upon the character of the monstrosity whether maintenance of a separate existence is possible or not. (Fig. 105.) The Siamese twins, for example, lived for many years. But acephalous, anencephalous,

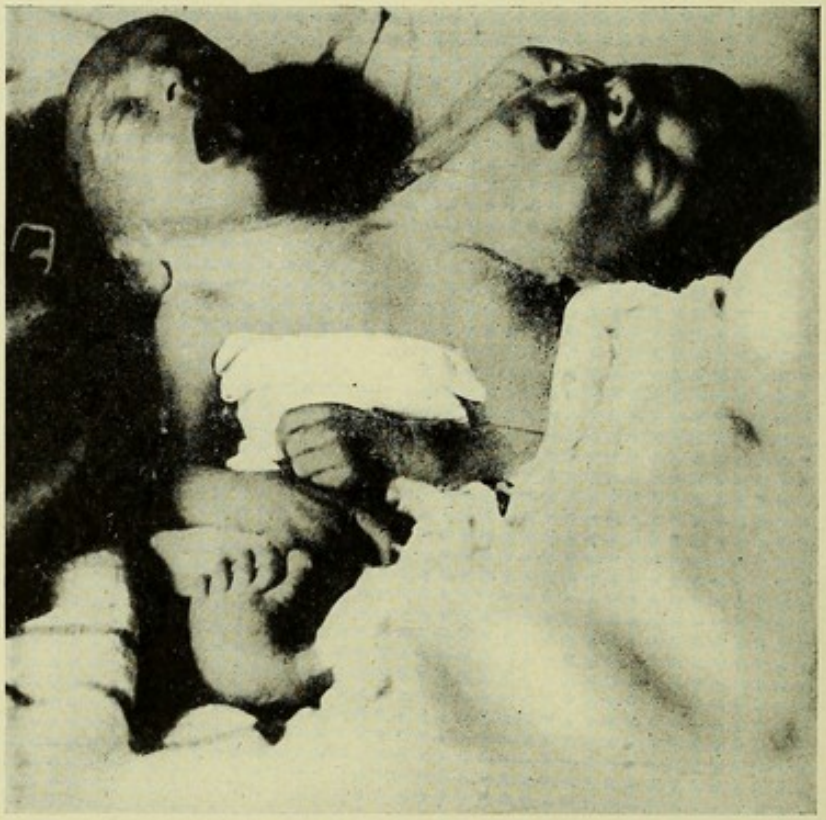


Fig. 106.—Front view of Monster (Fig. 105), showing the relation of the heads to the body, and the deformity of the feet.

hemicephalous, ectocardiac, and other teratological abnormalities usually die quickly after birth; but an anencephalous monster has lived for 61 hours after birth.[1] To kill a monster, or to prevent it from living, is murder in the eyes of the law. (Figs. 105 and 106.) In addition to the case of the Siamese twins—Chang and Eng Bunker—who lived to the mature age of 63 years and who died within two hours of each other, other cases of double or, as they are termed, xiphopagous or thoracopagous twins, who have attained to comparatively mature years, have been recorded; as, for example, the cases of Radica-Doodica, Millie-Christine, and of

[1] Onodi, *Monatsch. für Geburtsh. u. Gyn.*, March 1900.

Rosaline-Maria, twin sisters, and of Laloo, twin brothers. In some of these surgical operation to effect separation was performed. For further information the reader may consult the following references named in the footnote.[1]

(*c*) Evidence of intra-uterine death. A child whose body bears marks of maceration—putrefactive changes induced by the

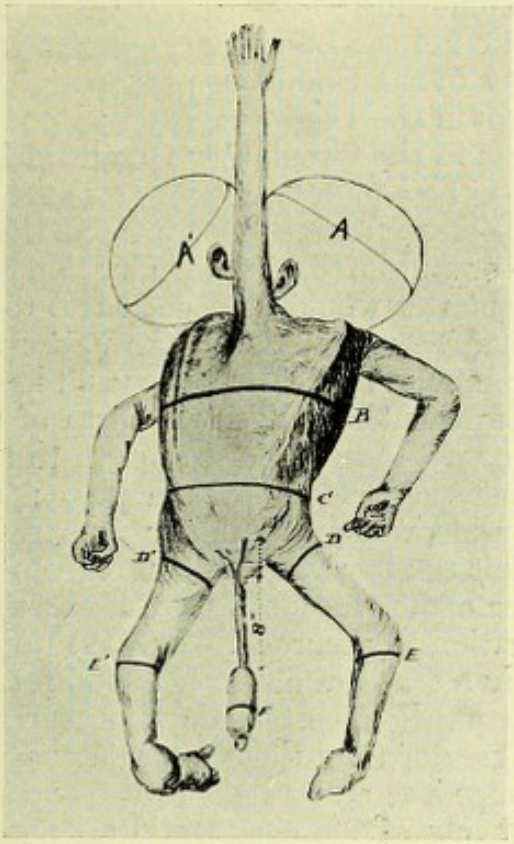


FIG. 107.—Diagrammatic Drawing of Monstrosity (Figs. 105, 106), giving measurements of parts. Back view.

A	= Circumference of Head		= 12¾ inches.
A′	= ,,	,,	= 12¾ ,,
B	= ,,	Thorax	= 15 ,,
C	= ,,	Abdomen	= 12½ ,,
D	= ,,	Thigh (right)	= 4 ,,
D′	= ,,	Thigh (left)	= 4 ,,
E	= ,,	Leg (right)	= 4 ,,
E′	= ,,	Leg (left)	= 3 ,,
F	= ,,	extremity of Caudal Appendage	= 2¾ ,,
Total length of Caudal Appendage			= 8 ,,

The hand which passes above the two heads possessed six digits, of which the first or thumb and the fourth were bifid.

body lying in the *liquor amnii*—would likely be born dead. But, then, one has to decide whether such appearances were produced within or without the mother's body, since all bodies to be examined are not found fresh, but, on the contrary, some are found advanced in decomposition.

[1] *B. M. J.*, vol. i., 1888, p. 436; *Trans. Path. Soc.*, vol. xxxix., p. 247; *Trans. Coll. Phys. of Philadelp.*, vol. i.; Bland-Sutton, "Tumours, Innocent and Malignant," 1893; and *B. M. J.*, vol. i., 1902, p. 465.

Given, however, the body of a child which presents none of the foregoing appearances, how are we to decide as to whether or not it was born alive ?

This is the question asked of the medical examiner in a criminal case, and it can only be answered from the signs found by post-mortem examination of the child's body.

The evidence of live- or still-birth must be determined from careful examination of the following :—

I. Condition of the Lungs ;
II. Changes in the Umbilicus ;
III. Changes in the Digestive Tract ;
IV. Changes in the Circulatory Organs and Channels.

We shall consider these in detail.

I. Condition of the Lungs.—Some have thought to include as an evidence of live- or still-birth, the configuration of the chest. Daniel and Plocquet thought this would be a good test to prove live- or still-birth. If infants had been made after the pattern of an india-rubber toy out of a certain mould, doubtless this would have been an excellent test, since by measurement merely of the girth of the chest one could have said whether or not it conformed in girth to that of the standard pattern in which inflation had not taken place ; but in respect that infants vary so considerably in their size and in individual measurements, it is impossible to say of the body of a given child from measurement solely whether or not its lungs have been expanded, or to do so with any approximation to accuracy. And the same is true of any set of figures comprising a series of observed cases, for it may well happen that in one set of observations certain chest measurements of the average dead child may be greater than those of the average living child, solely because of the average size and weight of the two sets. Casper [1] gives Tables of measurements of the chests of 1065 bodies of children that were either born dead, or that died shortly after birth, and he shows from these that the average chest of the children born dead had actually a larger measurement in the transverse diameter than that of the average living child. This, of course, would not be so, provided we were able to state the measurements of the chest before as well as after the establishment of respiration in the case of the children who survived birth, and what the measurements would be after respiration in the case of those who were born dead. The error of the calculation arises from working without knowable factors, and with factors of unequal value. So long as children at birth do not agree in size, in fatness, or in muscular development, and so long as the chest measurements are regulated by the original osseous form of the thorax, the muscular condition of the chest muscles, and the amount of fat thereon, it may be taken for granted that the configuration of the chest cannot be looked upon as a sign of any value whatever in determining this question.

In the same way, some have considered the position of the convex surface of the diaphragm with relation to the ribs as of diagnostic value. It is quite true—indeed, as a general fact it ought to be found—that the height of this structure relatively to the ribs is greater after a child has breathed than it was before. This is a truth applicable, as a general

[1] *Op. cit.* vol. iii., pp. 42-47.

principle, to all children; but when we come to institute comparisons between one child and another from this fact, our comparison at once breaks down from the point of view of accuracy since we are comparing two unknown things. Moreover, the height of the diaphragm in any one case, or in any set of cases, will depend mainly upon the degree of lung-inflation, which in itself is a variable condition in any series of cases of newly-born children. Further, if we can ascertain this height from dissection, we may safely neglect it, since the same dissection will reveal far more valuable and trustworthy phenomena.

Condition of the Lungs Themselves.—Whatever objections may be offered to the configuration of the chest as affording evidence

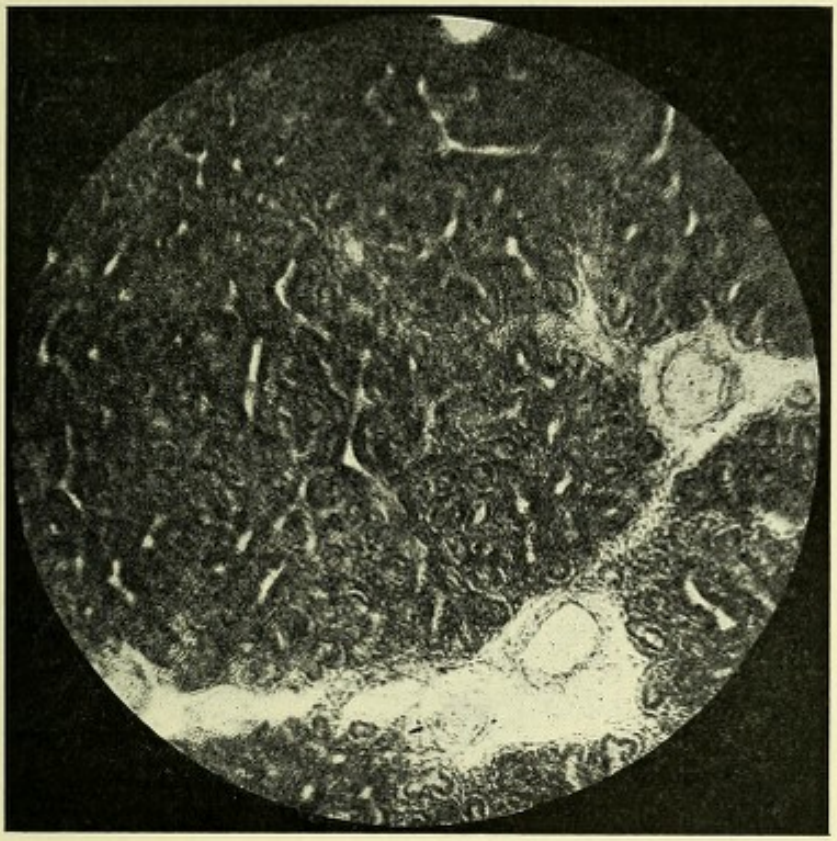


Fig. 108.—Photo-micrograph of Section of Lung-Tissue of still-born child showing unexpanded air-vesicles. ×150 diameters. (Author.)

of the live- or the still-birth of the child, such cannot be put forward to the facts found on examination of the organs of respiration, because they afford valid and satisfactory proof of the condition of the child with respect, at least, to the function of respiration. Prior to independent life, the lungs are absolutely useless in function; it is only when the living child is born that they become organs of function. (Fig. 108.) The course of the fœtal circulation is regulated to suit the former state. Whereas before birth the lungs only receive that amount of blood-supply which is necessary for their vitality and growth, after that event all the blood in circulation in the body of the child must pass through these organs to become reaërated. In order that the process of aëration may be accomplished, the respiratory function must be set in operation. Both changes, which happen contemporaneously

at the birth of a living child, produce, therefore, physical changes in the lungs, with respect to (*a*) volume, (*b*) colour, and (*c*) weight.

(*a*) *Changes in the Volume of the Lungs.*—Before birth the lungs do not fill the area of the thoracic cavity, the left not even partially overlapping the pericardium. In texture, they resemble much in appearance and consistence those of adult liver; and the lobules are very indistinctly marked. After the establishment of respiration, they more or less completely fill the cavity of the thorax—the completeness depending upon the thoroughness of the respiratory action—the left lung now more or less covers the pericardium; and in the apex of the right the appearances of inflation are usually most marked, because the air enters this part of the lung structure with the least difficulty. Between these two conditions of non-inflation and complete inflation, there are intermediate stages of incomplete inflation, in which circumstances it is almost impossible to affirm from physical appearances alone whether or not air has entered the lungs, to make certain of which fact further procedure is requisite.

(*b*) *Colour of the Lungs.*—Prior to respiration, the lungs are of a uniform reddish-brown, or liver-colour, but at the margins, because of the less thickness, they may appear more red on account of their greater translucency. Fœtal lungs present no patches of different colour. After respiration, the colour becomes marbled in general aspect; of a dark bluish-red ground colour with many bright red limited patches; or of bright red ground colour with dark bluish-red circumscribed patches. This marbling in appearance and colour is absolutely characteristic of natural inflation. This cannot be simulated by any artificial method; if, for example, the fœtal lung be artificially inflated, the colour becomes of a uniform bright red.

(*c*) *Weight of the Lungs.*—Two tests have been based upon the weight of these organs; one on the ratio between the weight of the lungs and the total weight of the body of the fœtus, which is called the *Static test* or *Plocquet's test*, having been suggested by W. G. Plocquet in a publication in 1774; the other, on the ratio of the specific gravity of the organs to that of water, which is called the *Hydrostatic test* or Raygar's test, which was instituted by Raygar in 1682.

Of the static test it may be said, that the number of observations made by Plocquet from which he formulated the principle of the test, was three in all; and it seems that from such limited observations he tried to establish this rule: That in children who had respired the ratio of the weight of the lungs to that of the body was in the proportion of 2 to 70, and that in those who had not breathed the ratio was 1 to 70. He then stated that when in any case the ratio of lung to body weight was as 1 to 70, the child had not respired, but where it was 2 to 80 that the child had breathed. This conclusion has many times been put to the test of practical experiment, and has always been found wanting. Dr Cory [1] gives notes of the examination of the bodies of 58 children who were either born dead, or who died shortly after birth, and he points out, in the cases of still-born children, that the average ratio of weight of lungs to that of body was 1 : 54·89; in the cases where there had been imperfect respiration, 1 : 48·65; and

[1] "St Thomas's Hospital Reports," vol. xxiv.

in the cases where perfect respiration had taken place, as 1 : 41·5. It cannot, therefore, be affirmed that this test is of any significance, because of the variability of figures which its application reveals.

Very valuable and reliable information on the other hand is obtainable from the Hydrostatic test, which, as has been said, is based on the well-established fact that a lung which contains air is specifically lighter than water, and, therefore, will float. There are, however, those who deny that the flotation of the lung proves that it is alone due to contained atmospheric air, and, on the other hand, that if the lungs sink the existence of previous respiration is thereby disproved. Before discussing these points, however, let us consider the method of putting the test into practical application. It is performed as follows. Take any commodious vessel, such as a hand-basin—or if the examiner prefers to carry his own vessel, let it be one of about one foot in depth, and from eight to ten inches in diameter—and fill nearly full with water from the tap. Having detached from the body of the fœtus both the lungs and heart *en masse*, place them in the water in the vessel; note what happens. The mass may either sink completely, or it will float more or less completely although submerged in greater or lesser bulk. Let us assume that it floats, but that the mass is submerged; then remove the heart from the lungs and each lung from the other, and test the flotation of each lung separately; should each float perfectly, then wrap the lung in a piece of soft cloth, place the whole upon the floor, and stand upon the mass with the flat part of the sole of the boot; then test the flotation once more; if it still floats freely, then it may safely be affirmed that the child had respired freely. On the other hand, let it be assumed that the original mass of organs together sinks completely, then detach the heart and lungs, and test each lung separately. Let it be assumed that the right lung sinks in its entirety; then cut up the lung into pieces and test each piece separately, noting whether each piece sinks or floats; separate the pieces which have floated, apply pressure to each after the above-named fashion but with a correspondingly less severe pressure, and test flotation of the pressed pieces once more; if they still float, it will indicate that these pieces, at least, contain atmospheric air. Repeat the process with the left lung; and at the conclusion, note the number and situation of the pieces which have floated, and thereafter, pronounce an opinion as to whether the respiration has been imperfectly established or but weakly established. In cases of imperfect inflation, our experience is that the upper part of the right lung is likely to float when the major portion of the left and the bases of both lungs sink. It is a good plan in such cases of imperfect respiration to take the specific gravity of the lungs before they are cut up into pieces. The operation is not difficult to perform, and the apparatus needed is neither bulky nor costly. A good pair of apothecary's scales with one pan attached to the beam by linked wire, and a glass jar of the dimensions named, are all that are required. It is necessary, also, that a counterpoise of exact weight be adjusted and attached to the scale-pan which enters the water, so that the balance will be exactly counterbalanced when the empty pan is placed in the water of the jar. Such a counterpoise made of lead, or glass, can be bought and hooked on to the pan. The

apparatus without the counterpoise is first used to weigh each lung *in air*, the weights in grammes being duly noted. Assume that the right lung weighs 25 grammes, and the left 21 grammes. Then proceed to weigh *in water*, by first attaching the counterpoise to the water-pan. Weigh the organs in the same order, taking care to note that the lung is wholly submerged in the water of the jar; note the weights. Calculate, as follows, the specific gravity of each lung :—

The right lung = 25 grammes in air
" " " = $\frac{\cdot 9}{24 \cdot 1}$ " in water

$\therefore$ 24·1 : 25 : : 1000 : x

$\therefore$ $x = 1037 \cdot 3$ = *specific gravity of right lung.*

Calculate the specific gravity of the left lung in the same way.

It is necessary to explain why the pressure above mentioned should be employed in such cases, if not indeed as a routine practice in all cases, which we prefer to do, on the ground that one would be prepared if questions are asked in the witness-box. The air which is taken into the lungs may be divided into *tidal* and *residual* air; the former may be expressed comparatively easily from the lungs, the latter only by destruction of the lung tissue itself. In the process of decomposition of the lung, putrefactive gases may develop and form underneath the pulmonary pleura, and this, if existent in quantity, might affect the flotation of the organ. But by exercising such pressure as has been indicated, these putrefactive gases are dispelled, and, therefore, as a factor in flotation, they are got rid of. Consequently, if after this procedure the lung float, we may confidently affirm that it contains atmospheric air. The general conclusions which may be drawn from this test are these : If one or both lungs, or if even portions of them float after pressure has been duly exercised upon them, the child has breathed perfectly, or imperfectly; and if both, and all the portions of both, lungs sink, that the child has not breathed at all.

To these conclusions it has been objected that a lung may float from other causes than respiration and atmospheric air contents, as for example, from—

(*a*) Artificial inflation.
(*b*) Spontaneous development of interstitial or vesicular emphysema.
(*c*) Putrefaction.

And that a lung may sink, although respiration has been imperfectly established, from such causes as the following :—

(*a*) Disease.
(*b*) Atelectasis.

These objections must receive some detailed consideration :

(1) *With respect that a Lung may float from Artificial Inflation.*—The first point to be noted is that artificial lung inflation is extremely difficult of accomplishment even at the hands of a skilled person, and practically impossible by an ignorant person; if it were not so, it would be more generally utilised as a means of resuscitating the semi-asphyxiated new-born. Elsässer declares that of 45 attempts to perform this operation, only one was completely successful. But this one successful case demonstrates its possible accomplishment, and, therefore, we must seek to discover appearances in the lungs which will differentiate

between artificial and natural inflation. The following points will usually indicate the differences :—

(*a*) Artificially-inflated lungs exhibit a uniformly distributed bright red colour, whereas naturally-inflated lungs present a mottled or marbled coloration, as before described.

(*b*) If section be made of the former, the surface will present a dry appearance, whereas from that of the latter, bloody, frothy fluid will be seen escaping. This is due to the fact that when a child takes its first breath it not only takes air into its lungs, but the course of the fœtal circulation is then diverted into the lungs, thus accounting for the foregoing appearances. Without the normal function of breathing, there will be no more blood in the organ than that which existed during the fœtal condition, in which state the lung still remains, except for the artificially-inflated air. If artificial inflation has been successful, it is apt to be overdone ; hence rupture of some of the superficial air-vesicles is likely to be seen by the naked eye, or by a hand-lens, on the free margins of the lungs.

(*c*) When artificial inflation has been attempted by the ordinary method of blowing into the mouth or nostrils, or by blowing through a tube introduced into the mouth, the stomach and intestines are apt to become abnormally filled with air, a condition which is only commonly found after putrefaction of the body has far advanced.

But a practical point suggests itself here. Where a mother, or anyone else present at her confinement, attempted to perform this operation, no charge of concealment of pregnancy would lie, for the very attempt to resuscitate the child in this manner negatives a desire to destroy it ; further, to a mother whose sole object is to prevent her offspring from living, such an operation would be the last thing she would try to do.

It is to be borne in mind that, contrary to what has sometimes been asserted, the same difficulty is experienced in expressing the air out of lungs which have been artificially inflated, as out of those naturally inflated.

(2) *Emphysema Pulmonum Neonatorum.*—This is an alleged possible condition of the lungs of the newly-born, which, however, has not been clearly demonstrated. It is not easily conceivable that in an organ which has never been used such pathological changes as emphysema could possibly occur ; and it is difficult to comprehend how the condition could develop in the lungs before birth. It appears to us that in those cases in which it was supposed to be present, there must have been entrance of air *per vaginam* to the child, the effect of which would be to stimulate the respiratory function of the child when it was in such a position that the respiratory movements were hampered, and forced inspiratory action induced, which might account for the emphysematous appearances found. The only other condition for which it may have been mistaken is the development of putrefactive gases in the lung tissues.

From time to time observers have recorded instances not only of intra-uterine respiration, but under certain circumstances, also of intra-uterine crying, or *vagitus uterinus*.

A correspondent of *The British Medical Journal* writes of a case [1] in which having resolved to induce labour at the eighth month owing to previous difficulty of delivery at full time, he introduced a female catheter, by which the amniotic membranes were opened high up in the uterus and about a quart of fluid escaped. "After a few minutes," he adds, "the cries of the fœtus were audible to all in the room. Air had entered the uterus through the catheter, on cessation of the flow of water." Labour set in about thirty hours after, and a male child was delivered by forceps, alive. A still more remarkable case is described by Planchu and Reure [2] in which the latter observer heard loud crying of the child *in utero* for more than an hour, on the ninth day before delivery. It appears that the mother had complained of a watery discharge, and as labour was slow in coming on, vaginal douches of hot water were used by means of a pear-shaped syringe which, it was proved later, ejected much air with the water. Reure was called to the case because of the crying of the fœtus "which was so loud on his arrival that he expected to find the child born." The crying lasted continuously for about two and a half hours. Daily, between that day and the delivery, the fœtal heart sounds were heard and counted—on the average, the beats were 135 per minute. The child was born alive breech first but much asphyxiated, and died because of the greater need of attention by the mother who was bleeding.

The only comment to be made on these cases is this: that it must either be supposed that the supply of air which caused the child first to breathe was kept up till its birth, else the child would have been born dead by asphyxia, or that the physiology of respiration of the fœtus *in utero*, under the foregoing circumstances, must be different from that after its birth, which is inconceivable.

M'Naughton [3] and others have recorded cases of *vagitus uterinus*.

(3) *Putrefaction.*—That the gaseous products of decomposition in the lungs may assist in causing them to float, there cannot, we believe, be the least doubt. But there must be substantial evidence of such putrefaction, coupled with a non-inflated state of the lungs, before this view can be entertained in an individual case. It would be absurd to expect that such products would be present in lungs to such an amount as would of themselves cause flotation, where the rest of the body bore no evident marks of putrefaction. Besides, in a child's body, the lungs are among the last organs to undergo putrefaction, and, therefore, marked evidence of putrefaction of the body generally would require to be present to permit of these gaseous products being deemed an important factor in the flotation. When lungs and body generally are far advanced in decomposition, it becomes impossible for the examiner to determine whether flotation, if it takes place, is due to the presence of atmospheric air, or of putrefactive gases, or of both combined. He should therefore frankly admit his inability to affirm that the child had breathed. This much can be safely said: that if a putrefying lung sink in water, it is good evidence that the child had never breathed, or had but imperfectly respired.

On the other hand, it is affirmed that a child may have breathed, and may have lived for some hours, without any response to the test flotation of lungs after trial. Such cases have, from time to time, been recorded. Among the most recent are the following:—[4]

In the first it is stated that an inquest was held on the body of an illegitimate female child, which was exhumed after being buried ten days. The evidence

[1] Vol. i., 1901, p. 256.
[2] *Lyon Méd.*, January 6, 1901: *B. M. J.*, vol. i., 1901, *Sup.* p. 14.
[3] *B. M. J.*, vol. i., 1908, p. 147.
[4] *Ibid.* vol. ii., 1900, p. 1567; and vol. i., 1901, p. 146.

at the inquest was to the effect that the child had been born precipitately, that the mother was first attended by a neighbour, then by a medical man, and last of all by the parish nurse, all of whom saw the child alive, though weakly. The child lived about five hours after its birth. The post-mortem examination showed that the child was at full term, and was fairly well developed. The lungs were found collapsed, not filling the chest cavity, and in a condition of complete atelectasis. On using the hydrostatic test, the lungs when tried together, separately, or in portions, sank, and presented the appearances and results of those of a still-born child. The medical man who made the dissection stated at the inquest, that had he not heard the evidence of five different persons on oath that the child lived five hours, he should have been compelled to swear that the child had been still-born and had never breathed. He offered the explanation that the child had lived the number of hours it did by whatever aëration the blood received through the mucous membrane of the trachea and larger bronchi. The second case was that of the child of a married woman which was born at seven months. It was washed and dressed, and although it never cried, it "made a moaning noise." It lived about seven hours. An inquest was held, and a necropsy performed. The medical evidence of the necropsy bore that the lungs were collapsed, and that no developed air cells, or vermilion spots, could be seen. The lungs as a whole sank in water, and although they were cut into small pieces, every piece sank to the bottom of the vessel. There could be no doubt whatever of the child being alive, although feebly, for seven hours, and the performance of the hydrostatic test showed not the least response to flotation of even isolated small portions of lung.

It must be frankly acknowledged that these are difficult facts to face, especially by anyone who pins his faith to the absolute veracity and impartiality of the hydrostatic test, for we start from the well-established fact in both cases that different competent witnesses swore that the child lived for hours. From the physiology of respiration, it would *primâ facie* be held impossible for children to live and breathe, however imperfectly, for five and seven hours respectively without some evidence of establishment of the respiratory function being left in the lungs. It would be interesting to inquire why it was deemed necessary by the coroner in each case to hold an inquest, when reliable witnesses swore to the live-birth of the child and its weakly condition in each case, and hence the cause of death could easily be accounted for. Were there suspicious circumstances in each case calling for an inquest and a post-mortem examination, and for what reasons were the medical attendants unable to sign certificates of the causes of death? We do not suggest the following possibility in the cases narrated, but it is not inconceivable that in such cases submersion of the child in water might account for the absence of flotation. Moreover, one would like to know more about the appearances of the lung section in the latter case, and of the condition of the body relative to putrefaction in the former, before a definite judgment was formed. We have never chanced to meet such cases as the foregoing.

Lungs may sink from Disease, such as Pneumonia.—While this is undoubtedly true of the hepatic stage of that disease, it presupposes the previous establishment of respiration; and in connection with the question of infanticide or concealment of pregnancy, the statement would only be relevant if it could be shown that the child was born suffering from pneumonia, of which no undoubted case has yet been published, so far as we know.

The same observations apply to pulmonary tuberculosis, since congenital disease of the lungs of such an extent as to prevent flotation

after respiration, is unknown. The same is also true of syphilis; for while such lesions have been found congenital, they are not extensive in the lungs. Asphyxiated lungs may float or sink, depending upon the asphyxiating cause. If the cause be drowning, they are not likely to float. The diagnosis in such a case would be cleared up, however, by other and additional signs, such as petechial ecchymoses on pleuræ, pericardium, or diaphragm.

Placzek declares that while the hydrostatic test is, in many respects, an excellent one, it is not always reliable for demonstrating whether a lung has been expanded by air or not, and he has suggested a new test which has this advantage, at least, that it does not interfere with the after-carrying out of the hydrostatic test. The basis of the test is the physiological fact that once air has entered the pulmonary alveoli, it cannot again completely escape, and that if a child has breathed, the intrapleural pressure will be positive, whereas if it has not breathed that pressure will be negative. The test, as carried out by himself, is as follows :—after cutting through the skin from the chin to the ensiform cartilage, the trachea was carefully dissected out and securely tied. Then the skin of the chest was reflected back as far as the line of the axilla. A trochar and cannula, the latter fitted with an airtight stop-cock, was then inserted through the third, fourth, or fifth intercostal space, midway between the line of the nipple and that of the axilla, into the pleural cavity. The trochar being now withdrawn from the cannula sufficiently to enable the stop-cock to be closed, was then entirely taken out, and to the free end of the cannula was attached a tube, communicating with a mercurial manometer. The stop-cock of the cannula was now opened, and the behaviour of the level of the mercury in the manometer observed. If the level rose, it might be inferred that the child had breathed, whereas if it remained stationary, it might be concluded that the child had not breathed. Placzek found that this occurred regularly in all the bodies of infants examined by him.[1]

Assuming that the child has survived its birth, but has some days afterwards been put to death, attention must be given to the following conditions, as indicative of the period it has lived—viz.

II. The condition of the umbilical cord;

III. The state of the stomach and intestines;

IV. The changes in the heart and circulatory system.

II. The changes which occur in the umbilical cord are of great moment in determining this question. The first signs of separation of the cord may be apparent from 36 to 48 hours after birth, and consist of an inflammatory line at the point of junction of cord with the abdomen. The line of separation becomes deeper daily till the 5th, 6th, 8th, or even the 9th day, when the separation becomes complete. Probably in the largest number of cases, the separation is accomplished on the 6th day, in the next largest, on the 5th, while in graded smaller proportions of cases, on the 7th, 8th, and 9th days respectively. On the average, therefore, the cord may be looked upon as separated by the 5th or 6th day after birth. Lowndes gives a case in which the body of a newly-born male child was found in a cellar with a scarf tied tightly round the

[1] *Münch. med. Woch.*, Feb. 18, 1902; *B. M. J.*, vol. i., 1902, s. p. 61.

neck. The lungs indicated that the child had respired. The umbilical cord for about half-an-inch from the navel was perfectly fresh, and its remainder, 2½ inches in length, was completely mummified. There was no ligature. From these appearances, he was of opinion that the child had survived its birth at least 24 hours.[1]

III. The changes chiefly to be looked for in the stomach and intestines are the presence or absence of food, and if present, its character, and the presence or absence of meconium in the small intestine. The presence of food, such as partly digested milk, would point to the fact that the child had survived its birth, although its absence would not point to the opposite conclusion. With regard to meconium in the bowel, its absence does not necessarily indicate that the child has survived its birth, since in breech presentations, which, in the absence of skilled assistance, are perilous to the life of the child, the meconium may be voided, partly as the result of abdominal compression, and partly from asphyxia induced by pressure on the cord.

IV. The changes in the heart and circulatory system ought to receive attention, although not much practical benefit may accrue from the examination because of the comparative variations of time when the fœtal structures close. All these structures—the *foramen ovale*, *ductus arteriosus*, *ductus venosus*, and umbilical vessels—become functionless, in ordinary cases, sooner or later after birth, but they are all pervious in the newly-born child. The *foramen ovale*, for example, does not become permanently closed till the second or third month; the *ductus arteriosus*, however, begins to shrink within three or four days, but is pervious to a fine instrument at the end of two months; the same may be reckoned of the *ductus venosus*. The umbilical vessels are the first to become obliterated. They begin to contract about 10 hours after birth, and are completely impervious within a week after.

Certain other tests of live-birth have been suggested by observers. Of these, the following may be mentioned, although no practical value may be attached to them.

1. *The Deposits of Uric Acid in the Kidney.*—These brownish streaks of uric acid in the ducts of Bellini are only to be found, say some, in children born alive and who have lived for not less than 48 hours. It is equally asserted that they are not found in children born dead, that their causation is not pathological but physiological, and further, that the phase of their existence is most marked between 48 and 216 hours after live-birth.[2]

2. *The Relation of the Weight of the Lungs to that of the Liver, which is called Bernt's Test.*—This test may be held to be practically valueless.

3. *The Presence or Absence of Air in the Middle Ear.*—During the fœtal state, the middle ear is filled by embryonic connective-tissue, which becomes replaced by air at a shorter or longer interval after the institution of respiration. If, therefore, the middle ear be found to contain air instead of this tissue, say Wreden, Werdt, and F. Ogston, it is a proof of live-birth; and if it contain a fluid corresponding in appearance to that in which attempts at breathing have been made, it is proof positive of respiration. The chief drawback to the applicability of the test in practice—and to our mind it is a fatal one—is that

[1] *Liv. Med.-Chir. Jour.*, July 1889. [2] Cory, *op. cit.*

the time of disappearance of this embryonic tissue varies from a few hours to two or three weeks.

The following conditions, summarised, when found on the body of a newly-born child, would warrant an examiner in affirming that the child had breathed :—

(1) When the child is sufficiently mature to be able to live an independent existence. Maturity may be held established if centres of ossification are found in the epiphysis of the lower end of the femur, and in the tarsal cuboid bone.
(2) When the lungs more or less completely fill the thoracic cavity.
(3) When the colour of the lungs is marbled, or mottled.
(4) When the lungs, or portions of them, after being duly tested, float in water.
(5) When a bloody, frothy fluid exudes from the lung section on slight pressure.

5. If the Child was born alive, what caused its Death ?—A child may be born alive in a weakly condition and may only survive its birth a few minutes or hours from what is termed, for want of knowledge of the more intimate cause, Birth Debility. Under this designation are comprehended various causes, such as congenital debility, effects of difficult parturition causing organic lesions of brain or skull, imperfect establishment of respiration, and some others. On the other hand, children may be put to death by violence in a variety of ways, or may meet with death accidentally by violence, or from other causes. But the medical examiner may have to conduct examinations on the bodies of newly-born still-born infants, which have been thrown into a waste-heap or other like place by parents who are either too careless or too poor to bury them, as well as the bodies of those who have been born alive, but who have died shortly after and have been disposed in a like manner, in addition to those which bear the marks of violence. It has been our duty to examine for medico-legal purposes about 100 bodies of newly-born children which have been found by the police exposed in public places, of which 22 only had not attained a viable age. One point must be enforced at this stage—That the fact of exposure of the dead body of a fœtus does not necessarily indicate either that it has been born alive, or that it has met with a violent death.

In the examination of a body, therefore, to ascertain the cause of death, the examiner has to consider not only the cause but the manner in which death has been brought about. For example, while the cause of death found may be asphyxia, the mode of producing the asphyxia may arise from the accidents of child-birth, and where there has neither been concealment during pregnancy nor at birth ; or from intentionally applied violence, in which case the crime of child-murder has been committed. It will therefore be necessary to consider the causes from which the child may be still-born, as well as the causes by which the child has been prevented from living at or after its birth. A child may be born dead from causes such as the following :—

(*a*) Injuries received while *in utero*.
(*b*) Accidents in child-birth.
(*c*) Congenital disease.
(*d*) Immaturity.
(*e*) Violence.

I. *From Injuries received by the Child in Utero.*—These injuries may have been produced intentionally or accidentally. Fractures of the cranial vault, rupture of blood-vessels in the brain, rupture of internal organs, and fractures of the extremities have resulted from the external application of violence to the abdomen of the mother.[1] We had in our possession, taken from the body of a child born dead, fractures of both radius and ulna, the history of the case being that the mother had sustained a fall some time before its birth. Burdach[2] narrates the case of a woman who, in the sixth month of her pregnancy, received an injury to her abdomen sufficient to fracture the forearm and leg of the child, who, although carried by the mother to full time, showed at birth the fractures united at an angle. As to fractures of the cranium inflicted *in utero* some healthy doubt may at first be entertained. In usual circumstances, it is difficult to comprehend how they may be produced, because of the protecting influence of the *liquor amnii*, and the situation of the head *in utero* in cranial presentations. But this doubt must not be carried the length of absolute incredulity, since it ought to be remembered that in breech presentations the head is in the upper segment of the uterus, and thus is exposed to violence. Moreover, cases have been recorded in which extensive cranial injuries have been so produced. Two such cases are quoted by Casper.[3]

One by Blot, in which a primiparous woman during labour and before the rupture of the membranes, accidentally fell from two storeys in height into a courtyard, whereby she had her femur fractured, besides receiving many severe contusions. The child by this time had passed through the *os uteri*, much crepitation was felt on its head, and it was delivered dead by the aid of forceps. On dissection of the head, a fracture of each parietal bone was found, and much bruising of the scalp. Maschka records the second.[4] It was that of a woman who, towards the eighth month of her pregnancy, precipitated herself to the ground from a height of two storeys and fractured both thighs, of which injuries she died. On the head of the fœtus *in utero* several fractures of both parietal bones, and much bruising of both scalp and brain were found.

On the other hand, a pregnant woman may herself receive severe injuries without any injury being sustained by the fœtus. Dr Pagan of Glasgow used to relate the case of a woman who, eight months pregnant, was accidentally run over by his carriage and severely injured, but whose child was unhurt. Elias records the case of a pregnant woman who, four weeks before full term, fell from a second-floor room to the ground, striking the right buttock. Labour came on next day, and the child, which was alive immediately before the accident, was born dead. Post-mortem examination of its body showed two fissures in right parietal bone and one on left side of frontal bone with an indentation.[5]

While the foregoing cases are out of the category of infanticide associated with concealment of pregnancy or of birth, they show that such injuries might be inflicted upon the fœtus *in utero* as to cause intra-uterine death.

II. *From Accidents during the Delivery of the Mother.*—It is in this class of cases that the most careful scrutiny of the facts is demanded, since, most usually where a defence is offered, death of the fœtus by

[1] Casper, *op. cit.* vol. iii., p. 110.
[2] Leishman's "Midwifery," 2nd edit., p. 419.
[3] *Op. cit.* vol. iii., p. 114.
[4] Prager's *Vierteljahrschrift*, 1856, Bd. iii., sec. 105.
[5] *Monatschr. f. Geb. u. Gyn.*, Nov. 1907.

accident at birth is pleaded. It is true that a fœtus may die during the process of child-birth from a variety of causes. Some, although living up to the time of birth, succumb from debility during the process; others die from the effects of tedious labour, or from want of skilled assistance owing to malpresentations, such as funis and breech presentations, or from such a complication as coiling of the umbilical cord round the neck; others, again, due to maternal pelvic deformity, or a normally tight pelvis, may suffer from fracture of the cranium, or intra-cranial effusion of blood. In all of these cases careless or poor people may simply throw away the body of the fœtus to save themselves the expense of proper burial.

A fœtus may die also from accidental causes at the moment of delivery; (*a*) from suffocation in the dress of the mother, or in the bedclothes, or in the discharges which usually accompany delivery; (*b*) from being projected from the maternal parts into a vessel containing water, such as a *pot-de-chambre*, a chair-stool, a water-closet, a tub, or other capacious vessel for holding slops. This may happen from the fact that, just before the birth, the pressure of the head on the rectum and bladder creates a strong desire on the part of the woman for evacuation of the contents of these organs, which if acted upon, may, by the occurrence of a strong pain, cause the child to be projected into the vessel, and its death by drowning. We have met with two *bona fide* cases in our experience; one in which a young woman, in labour with her first child, was delivered of her child into a *pot-de-chambre* which contained a quantity of urine. She shouted for assistance to her neighbour, but who, powerless to help, rushed out of the house for assistance, and on our arrival we found the child—a small one—head downwards in the position described; in the other, a married woman, in labour with her third child, went out to a water-closet on the stair-landing of a tenement flat, and when there was seized with violent pains, and was delivered of her child in the closet-pan. She shouted for help, and the child was rescued and with great difficulty was resuscitated. In a third case which happened in the experience of a colleague, a woman while in labour was straddling over a small slop-tub because of her urine being forced from her by the pains, and while in that position was delivered of her child which fell into the water and was drowned before assistance arrived. Harris records a case in which a primiparous woman was unexpectedly delivered of an eight months' fœtus while sitting on a night-stool. Examination of the body showed that its face and lips were somewhat blue and congested, and that the lungs sank in water.[1] In precipitate labour, a child may be projected with such force from the mother's body to the ground that cranial injuries, sufficient to cause death, may be produced. Casper, Swayne, Landsberg, and other writers have recorded cases of this kind, in which the event happened before eye-witnesses. To test the possibility of this, Chaussier conducted a series of experiments, with the result that of the bodies of 25 new-born children dropped from a height of 30 inches from the ground—the average height of the female genitals from the ground in the standing posture—fractures of the cranium were produced in 24, and of these 22 had sustained fractures of either

[1] *Lancet*, vol. ii., 1889, p. 1001.

one or both temporal bones. It may, therefore, be taken as a well-established fact that such fatal injuries may be produced in the manner indicated.

The two following cases from our case-book were, probably, due to this cause :—

1. In June 1908 we examined in Motherwell the body of a newly-born male child which had been found in a box belonging to a domestic servant. The body was fairly well nourished. It measured 20½ inches. Attached to abdominal wall was a length of umbilical cord which also measured 20½ inches in length, the free end of which had been torn and not cut. The fœtus was of mature uterine age. Lips and inner lining of mouth, finger and toe nails, were dusky livid in colour. Over pit of stomach, two inches above and to left side of umbilicus, was a superficial wound of skin measuring ⅜ths of an inch long, which was accompanied by bruising of underlying skin and tissues. Internal dissection revealed considerable extravasation of blood in upper and back part of scalp, similar areas over sides of head, and a linear fracture of left parietal bone 1¼ inches long, which extended downwards from sagittal suture. There was effusion of blood on surface of membranes and more around the cerebellum. The lungs were fully inflated, were mottled in colour, and floated freely after application of usual tests. They showed Tardieu's spots on the surface and were found to be congested on section. These punctiform ecchymoses were also found on surface of heart. The right heart was full of dark blood. We reported that (1) the cause of death was fracture of skull and effusion of blood on brain and asphyxia, (2) that these were the result of violence, (3) that the form of violence might have been a fall from the parts of the mother while in a standing position to the ground or floor at time of delivery, (4) that the asphyxia might have been caused by the child being wrapped while alive in clothing, and placed in a box, and (5) that the child was born alive.

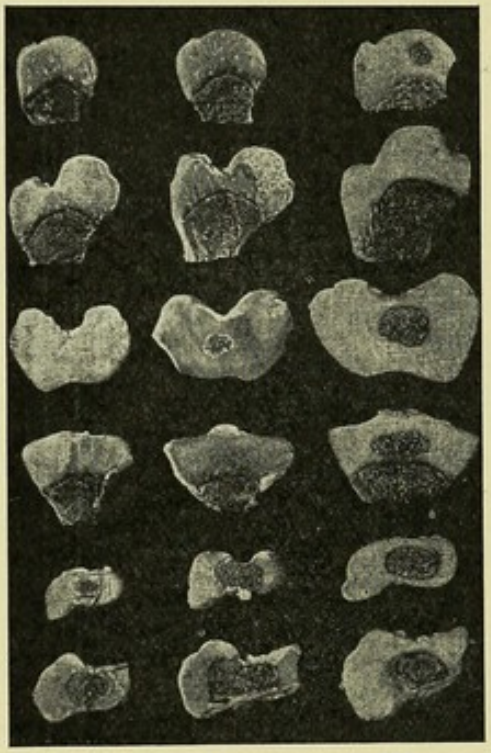
The mother was tried at the Circuit Court, Glasgow, and after evidence was found guilty of concealment of pregnancy.

2. In a recent case (1909) a young Polish woman was tried at a sheriff and jury court on the charge that having been delivered of a living male child, she did at or immediately after delivery drop said child or let him fall upon the floor of a house or closet or upon the ground in a court, and did kill him. The body of the child was found secreted behind a flagstone in the courtyard of the house where she lived. It was covered with household ashes. On examination of the body, we found superficial bruises and scratches on the right cheek, the left cheek, and front of neck, with bruises and abrasions around both ears and on scalp on each side above the ears. From the middle of the back downwards and forwards to the left groin was a large series of scratches and abrasions. Dissection of body showed extravasation of blood in deep tissues of both temples. There was no *caput succedaneum*. On the upper surface of both hemispheres of brain was a layer of fluid blood, as also on surface of cerebellum, and on front of left frontal lobe was an area of bruising. There was no fracture of skull. The lungs did not completely fill their respective cavities, but they were mottled in colour, and floated perfectly *en masse* with heart and thymus gland, separately, and after pedal compression. The lower femoral epiphysis contained a small osseus nucleus, but less in size than that found in the average mature child. The placenta, which had been found beside the body, had a length of umbilical cord measuring 16½ inches attached to it. Its free end had been cut.

The jury, after hearing evidence, found the accused "not guilty."

Cases, however, may occur without precipitancy of labour in which cranial fractures may be produced. Mace records a case in which a woman of 25, a tri-para, awoke in the middle of the night without pains. During the act of micturition the fœtal head appeared at the vulva and was soon born, but with one of the parietal bones fractured, although there had been no interference, no rupture of cord, and the child did

not fall to the ground.[1] At the same time, it must not be forgotten that cases of "painless labour" are not unknown; indeed, many have been recorded. Renshaw records one in which the child was unexpectedly expelled on the floor while the mother was standing by the fireplace, the cord being ruptured.[2] Probably one of the most difficult cases to decide as between strangulation by natural causes and by applied violence, arises where a mark is found upon the child's neck. Every experienced obstetrician knows that coiling of the umbilical cord round the neck of the child is by no means uncommon. It is not difficult, therefore, to conceive a case in which a woman may be suspected



I. II. III.

FIG. 109.—States of Ossification of Humeral and Femoral Epiphyses and Posterior Tarsal Bones. From above downwards, the order is as follows—viz. (1) Epiphysis of Humerus; (2) Epiphysis of Femur, upper and lower; (4) Tibial Epiphysis; (5) Astragalus; (6) Os calcis. Series I., Ossification in those bones in Eighth-Month premature Female Child; Series II., in Full-term Female Child; and Series III., in 3½-months-old Child. (From Hofmann's "Atlas of Legal Medicine," by permission of the publishers.)



FIG. 110.—Section of Lower Limb and of Humerus of Mature, Newly-Born Child. Points to be noticed: (1) absence of osseous nucleus in upper epiphysis of femur; (2) presence of nucleus in lower epiphysis; (3) nucleus in head of tibia; (4) nuclei in astragalus, os calcis, and cuboid tarsal bones. It is exceptional to find a centre in upper humeral epiphysis at mature birth, but it is present sometimes in robust infants. At the seventh month, the nucleus in os calcis is the size of a pea. (From Hofmann's "Atlas," by permission of publishers.)

improperly as the murderer of her child, when after all it has been strangulated by the cord during birth. We have examined two cases at least in which this was the apparent cause. The mark produced by the umbilical cord on the neck is never well marked, and the death as not so much due to the constriction exercised, as to asphyxia induced by interference with the placental circulation through the cord.

[1] *L'Obstét.*, vol. vi., p. 54, Jan. 1901. *Vide* also Cory, *op. cit.* p. 4.
[2] *B. M. J.*, vol. i., 1906, p. 737.

III. *From Congenital Disease.*—Syphilis is the usual cause of death of the fœtus, and the death may not occur till nearly the end of the term of pregnancy in cases where a woman has had a succession of still-births from this cause at varyingly earlier periods. Of the lung conditions atelectasis is probably the most common. Abnormal cardiac formations also cause death either during delivery, or almost immediately after.

IV. *From Immaturity.*—As has been already remarked, a fœtus under the intra-uterine age of seven months will not live under ordinary circumstances. Proofs of the immaturity are best obtained by examining for the centre of ossification of the lower epiphysis of the femur. This appears at the end of the ninth lunar month of intra-uterine existence, and becomes well marked by the end of the tenth. For all practical purposes of the determination of maturity, it is sufficient to examine for this. But if greater accuracy is desired, then the tarsal cuboid bone should be examined, since the ossific centre in that bone appears at the tenth lunar month. At maturity, the ossific centre of the lower femoral epiphysis is about the size of a small pea, and measures about 5 millimetres in diameter. While it is advisable that the height and weight of the fœtus should be taken, it is better to rely upon the presence or absence of the femoral osseous nucleus as evidence of maturity, since small children as well as large may be born mature. To determine whether or not the fœtus was viable, examination of the *os calcis* should be made, for an osseous centre about the size of a pea is most usually found between the 28th and 30th week of fœtal development. To examine for the femoral osseous centre, the easiest method is to forcibly flex the knee, cut down through the epiphyseal cartilage of the femur, and then to cut thin sections so as to expose, if present, the little nodule of bone. The other centres are not so easily cut down upon, but ordinary anatomical knowledge will indicate ways.

The bodies of children born illegitimately are sometimes concealed in strange places, and, sometimes, for long periods of time after the births have taken place. We have had to examine such bodies found in band-boxes, in trunks, and other places, the mothers being at the time of delivery in domestic service, and the deliveries unknown to the maids' mistresses. The following is illustrative of the above statement :—

The body of a male child was found in a tin trunk which had been left in the left luggage office of one of the Glasgow railway stations, the trunk having been opened by the police owing to the stench which proceeded therefrom. The body was that of a fairly well-nourished child, measuring twenty inches in length, and exhibited externally marked signs of decomposition It had lived about a week, because the umbilicus was healed. The body was enveloped in an apron and a cotton cloth. Over and surrounding the entire head, face, and neck was a sheet of cotton-wadding. Around the neck and compressing the tissues of the neck was a band of flannelette cloth, which, in its rounded form as fastened round the neck, measured only one inch in breadth, but when unfolded and spread to its ordinary breadth measured seven inches in breadth. On other parts of the body were two pieces of cloth, and a piece of Gamgee tissue. Around the mouth and nostrils the cotton-wadding had adhered, by reason of some fluid which had exuded from these openings. On removal of the

band from the neck, marks of constriction were left on the soft tissues. On examining the interior of the mouth, there was found therein and lying on the pot of the tongue a piece of compressed cotton-wadding in the form of a plug, which measured 1½ inches long by 1½ inches broad at its broadest part. The nostrils and throat were unobstructed. The bones of the left side of the head, above and behind the left ear, were flattened inwards as if from pressure or weight, but there was no wound or bruise externally on the scalp at this or any other part. The thumb of each hand was lying on the inside of each palm, and the fingers were partially flexed over the thumbs. There was no wound externally on any part of the body. Examination of the head cavity showed at the point of flattening separation at the suture of the left parietal from the left frontal bone, but there was no effusion of blood either above, around, or below the line of separation, or at any point within the cranial cavity. The brain, while semi-fluid from decomposition, was normal. There was no fracture of base of skull. On examination of thoracic cavity, the lungs were found to be wonderfully fresh, considering the external evidences of decomposition. The left lung did not fill the left pleural cavity. But the right was fully inflated. There were no punctiform hæmorrhages on their pleural surfaces. On section, they were not found engorged with blood nor was there hyper-distension or rupture of air cells on the lung margins. The heart chambers on both sides contained a little dark-coloured viscid blood. Examination of the abdominal cavity showed that the stomach contained the remains of some form of milk-food. The other organs appeared normal.

We gave it as our opinion, that while there was some evidence pointing to death from asphyxia, the amount and degree of the signs found precluded us from arriving at the clear opinion that the child had died of acute suffocation from strangulation by the band found around the neck, or the plug of cotton-wadding in the mouth. Such signs internally as were indicative of asphyxia might have resulted from a natural cause, and, judging from the position of the thumbs and fingers of the hands, such a cause might have been convulsions.

Inquiry by the authorities did not reveal sufficient evidence to warrant a charge being preferred against the mother, who, in the meantime, had been discovered and had been apprehended, pending investigation.

V. It now becomes necessary to consider the bodies of fœtuses which have been found bearing marks of violence upon them. Having discussed the conditions under which such marks may arise from accident, we must now turn our attention to injuries which may have been inflicted homicidally, and which constitute the crime of infanticide.

The most distinguishing characteristic of homicidally inflicted violence, speaking generally, is its brutality—that is to say, the violence has been overdone. This is not true of all cases, but it is true of the bulk of them. It is by no means uncommon, for example, to find cases of which the following, recorded by the late Professor Ogston,[1] may be taken as a type.

"Besides fracture of the parietal and frontal bones of the cranium, the side of the head and face were flattened, and impressions of large shoe-nails were visible on one cheek." In this case, the woman had been delivered secretly in a cow-house, and the marks on the child's face corresponded to the nails in her shoes; and it was not difficult to arrive at the opinion that she had trampled and stamped upon it with her feet.

In another case, fractures of the cranium, lower jaw, left arm, and both legs were found, and the tongue was torn out. At a Circuit Court held in the Northern Counties of Scotland a few years ago, a hotel servant was convicted of concealment of pregnancy. The body of her child had its neck lacerated, and its lower jaw fractured. In a case which we recently examined, extensive fracture of the skull was found, with laceration of brain and extravasation of blood upon the surface and into the substance of the brain. Occasionally,

[1] *Op. cit.* p. 259.

however, injuries are found which are not of the ordinary character. We examined the body of a female fœtus, of which the left forearm was awanting from the elbow-joint, on the left side of which was a large wound the size of an ordinary saucer, both of which were evidently of post-mortem production. The body was found in the river Clyde. It was evident from the presence of a large *caput succedaneum* that the child had been born after a difficult labour, but the lungs responded perfectly to the hydrostatic test, and they completely filled the chest cavity. The examiner, in every case, should carefully examine the head over the fontanelles for punctured wounds, as these are most vulnerable parts which may be easily penetrated by a long, sharp instrument, such as a large needle, without leaving much mark behind. In short, the presence of injuries on the body of a new-born child ought at once to raise the suspicion of intentional violence.

The following, from our case-book, illustrates another phase of the violence which may be employed :—

Infanticide. Fatal Injuries produced by throwing Child over a Window to the Ground from a Height of Three Storeys.—In May 1908 we examined the body of a newly-born female infant which had been found in the grounds of a public institution close to the windows of the servants' dormitories. The length of body was 16½ inches. Attached to umbilicus was the entire umbilical cord and placental covering. On outer posterior aspect of trunk and right thigh, and extending from neck to ankle on right side, was a large number of small superficial punctured wounds of skin of varying sizes, and on outer aspect of right thigh, a series of superficial scratches, varying in length from one-half to one inch in length, which ran both parallel and transversely to axis of limb. Blood had issued from interior of right ear, and clotted blood was found in the passage, and there had also been bleeding from the nose. Palpation of head indicated fractures of skull on right side and posteriorly. There was no osseous nucleus in lower femoral epiphysis. Reflection of scalp showed that the deep tissues, especially on right side around the ear and on occipital region, were thickly infiltrated with extravasated blood. The following skull fractures were found :—(1) fracture of right parietal, which extended both vertically and horizontally, the vertical fracture being 2⅓ inches long, and the horizontal, 1¼ inches ; (2) fracture of left parietal, of a triangular shape, the three limbs of fracture measuring 2 in., 1½ in. and ¼ in. respectively ; and (3) fractures of occipital bone in several places. There was much blood on and under meninges, and the brain substance was much destroyed. In the deep tissues in front and on both sides of sternum was an area of extravasated blood covering several square inches. Both lungs were more or less fully inflated, the right more than the left. They were mottled in colour.

The fronts of both lungs bore marks of bruising in the form of areas of extravasated blood. The lungs, thymus gland, and heart *en masse*, the lungs separately, and after pedal compression, floated perfectly. We reported (1) that the child was viable but not of mature uterine age, being probably eight months or thereby, (2) that it had freely respired, (3) that it had been born alive, and (4) that the cause of death was the severe injuries to skull and brain.

It appears that a young maid had given birth to the infant in her bedroom, that it had been heard to cry, that she opened the lavatory window, and threw the body out to the ground, that the body fell on rough gravel material, and that it was there found.

A somewhat parallel case is recorded by Garland, in respect that the perfectly nude body of a live newly-born female child was found lying in a public street in Leith which had been thrown from the window of a house on the first floor, a height of 14 feet from the ground. There was attached to the umbilicus about fifteen inches of umbilical cord, the free end of which had been torn and left untied. The infant died six hours later. Externally the body showed no marks of violence, but the scalp all over felt soft on palpation. In the left parietal region there was a non-discoloured swelling, and the scalp tissues, when cut into, revealed a copious effusion of coagulated blood. The left parietal bone showed a somewhat depressed stellate fracture, the longest limb of which measured two inches long, and the shortest, one inch. The offender in this case,

however, was the father of the child, who was a widower with children, to whom the mother of the infant acted as housekeeper. At the High Court of Justiciary, Edinburgh, he was charged with murder, but was found guilty of culpable homicide and was sentenced to ten years' penal servitude.[1]

A fœtus may bear the marks of gunshot wounds, where the projectile has penetrated the abdominal wall and uterus of the mother.

In one case recorded by Rubetz,[2] three wounds were found on the body of the fœtus. One of the bullets had entered to the left of the spine of the first lumbar vertebra, wounded the intestines, the diaphragm, left lung, and heart, and made its exit from the body near the left nipple, then entered the brain of the fœtus near the left ear, where it was found. The mother died from septic-æmia, probably due, it was stated, to a fragment of clothing having been driven into her body by the bullet.

Another form of infantile death is Homicidal Suffocation. This may be produced by strangulation with a ligature, by drowning, or by impaction of foreign bodies forcibly inserted into the mouth and air-passages. In many cases it is impossible to determine the cause of the asphyxia, although this proximate form of death has been clearly demonstrated by the internal post-mortem appearances, or whether it has been produced accidentally or homicidally. Where a ligature is found tightly encircling the neck, and internal signs of asphyxia are present, it is not difficult to form an opinion. In all such cases the nature of the ligature should be noted, the ligature itself preserved, and the mark upon the neck carefully dissected for evidences of extravasation. The appearances of the lungs, the froth in the air-passages, and the watery, dark, bloody exudation on lung-section, would point to drowning. The presence of foreign bodies in the mouth and air-passages when accompanied by the internal signs of asphyxia indubitably point to homicidal suffocation.

In one case, tried before the Perth Circuit a few years ago, a woman was convicted of culpable homicide for having suffocated her newly-born child by stuffing pieces of paper into its mouth, with the object presumably of stifling its cries. In another case, where the body of a male child was found in the Clyde in a box loaded with pieces of iron to cause it to sink, the post-mortem examination indicated that it had been strangled. The method of disposing of the body also indicated secrecy.

Strangulation may also be effected by compression of the throat with the fingers. In such cases the plea of attempting self-delivery is sometimes set up.

The presence of marks of constriction on the neck, accompanied by bruising, coupled with the fact that the lungs are found well inflated, can only point in the direction of homicidal strangulation.

In March 1908 we examined the body of an apparently newly-born female child which had been found lying exposed in a public place. Its body weighed a little over 7lbs., and it measured 21 inches. It was mature. The tongue protruded beyond line of gums, but not beyond the lips. Lips and finger-nails were livid. Attached to body was a piece of umbilical cord, measuring 1½ inches long. It was not tied. Its end had been cut. Around the neck was

[1] *B. M. J.*, vol. i., 1907, p. 1182.
[2] *Ibid.* vol. ii., Nov. 12, 1899.

a depressed mark of a circular form, the margins of which were harder than surrounding skin. In front and on each side of windpipe were marks of bruising. Internal dissection revealed extravasation of blood in scalp tissues over upper part of right parietal bone, a two-limbed fracture of bone beneath, each limb measuring 1½ inches long, effusion of blood on *dura mater* and on brain, and bruising of brain tissue. The tissues in front and at sides of windpipe showed deep bruising and extravasated blood, but no extravasation in line of neck mark. The surfaces of both lungs exhibited punctiform ecchymoses—Tardieu's spots—the lungs floated freely after usual tests. Lungs were full of dark blood, as was also right heart. We reported that (1) said child was mature, (2) that it had respired freely, (3) that it died from asphyxia the effects of compression of the neck by a ligature applied round the neck and of compression directly applied over the windpipe, and from the effects of the fracture of skull and effusion of blood on the brain, and (4) that these injuries were probably inflicted after the child had been born from the parts of the mother.

A domestic servant in Somerset during the absence of her mistress was delivered of a child, the body of which was afterwards discovered rolled in a calico skirt between the bed and the sacking. The neck presented appearances of constriction, there being a narrow mark, irregular both in width and depth, but accompanied with little bruising. The medical man who was called to see the body thought the compression mark due to the umbilical cord, but the lungs were fully inflated, filled the cavity of the chest, and together with the heart, floated in water, showing that the child must have breathed freely—probably cried—after its birth. The coroner's jury returned a verdict of infanticide. She was convicted of the charge of concealment of birth. At the Essex Winter Assizes, a midwife was charged with the crime of wilful murder of a newly-born male child. A witness testified that as soon as the child was born, the accused used a napkin with violence on the child's face, and that, later, she saw a piece of garter tied round its neck. Medical evidence showed that there were three depressed marks on the neck, apparently caused by a cord, that the child had respired, and that it had died of suffocation.[1]

The common defence in the charge of infanticide in cases where fracture of the skull is found is the plea of precipitate labour. The value or relevancy of this plea may be established by the medical evidence obtainable by an examination of both the mother and the child. The points to be attended to in the examination of the former are the following :—

(*a*) Whether the woman is a primipara or multipara ;
(*b*) If the pelvic parts of the woman be roomy ;
(*c*) Whether or not there is laceration of perinæum.

And in the examination of the latter—

(*a*) Whether or not the umbilical cord be ruptured ;
(*b*) Whether or not the placenta and fœtus are still united by the cord ;
(*c*) The character of the cranial lesions ;
(*d*) The presence or absence of *caput succedaneum* ;
(*e*) The size and development of the fœtus relative to the pelvis of the mother ;
(*f*) The condition of ossification of the fœtal cranium ;
(*g*) The presence or absence of other marks of violence upon the body.

Careful consideration and review of the facts will enable the examiner to test the plea offered by the logic of the facts.

Again a child may die from omission to ligature the umbilical cord

[1] *B. M. J.*, vol. i., 1901, p. 432.

after cutting and before the circulation in it has ceased. This would be a typical case of infanticide by omission. The appearance of the severance of the cord with a sharp instrument, the absence of a ligature, and the comparatively bloodless condition of the body, are indications which would point in this direction.

It comparatively rarely happens that a child's death is caused by total neglect and exposure after its birth, but such cases are not unknown. In a recent case tried at Paisley, a young farm servant, who gave birth to a living male child in the cowshed, left it lying just as it had been born on the floor of the cowshed, in consequence of which the child died from congestion of the lungs. She was found guilty.

Newly-born children may be killed by poisoning. Such cases are rare, for the simple fact that a woman who desires to rid herself of her newly-born offspring usually adopts the quickest and readiest means of preventing it crying, and thus announcing its arrival into the world; and so she either strangles it or uses such other mode of violence as first suggests itself to her.

Assuming, however, that in any of the foregoing cases in which marks of violence have been found, and which unmistakably are the cause of death, and that along with these, on dissection of the body, the medical examiner finds unequivocal evidence of complete respiration, under what circumstances would he be justified in affirming that the child was live-born in the legal sense of that term, at the time of infliction of the injuries? It is just at this point that criminal charges of child-murder break down, and the prosecutor is compelled to accept a plea, or a verdict, of concealment of birth, or concealment of pregnancy. We must, therefore, review the reasons for this.

In June 1893, a Return of Still-births in England and other countries was printed for the House of Commons. The object of the Return was to discover the practice of other countries regarding the registration of still-births, but in the schedule of questions sent out for answers, one was as follows:—"What are the penalties for criminally causing a child to be still-born?" The answer for England is somewhat startling. "For procuring abortion the punishment is penal servitude for life, or for any less term of imprisonment. Where there is no procuring of abortion, *the killing of a child in the act of birth and before it is fully born is not an offence by the present law*, although if injuries are inflicted before birth which cause the child's death after birth, the law of murder applies." The reply for Scotland was: "Criminally causing a child to be still-born falls under the crime of 'procuring abortion,' the punishment for which, on conviction, is arbitrary"; and, for Ireland: "It is difficult to conceive any act or attempt made to procure the birth of a child still-born which would not be punishable as the procuring of abortion, or attempting to procure it, under 24 & 25 Vict. c. 100, sections 58 and 59, and 27 & 28 Victoria, c. 67, section 2, with penal servitude for life, or not less than five years, or imprisonment with hard labour for any time not exceeding two years."

It would appear that the answers for the two last-named parts of the kingdom miss the precise point of the query, in respect that a child may be caused to be still-born during the natural process of labour at the full time without any unnatural means whatsoever having been used

to bring on the labour, and that it may be done to death during the natural act of birth. It is this destruction of the child during the parturient process which does not constitute an offence against the law —that is to say, that if the parturient mother, or any other person, lay violent hands upon the child as it is being born and before complete delivery from the maternal parts is effected, they are not chargeable with any offence against the law.[1] As has been already stated, the legal definition of "live-birth" is not statutory, but judge-made, and is as follows :—A child is live-born in whom independent existence has been established by the action of its own organs after complete delivery. Many cases may be cited to illustrate this.

On one occasion at the Norfolk Spring Assizes, Mr Justice Coleridge laid it down as law that before the prisoner could be convicted of having murdered her child, the prosecutor must prove that the body of the child was delivered from the body of its mother before the violence was inflicted which caused the child's death. Mr Baron Parke, in another case, stated that the law requires that the child should be born alive, and that the whole body of the child should have come from the body of the parent. These words were addressed to the Grand Jury, to whom he further said: If it should appear that death was caused during delivery, then you will not find a true bill. Mr Justice Erle, in 1845, in a case, in which the head of the child was nearly severed from the body, told the jury that before they could find the prisoner guilty, they must be clear in their minds that the child had a separate and independent existence ; that it must, in short, have been wholly born before the violence to it was inflicted ; and that the child might have breathed during the act of birth, and, therefore, although it was a live child in the medical sense, it was not in the legal sense.[2] So recently as March 1901, Mr Justice Wright in the case of R. *v.* Pritchard for alleged infanticide tried at the Shrewsbury Assizes, said regarding live-birth, "That the true test of separate existence in the theory of the law (whatever it might be in medical science) is the answer to the question whether the child is carrying on its being without the help of the mother's circulation." [3]

(see below) for reference to Lord Young's decision

This last legal pronouncement levels up the difference in definition between the law and medicine, inasmuch as it is well known that a child may not only breathe before complete birth, but cry audibly before its body is completely born from the mother's parts, and that it can only do this by virtue of the independent exercise of its own organs, and quite apart from the aid of the circulation of the mother. If this last decision could be accepted as the uniform expression of the law by judges, the medical profession would be content to accept it as being not only in accordance with physiological fact, but as tending to repress the crime of child-murder which has, in many cases, gone unpunished because of other interpretations of the law by other judges.

With these facts in mind, we return to the answer to the question : Under what circumstances could a medical witness with reason affirm that a child upon whose body are marks of violence was live-born in the legal sense ? We are of opinion that he could do so :

1. When the lungs of the fœtus have been found fully inflated, and filling the thoracic cavity ;
2. When the violence found upon the body is so distributed, or is of such a character, that full delivery of the fœtus is indicated.

[1] *Vide* paper by the author, *Edin. Med. Jour.*, July 1895.
[2] Ryan's "Infanticide," pp. 7, 8.
[3] *Times*, March 5, 1901 ; *B. M. J.*, vol. i., 1901, p. 684.

3 White L. 240 Case of Scott.

And in the case of children, who have been allowed to live for days at least after birth, and have been put to death ;

1. By changes in the umbilical cord ;
2. By the presence of food in the stomach.

It is very rare, indeed, that a charge of concealment of pregnancy, or of birth, is by itself preferred against a woman ; it is usually accompanied by the major charge of infanticide. In other words, the former practically constitutes infanticide by omission, the latter, by commission. The inference of the law, where a woman conceals her condition during the whole course of her pregnancy, makes no preparation for, and calls for no assistance at the time of her delivery, is that she is conniving at the death of her child by omitting to do those things which a woman in ordinary circumstances would not fail to do. But at the same time, the law does not place upon the woman the burden of proving that her child was still-born, but puts upon the prosecutor the burden of proving that her child was born alive, and demands of him a proof of the most difficult kind to establish, because of the secret character of the circumstances in which the birth takes place. This to our mind is quite illogical. The older law placed this duty of proving that the child was still-born upon the mother. During the existence of the present law, the subject has been considered by two Parliamentary Commissions—viz. the Capital Punishment Commission of 1865, and the Criminal Code Bill Commission of 1879, in the reports of both of which recommendations were made to reversion to the former law.

The former arrived at the opinion " that an Act should be passed making it an offence punishable with penal servitude or imprisonment at the discretion of the Court, unlawfully and maliciously to inflict grievous bodily harm or serious injury upon a child during its birth, or within seven days afterwards, in case such child has subsequently died. No proof that the child was completely born alive should be required. With respect to the offence of concealment of birth, we think that no person should be liable to be convicted of such offence upon an indictment for murder, but should be tried upon a separate indictment." The latter Commission, in the Draft Code which it made, proposed in clauses 185 and 186 thereof, that " every woman shall be guilty of an indictable offence, and shall be liable upon conviction thereof to penal servitude for life, who, being with child, and being about to be delivered, with intent that the child shall not live, neglects to provide reasonable assistance in her delivery, if the child dies either just before, or during, or shortly after birth, unless she proves that such death was not caused either by such neglect or by any wrongful act to which she was a party." Clause 186 deals with the penalty of neglect to obtain assistance in child-birth in order to conceal birth, where as the result of such neglect the child is permanently injured thereby, or dies either just before, or during, or shortly after birth.

It is highly desirable, indeed, that such should become law as soon as possible, if the crime of child-murder is to be successfully repressed. But even under such a law, curious cases might arise. Perrin de la Touche [1] records a most interesting case of which the following are the main facts :—

It is intended to illustrate a reasonable defence of loss of consciousness on the part of the mother at the birth of her child, the child dying in consequence of want of assistance. In February 1894, he was asked to make an autopsy

[1] *Le Bulletin Médical*, March 1899.

on the body of a newly-born child which showed that it had breathed freely, but had died of asphyxia and with no marks of violence upon its body. He, thereafter, made an examination of the mother, who lived by herself in an apartment between two suites of rooms occupied by families of workpeople. She had confided the fact of being pregnant to her female neighbours. She was taken in labour in the morning, but after midday the pains became so very severe that she was compelled to take to bed, from which she called for assistance from her neighbours, but in vain. Soon after, the head presented itself at the vulva, and she could feel it with her finger. Thinking that delivery was just at hand, and no one coming to her help, she waited, but becoming impatient, owing to the slow progress of the head outwards, and fearing in her ignorance that it might go back, and her life be thus endangered, she thought that she might hasten the process by enlarging the vaginal opening. Thereupon she took a pair of scissors, and made an incision to one side in the tightly stretched posterior vaginal wall, and the child was born, upon which she lost consciousness. When she came to herself, the child and the placenta were lying between her thighs. She then tied the cord with a piece of thread which she got on a table by her bed, removed the body of her child which was dead, and wrapped it in a covering. Hearing her neighbours returning home, she again shouted for assistance, which then came. A wound was found in the situation described which measured 2½ centimetres in length. The examiner reported that he believed the facts stated by the woman were admissible, that unconsciousness or syncope had supervened at the moment of delivery, and that the child had been accidentally suffocated between the thighs of the mother.

Procedure at Autopsy of a Newly-Born Child.—The examination of a dead body of a child is in no wise different from that of an adult, but the following points, after the wrappings of the body have been noted for identification purposes, demand special attention.

(*a*) The general conformation of the body with respect to maturity or immaturity;

(*b*) The appearance of the body; whether it has been washed, or not;

(*c*) The state of the natural openings of body, with respect to presence or absence of foreign bodies;

(*d*) The presence or absence of marks of violence;

(*e*) Height and weight of body;

(*f*) Condition of cord and umbilicus; length of cord; if ligatured or not, and if tied, the character of the ligature;

(*g*) Whether placenta is still united to body or not by the cord.

Internal Examination.

(*a*) *Head Cavity.*—Just as in ordinary cases, except that the bone should be divided by strong scissors, and the brain should be divided at level of bone incision, and removed with the calvarium. The basal portion of brain which remains can then be removed, and the base of skull examined. Any attempt to remove the brain in the ordinary way is likely, by reason of its softness, to end disastrously.

(*b*) *Neck.*—Carefully examine for marks of constriction.

(*c*) *Chest Cavity.*—After removing sternum, etc., examine chest organs *in situ*. Note the volume of the lungs and the amount of area of cavity occupied by them; the position of highest convex part of diaphragm; the colour of the lungs, and their consistence by palpation; the presence or absence of punctiform extravasations or Tardieu's spots. Remove lungs and heart, *en masse*, and apply hydrostatic test according to the

manner given (p. 419). In cases in which they seem imperfectly inflated, take specific gravity of each lung.

(*d*) *Abdominal Cavity.*—Note condition and appearance of organs *in situ*; condition of umbilical vessels; presence or absence of food in stomach; presence or absence of meconium in small intestine, and if present, to what amount.

(*e*) Examination of Spine: as to injuries, or *spina bifida.*

Note.—The best evidence of maturity is the presence of an ossific centre of 5 mm. in diameter in lower femoral epiphysis, and of another in the cuboid bone of tarsus; of viability, of an osseous nucleus in the *os calcis* about the size of a pea. (*Vide* Figs. 109, 110.)

INCEST

The crime of incest is statutory in Scotland, while it is an offence against the canon law and, lately, against statute law in England. It consists of illicit intercourse between a man and a woman within the limits of prohibited relationship as laid down in the 18th chapter of Leviticus. The Act by virtue of which the crime is statutory in Scotland is 1 Jac. VI. cap. 14, passed in December 1567, entitled "Anent them that committis incest"; wherein it is ordained "That quhatsumever person or persones that committis the said abhominable cryme of incest, that is to say, quhatsumever person or persones they be that abuses their bodie with sik persones in degrie as God in His word hes expresslie forbidden, in ony time cumming as is contained in the xviii chapter of Leviticus, sall be punished to the death." In order to constitute the crime, attempt is not enough:[1] there must be actual intercourse. The punishment according to statute is death, but the practice is to restrict the pains of law. The Statute Law Revision (Scotland) Act, 1906, repealed the words "to the death." But the Act itself is virtually replaced by the 50 & 51 Vict. cap. 35, s. 56. In R. *v.* Wilson, Glasgow, 1869, the prisoner was sentenced to penal servitude for life; in R. *v.* Colquhoun, to 20 years' penal servitude. Medical evidence in such cases resolves itself into affirmation of non-virginity of the female, or the existence of pregnancy. We have examined four girls for evidence of paternal crime, and although in all of them signs were quite distinct of trafficking in the sexual parts, in only one, in which pregnancy resulted—R. *v.* M'Coll, tried at Glasgow Circuit Court in the spring of 1897—did a prosecution follow. In a case tried at the same court in September 1909, the charge against the accused was that he had been living incestuously with his brother's wife, who had borne a child to him, knowing that his brother was alive.

[1] Hume, i. 452.

CHAPTER XIV

RAPE AND DEFLORATION

The crime of Rape is defined as the carnal knowledge of a female by force and against her will, or of a girl below thirteen years of age, whether by force or not. Defloration is the rupturing of the hymen, the result of such carnal knowledge. Up till the passing of the 24 & 25 Vict. cap. 100, sec. 48, the punishment was death; thereafter, periods of penal servitude or imprisonment. The effect of reducing the severity of the punishment was to lead to increased frequency of the crime. It has been stated [1] that the crime had increased by 57 per cent., and two years later, it was stated in Parliament that the increase was as high as 75 per cent. In consequence of this, the Act named was amended by the 38 & 39 Vict. cap. 94 (1875). Later, owing to allegations which were made of the deplorable prevalence of procuration of girls for illicit practices, and which were proved, the 48 & 49 Vict. cap. 69—the Criminal Law Amendment Act, 1885—was passed, which Act is now the law of the land. A short résumé of the provisions of this Act will prove useful.

The Act is divided into three parts. Part I. deals with procuration generally, procuring defilement of a woman by threats or fraud, or by administering drugs.

Section 4 of Part I. enacts that any person who unlawfully and carnally knows any girl under the age of thirteen years shall be guilty of felony, and any person who *attempts* the foregoing shall be guilty of a misdemeanour;

Section 5, that any person who unlawfully and carnally knows or attempts to have unlawful carnal knowledge of any girl being of or above 13 and under 16 years of age, or of any female idiot or imbecile woman or girl, shall be guilty of a misdemeanour, provided that it shall be a sufficient defence to the former part of the section if it shall be made to appear to the court or jury that the prisoner had *reasonable* cause to believe that the girl was of or above the age of sixteen years;

Section 6 applies to a householder, etc., who permits the defilement of a young girl on his premises;

Section 7 deals with the abduction of any unmarried girl under the age of 18, with intent to have carnal knowledge; and

Section 8 with any person who detains any woman or girl against her will for the above purpose;

Section 11 enacts against the crime of sodomy.

Parts II. and III. have to do with the suppression of brothels, and with definitions of no medico-legal interest.

The Act applies to the three sections of the kingdom, and in its application to Scotland, the expression "misdemeanour" shall mean a crime and offence, and "felony," a high crime and offence.

What is the legal meaning of carnal knowledge? By the 9 Geo. IV. cap. 31, section 18, carnal knowledge is held to mean actual pene-

[1] *Law Times*, January 4, 1845.

tration of the body of the female,[1] although there be no emission of semen. As to the degree of penetration necessary to constitute the offence, it has been ruled that the " slightest " penetration of the penis within the vulva is sufficient—even to such a slight degree that the usual signs of virginity are not interfered with.

It is necessary, however, that force be used, and that it be used against the will of the female. What is considered legally as force ? According to Macdonald [2] the force used must be force by which physical resistance is actually overcome—in other words *physical force.* Neither does it make any difference what are the means employed to overcome the physical resistance ; whether the victim be held by another while the crime is being committed, or the victim is coerced into submission for fear of her life by the act of her assailant, which may be deemed *moral* force, or where her powers of physical resistance are rendered negative by the administration of drugs for the purpose, or where from physical disability the female is unable to offer resistance.

According to Macdonald,[3] Scots law, in the case of an adult woman in possession of all her faculties, holds it essential to the commission of the crime, that the woman has resisted to her utmost, and that a rape would not be committed where the female, after resisting vigorously for some time, at last gave consent. " The resistance," says Macdonald, " must be to the last, and until overcome by unconsciousness, complete exhaustion, brute force, or fear of death." [4] The crime may be committed against any female, whatever her character may be, except in the relationship of husband and wife.

There is no age fixed by law in respect of the male sex before which a male person is held incapable of committing this crime. Probably the earliest age where conviction has followed was that of a boy aged thirteen years and ten months [5] who was tried at Ayr, September 20, 1841. According to the law of England, a boy under 14 is held incapable of committing this crime (R. *v.* Groombridge, 7 C. and P., 582). Section 4 of the Criminal Law Amendment Act, 1885, provides that where the age of the committer of the crime does not exceed sixteen years, he may be whipped, instead of being imprisoned. Although this Act makes it a penal offence in the case of criminal intercourse with an idiot girl, it is open to the prisoner to show that the female was a consenting party.

The following English cases illustrate this. In the case of R. *v.* Fletcher [6] the idiot woman used no resistance, and the prisoner alleged consent ; the Court held there was no evidence to go to the jury. In R. *v.* Barratt [7] where the father of the idiot girl caught the prisoner in the act, the Court put it to the jury that if they were of opinion that the girl consented from animal instinct, the accused ought to be acquitted. He was found guilty of attempt. In a case, R. *v.* Campbell, tried before Mr Justice Phillimore at the Carlisle Assizes, Nov. 1898, where the accused was charged with having had sexual intercourse with a

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[1] Bell's " Notes," p. 83.
[2] " Crim. Law," p. 192.
[3] *Op. cit.* p. 193.
[4] Hume, i., p. 302 ; More, ii., pp. 375-376.
[5] Swinton, vol. ii., p. 564 ; Bell's " Notes," p. 83.
[6] *L. R.* i. *C. C. R.*, p. 39.
[7] *Ibid.* ii. *C. C. R.*, p. 81.

female lunatic, the accused was found guilty but insane, and was ordered to be detained during Her Majesty's pleasure.[1]

As we have already seen, the law enables a prisoner charged with misdemeanour in having carnal knowledge of a girl between the ages of 13 and 16, to show that he had *reasonable* cause to believe that she was over the age of 16 years. In such a case,[2] Lord M'Laren in his charge to the jury where this defence was pleaded, said as follows :— " It is not enough to establish this defence that from the appearance of the girl she might be believed to be above sixteen. No defence can be founded upon impressions formed from the appearance of the girl ; if such a defence could be entertained, it would nullify the statute altogether, because the accused would only have to say that while the girl's age might be only 14, he believed, and had grounds from her appearance for believing, that she was over 16. That would never do. It must not be the mere supposition on the part of the accused ; it must be that he formed the opinion upon information, or other intelligible and reasonable grounds of belief. This is the legal meaning of the statute as explained in the judicial opinion of the present Lord Justice-Clerk (R. *v.* Hoggan, April 14, 1893, I. Adam 1), and you may take it from me that this is the true interpretation of the statute." From these decisions, therefore, it may be held as law that credible information obtained perhaps from the girl herself, or otherwise, is alone a valid defence. But what is to be understood as " other intelligible and reasonable grounds of belief " ? It is a matter of the commonest experience, for example, that the age of a person is arrived at from the physical appearances of the body, living or dead, and such opinions are received in Court almost daily. It would be perfectly absurd if a prisoner's opinion of the age of the girl was of itself to be considered as " reasonable cause of belief," but the question at once arises, would it be an intelligible and reasonable ground of belief, if a series of witnesses were to aver that from the physical conformation of the girl it was also their belief ? It is a matter of constant observation in daily life, and it is well known by medical men, that the evidences of physical maturity in girls between the ages of 13 and 16 are as variable as is their stature, or their weight, and that there are many girls of such ages who might well be mistaken for a more advanced age than that of sixteen. This is not a case in which physical force has been used, but one in which, although the girl has given her physical and moral consent, she is incapable by the foregoing Act of giving her *legal* consent. In a recent case in which we gave evidence, the age of the girl on the day on which the alleged rape was committed was sixteen years and one day. Had the act been committed two days before, it would not have been, for the reason given, of any avail for the accused to plead that consent had been given, or to defend himself on the assumption that the girl was sixteen years of age. Obviously, the difference of time of two days would make no difference in her physical appearance. But so long as the law enacts that only after the attainment of sixteen years of age can a girl give consent, so long must judges administer it.

[1] *B. M. J.*, 1898, vol. ii., p. 1528.

[2] R. *v.* Macdonald, 8, *Scots Law Times* case, No. 72, 37 ; *Scot. Law Reporter*, p. 756.

Physical Signs of Rape.—From what has been said respecting the legal interpretation of the kind of force and amount of penetration necessary to constitute this crime, it will be obvious that from the medico-legal point of view the physical signs of rape will vary in different cases, or may even be absent, although the crime has been committed.

It is easy to conceive the possibility of legal commission of the crime without any physical evidence whatever being found on the body of the female to justify a medical examiner in doing more than reporting the negative facts. Since the slightest penetration, without emission, constitutes the crime, no physical signs of defloration are likely to be produced; indeed, there may be no local evidence whatever of the juxtaposition of the male and female parts. Therefore, the medical examiner is not justified in affirming, because no such physical evidence is forthcoming, that a rape has not been committed. If evidence exists, the range of physical signs will vary according to the capability of physical resistance of the ravished female. In the case of young children, females who have been drugged, or those who are in a state of unconsciousness from any other cause, the effects of bodily resistance will probably be absent while the local signs of accomplishment of the act are likely to be well marked; but even then, it will depend upon whether or not the female has been accustomed to sexual intercourse what these signs are. Therefore, we must distinguish in cases of rape between the general signs of physical resistance and the local evidence.

I. *Signs of Physical Resistance.*—If we start from the assumption that a healthy, vigorous young woman alleges that she has been ravished, the first thing the medical examiner must look for is evidence of the signs. If the woman has resisted to the uttermost, she will probably bear marks upon her body of her violent resistance, and probably also, she will have left marks also upon the body of her assailant. In such a case, therefore, the examiner should look for evidence of the signs of violence upon her body, such as wounds, bruises, or scratches. In the absence of these, he ought to exercise, at first, a healthy scepticism as to the truth of her statements, unless she avers, and evidence from the local signs in her sexual parts so far bear out her statement, that she had fainted, or had been drugged. At the same time, our experience has led us to the belief that this scepticism may be carried too far. There are, unquestionably, girls who become paralysed from sheer fright or terror when an attack of this kind is made upon them, and are rendered incapable of offering serious resistance, with the consequence that their bodies do not bear evidence of injuries such as might be expected from a severe struggle, while locally there may be all the needed signs of the accomplished act of penetration. In any such likely case, the acts and demeanour of the girl immediately after the alleged commission of the crime should be subjected to very critical investigation, since valuable evidence may be apparent, corroborative or otherwise, regarding the alleged rape. In the case of children, the examiner need not look for evidences of physical resistance, because children are incapable of exercising sufficient resistance whereby injuries are usually caused.

II. *Local Evidence of Accomplishment of the Act.*—Subject to the qualifications already laid down, the examiner would be compelled to

conclude that the crime had been completed if the following signs in the sexual parts which are associated intimately with the recent loss of the signs of virginity were found. It will be advisable, therefore, to first discuss the Physical Signs of Virginity.

These signs are comprehended in the following :—

(*a*) An intact hymen,

(*b*) A normal condition of the fourchette and posterior commissure ;

(*c*) A narrow vagina with rugose walls ;

(*d*) An undeveloped condition of the nipples, and the absence of darkened areolæ round them.

These, taken together, may be held to be clear evidence of virginity ; taken singly, they cannot be so reckoned.

I. *An Intact Hymen.*—With regard to the hymen, some have disputed entirely its existence. This, however, is quite wrong. It is to be found as a normal structure in the great majority of virgin females, and in a more or less perfect condition, except in certain cases in which from varied causes it has been more or less destroyed. It may be found to exist from the condition of a slight annular ring fringing the opening of the vagina, to that of a complete imperforate curtain which entirely shuts off the passage from the external genitals. Between these two extremes there are varying forms, all of which contain one or more openings in the membrane of variable shape, situation, and size. From a want of knowledge of these forms, we assert that mistakes have been made by examiners with regard to the occurrence of rape. But while its recent rupture would signify the forcible introduction of an instrument of some kind, and while its absence does not necessarily indicate



Fig. 111.—Virgin Hymen, with central slit. (From Hunterian Collection, University of Glasgow.)

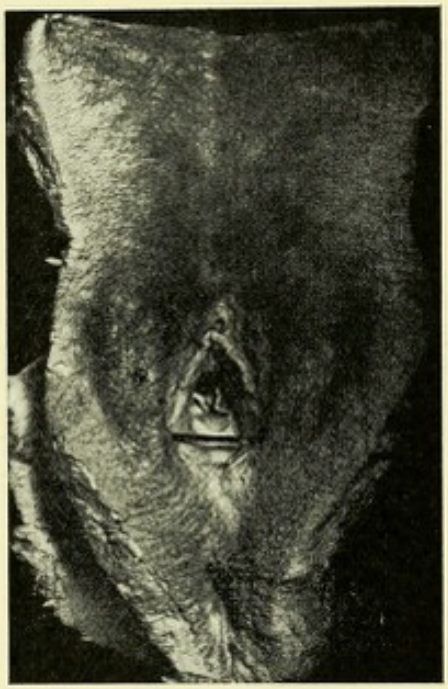

Fig. 112.—Virgin Hymen, of the semilunar type. (From Hunterian Collection, University of Glasgow.)

loss of virginity, neither does its persistence unequivocally point to the existence of virginity. It is not necessary to quote many cases to illustrate what is a well-known fact—viz. that a hymen may remain unruptured even where fruitful coition has taken place and pregnancy has resulted, and where it has remained intact until it was ruptured by the birth of the child, or was surgically opened to permit of the passage of the child.

Albespy [1] records a case of a single woman, aged 23, who became pregnant after a single coitus. At her confinement, the midwife diagnosed presentation of the *cervix uteri* at the vulva. Albespy, on examination, was at first puzzled as to the condition, but concluded that it was simply a tough, unruptured hymen—½ centimetre in thickness—which he slit open by two lateral incisions, and thus enabled the labour to proceed. Lemaistre [2] gives a case in which a woman, aged 42 and married for twenty years, became pregnant for the first time. Although sexual intercourse was regular, penetration had, apparently, never been complete. She aborted at the fourth month, and a fœtid placenta was expelled naturally. He proceeded to examine the uterus, but found for the first time that the mouth of the vagina was practically closed. On further examination, he discovered that the hymen, although elastic, had never been ruptured, but in its centre he found an orifice, large enough to admit the tip of the little finger, which he opened up. Another case is recorded [3] where a medical practitioner, called to assist a woman who was aborting, found an extremely tough and dense unruptured hymen with an opening close under the pubis, through which the tip of the forefinger could not be passed without much pain to the patient. The hymen was then opened up under chloroform, and the putrid aborted mass, found in the vagina, removed. In a further case, the hymen was found intact at the birth of a child at full time.[4] Hickinbotham records two cases of women in labour at term with their first children, in each of whom the hymen was unruptured.[5]



Fig. 113.—Deflorated Hymen, after Parturition, in Adult Woman. (From Hunterian Collection.)

On the other hand, the hymen may be absent without any possibility of precursory sexual defloration, from accidents during childhood, from gynæcological examination or operation, or from masturbation.

II. *Normal Condition of Fourchette and Posterior Commissure.*—These are not usually affected in their integrity in cases of rape, unless the violence offered is of the most severe and brutal character, and by instruments other than the penis.

III. *A narrow Vagina with Rugose Walls.*—This is usually present in the virgin female, from the fact that its anatomical conformation has not been disturbed by anything more solid than the menstrual flow. The absence of this characteristic does not, however, necessarily indicate rape; as it may be produced by masturbation, or by mechanical dilatation to befit young girls for sexual intercourse. It was our duty

[1] *La Gynæcologie*, Aug. 15, 1898; *B. M. J.*, vol. ii., 1898, s. p. 74.
[2] *Revue Médicale*, June 1898; *B. M. J.*, vol. ii., 1898, s. p. 74.
[3] *The Lancet*, vol. ii., 1898, p. 1325.
[4] *Ibid.*, Nov. 12, 1898.
[5] *B. M. J.*, vol. i., 1881, p. 1001.

upon one occasion to examine three young girls in whom it was alleged this was done for the purpose named, and where the conditions found were certainly indicative of traffic of some kind.

IV. *Undeveloped Nipples and Absence of Areolæ.*—These are points of negative value only, since a woman need not become pregnant from coition, and since the nipples may present their virgin appearance even in a prostitute.

From a review of the foregoing signs, it will be apparent that they must be found conjointly to afford good evidence of the virgin state.

EVIDENCE OF RAPE

We return now to consider the signs in the sexual parts of a female which when found would entitle the examiner to conclude that a rape had been committed.

These are :—

1. A recent, complete rupture of the hymen ;
2. Presence of blood, fresh or dried, about the vulva ;
3. Marks of bruising, excoriation, or inflammatory action of the parts ;
4. Presence of semen in vagina, or on body or clothing of female ;
5. To these objective signs, the following subjective signs may be added :—(*a*) discomfort in walking ; (*b*) frequency of micturition ;
6. Possibly, a yellowish or yellowish-green discharge, more or less plentiful, from vagina.

There should be no difficulty in finding laceration or rupture of the hymen when it is present, but the amount of the laceration will obviously depend upon the area to which the hymen originally extended, and to the completeness of the coition. The laceration presents a tear, or series of stellate tears in the membrane, marked by a bloody or inflamed line or lines. The remains of the hymen constitute what are afterwards known as the *carunculæ myrtiformes*, which, shortly after rupture, are red and look irritated, but which, after some time, become shrivelled, and have the appearances of different-sized, small, round projections of mucous membrane bounding more or less the vaginal entrance. Notice must be paid to the presence of blood about the vulva, thighs, and pubic area of the body of the female, and on her clothing. While blood is commonly present after rape with defloration, it is not always. Whether blood be present or not, and, if present, in what amount, will depend on the completeness, the form, and the vascularity of the hymen. It sometimes happens from the unusual quantity of effused blood that the examiner may be led to suspect that the assailant has also been wounded locally in the genitals. In two cases which we examined, the quantity of blood found on the girls' underclothing, and at the place where the crime was committed, was greater than could have been looked for from the lacerated area of hymen. On examination of the suspected males who had been apprehended, a recent rupture of the *frænum penis* was found in each case. We shall refer to one of these cases later. But apart from any such injury to the male, coitus may

cause considerable bleeding, where in the hymen a small arterial vessel has been incompletely torn. We have not seen this in rape, but we have seen it in the case of first coitus after marriage. The examiner must be on the alert, however, that he is not being deceived by a false charge of rape, and that the presence of blood is nothing more than menstrual blood, or that the coitus has not merely induced the menstrual onflow. It is always necessary to discover the laceration of the hymen where hæmorrhage is present. There will be corroboratory evidence of the use of violence if bruising or excoriation of the external genitals be found, since it indicates that the violence has not been confined to the vaginal opening, which would likely be the case if a foreign body, other than the penis, were intromitted either by the woman herself, or by another, in order to simulate rape.

Accompanying the foregoing signs, unequivocal evidence of their cause is afforded when semen is found in the vagina, upon the person, or upon the clothing, of the female. It is important in all cases of alleged rape that the vagina should be examined for spermatozoa. We have found by experience that the best way—and the least painful to the female—to obtain vaginal fluid for microscopic purposes, is to introduce into the vagina a pipette, the pointed end of which is slightly curved, and the other end of which is covered with a miniature rubber-ball; indeed, a somewhat elongated ink-pipette is as good an instrument as any, since its introduction is easy and painless. When introduced against the posterior wall, slight pressure backwards should be made so that a depression is formed in the vaginal wall, into which any vaginal fluid will gravitate, which, on allowing the rubber-ball to slowly expand, will be sucked up into the pipette. Thereafter, a dozen microscope slides may be dotted with the discharge, and then examined by microscope. These may be allowed to dry, and before being examined may be stained with dilute carbol-fuchsin or gentian violet, which enables the examiner the more easily and rapidly to detect the spermatozoa. The hair of the *mons veneris* and of the body area in and around the external genitals, and any suspicious stains upon the clothing, should be examined afterwards for evidence of the emission of semen, in the manner to be hereinafter described. The absence of semen, however, does not of itself indicate that rape has not been committed, because emission may not have taken place.

In addition to the foregoing signs, the female may complain of difficulty or pain in micturition and discomfort in walking; but these, in our experience, are rarely encountered where the rape has been committed upon an adult female; they are much more common in children or young girls.

In comparatively rare cases, a purulent discharge of a yellowish or yellowish-green colour may be found about the genitals. Indeed, in the case of children, its presence is most commonly the reason why a mother suspects or thinks that her child has been tampered with. Such a discharge may be due to gonorrhœa from infection by actual coitus or contact with an infected male, or to simple vulvo-vaginitis or vulvo-vaginal catarrh, due to a variety of irritating causes. It is a fact beyond dispute, owing to the prevalence of a widespread belief amongst persons of the lowest classes that coitus with a healthy young

person of the opposite sex will cure them of gonorrhœa, that gonorrhœal infection is conveyed to young children—especially females—and hence it is that rape upon young female children under twelve years of age is so prevalent, along with the other reason that females at these earlier ages are less able to offer resistance. In a recent case, two young female children were affected with gonorrhœal vulvitis due to the trafficking of a male lodger in the house who was suffering from gonorrhœa. He pled guilty at the trial. The gonococcus was found. A far more common cause of purulent discharge, however, is vulvo-vaginitis. This arises from uncleanliness, scratching with dirty fingers, local irritation, such as thread-worms in rectum, cold, etc., and it might easily be mistaken by a careless examiner for gonorrhœa. Of some 70 cases, in which we have examined women and girls for evidences of alleged rape or indecent assault, 11 of them bore evidences of vulvo-vaginal catarrh. The following case affords several points of interest :—

A girl of seven years, playing with her companions near a coach-house where an ostler was employed washing a carriage, was called by him into the harness room to go a message. The man there attempted to violate her, but she screamed so lustily, and her companions came in so quickly to find the cause, that the man was baulked in his attempt. She did not complain to her mother until two days afterwards, when, on her mother examining her and finding the parts unusual, we were asked to examine her. She was suffering from a muco-purulent discharge which coated the vulva, with superficially eroded patches of mucous surface. The man was apprehended, but he was found to be free from any disease. We gave it as our opinion that she was suffering from vulvo-vaginitis, and, after local treatment, she was well in a few days. The man was released from custody for want of evidence of attempt, chiefly because the girl herself said that he did nothing more than catch her and throw up her dress, which could not be corroborated. She was a weakly girl.

This resemblance of vulvo-vaginitis to gonorrhœa is not confined to its physical appearances. Vigereni and Casarini[1] from their examination of the bacteriology of this disease affirm that clinically it is often impossible to distinguish between it and gonorrhœa, and further that in simple vaginitis a diplococcus is commonly found which microscopically is very like the gonococcus, but differs from it in that it does not respond to the same culture tests. They never found the gonococcus in the vaginæ of healthy children, and in the cases of those in which it was found, the history of the contagion could be traced. In doubtful cases, therefore, bacteriological examination should be resorted to. The following case is somewhat remarkable :—

A mother brought her child to the police. She was suffering from a muco-purulent discharge from the vulva, and inflammation of the parts. The girl stated that two boys had " done things " to her. The boys were apprehended and brought from their beds to the police office, where we examined them. On further inquiry of the girl, it was elicited that the boys had thrown her down in a dark passage and had criminally assaulted her two or three days before her mother brought her to the office. On looking at the boys one would have said it was impossible, as one of them was about thirteen years of age, the other being younger, and both looked physically puny. The younger was examined first, but he presented nothing unusual. On examination of the elder, we found a muco-purulent secretion round the foreskin and issuing from the urethra itself.

[1] *La Rif. Med.*, Nov. 29, Dec. 1, 1898 ; *B. M. J.*, vol. i., 1899, s. p. 19.

There was no rupture of the hymen. We gave it as our opinion that the boy was suffering from gonorrhœa, and that simple contact with the girl might convey the disease to her. The painful part of the case was that the boy confessed that he had been bribed by a young adult prostitute to lie with her, from whom he had evidently contracted the disease. He was charged with indecent practices, and convicted.

When rape is fully accomplished, the extent of the local violence is usually greater in the case of girls below twelve years of age than in those above puberty, or in women. The reason for this is to be found in the fact that at the earlier ages the urinary portion of the external genitals is more developed forwards than just before or after puberty, when the genital portion projects most (the urinary receding within the vulva), and also because more violence is necessary for the intromission. Ogston[1] records the case of a girl of eleven who died from the effects of this crime, and upon whose body post-mortem dissection disclosed tearing of the external genitals and perinæum, the vagina torn away from the uterus, and a large rent in the peritoneum, with effusion of blood into the abdomen. Other cases have been recorded of like severe injuries, although not so extensive as in the case quoted.

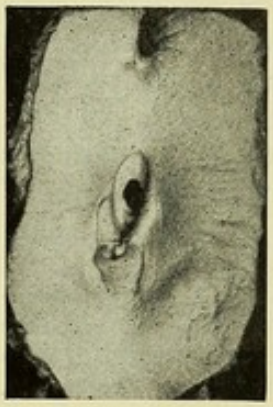

Fig. 114.—Hymen of Child of Four Years—Annular type. The illustration also shows the prominence of the Urinary portion of the Genitals. (From Hunterian Collection.)

It is almost incredible that injuries such as these could be committed during the act of coitus, but we are bound to believe that it is possible, from recorded cases in which coitus for the first time under legal conditions produced such injuries.

Looof[2] records a case in which laceration of the posterior vaginal fornix was produced by a natural force. The woman was aged 23, and coitus had occurred in the sitting posture. The vagina was torn from the back of the *cervix uteri* for 1½ inches, and in the wound an artery was opened which bled freely, but the peritoneum was intact. Mylott[3] gives the facts of a case in which he was called in the night to attend a newly-married woman who was bleeding freely. During the first act of coitus she felt a sharp pain, followed immediately by profuse hæmorrhage. On examination of the vagina, a tear was found which, beginning at the mouth of the vagina, extended upwards to the left of the median line to Douglas' pouch, which it crossed, and there passed to the right side of the vagina.

Dilatation of the vagina is stated by certain authors as an additional sign of rape; but though seen in cases where coitus is not uncommon, it is not found after a rape in which coitus has been effected for the first time. It must be exceptional to find cases such as that recorded by Casper,[4] in which the mother of a girl aged ten was charged with gradually dilating the vagina in order to befit her for commercial traffic with men.

In many of the cases which we have examined for the evidences of alleged rape, no physical signs were discoverable, as the hymen was intact, and there was no evidence of bruising locally, nor of injuries

[1] *Op. cit.* p. 91.
[2] *Ann. de Gynéc. et d'Obstét.*, March 1898.
[3] *B. M. J.*, vol. ii., 1899, p. 760.
[4] *Op. cit.* vol. iii., p. 318.

generally; but these were mostly in girls of tender years. In certain others, the hymen was ruptured; but in no case was there any more extensive laceration than that. The following cases illustrate several of the points which the examiner has to consider:—

1. H. L., a married woman, aged 38, was attacked by a vigorous man on the tow-path of a canal. She screamed and resisted vigorously. On assistance coming to hand, the assailant ran off. She at once proceeded to the police station and lodged her complaint, and we examined her shortly thereafter. The following was her condition:—Her clothing was soiled from coal-dust and dirt, her face being likewise more or less covered with the same. Her face was swollen at the angle of the lower jaw on the right side, her upper lip was bruised and swollen, the right side of her face and throat was marked with many scratches and abrasions, and there was a bruised swelling, with abrasions, on the right temple. On examination of the sexual parts, it was found that she was menstruating, that there was dried mud on the lips of vagina, and there were bruises and slight abrasions of outer aspect of right thigh. She averred that intromission was not complete. A man was apprehended a few hours after, closely corresponding to the description she gave of her assailant, but examination of his body revealed nothing to connect him with the crime, and the woman herself was not quite certain of his identity, as the act was committed at night.

2. In May 1907, we received instructions to examine a young woman, a domestic servant, who alleged that some few days before while residing at a coast watering place with the family, she had been ravished in the back kitchen early in the morning by a milkman. The alleged assault took place sixteen days before our examination. In presence of her mistress, and by expressed consent of the girl, we made the examination, which did not reveal any marks of bodily injury, but showed that the hymen had been ruptured from top to bottom, and that the ruptured edges were healed. The vagina admitted two fingers without causing pain.

The girl, who alleged her age to be nineteen, did not look that age, being small in stature and poorly developed in physique. She said that at the time of assault she was only partly clothed, as the hour was 6 A.M., that she was suddenly seized by her assailant, thrown down on top of the kitchen table, that she then fainted, and only recovered consciousness some time thereafter. Her mistress said that about this hour she had rung for the servant, but there being no reply she went down to the kitchen, and not finding the maid there went into the back kitchen, which is built out at the back of the house, and there found her leaning against the table in a dazed condition, but the girl said nothing to her at the time. Certain articles of underclothing belonging to the girl which she wore at time of assault were sent to us for examination a week later. On the chemise, front and back of the skirt, were many stains of varied appearance, but chiefly of blood, and on the knickers were reddish stains in the fork of the garment, and whitish, starched-looking stains on inside of left leg nearest genitals. All of these stains were dry and stiff.

Careful microscopic examination was made of preparations from all the stains. They showed red-blood corpuscles, squamous epithelium, and cellular débris, but no complete spermatozoa. As a month had elapsed between alleged assault and time of examination of stains, we were not surprised, even had spermatozoa been originally present, not to discover their presence, as our experience is that in seminal stains kept dry for weeks there is a considerable chance not to find spermatozoa.

3. In a recent case (Sept. 1909), in which a girl was aged sixteen years and one day on the day of an alleged rape, and on whose underclothing examined three or four days later spermatozoa were plentifully found, the medical man who first examined her stated in his report that he saw no evidence of blood about the genitals or on the clothing, nor of spermatozoa. He said further that there were no marks of injury on the body and that there was no hymen. On these grounds he concluded that if sexual connection did take place at the time alleged, the girl was habituated to coitus. We examined the girl ten days later. We found a hymen which had been ruptured from top to bottom and to one side, and that the vagina would not freely admit the tips

of two fingers. The defence was that the prisoner did not commit the act. The judge, in summing up, commented on the absence of marks of violence on the person of the girl as being against the view that she had physically resisted to the uttermost as by law she was bound to do, and that although the girl immediately after the assault had been committed had gone back crying to some people and told them of the occurrence, and later, still crying, evoked the interest of a married woman who called the police, the judge suggested that this might be *post facto* grief after consent had been given. The jury found the prisoner not guilty.

This case is of further interest in that had the rape been committed two days before, the prisoner would have come under the Criminal Law Amendment Act, 1885.

Examination of the Accused.—When his consent is obtained, it is a good plan to examine the accused, for it may happen that evidence will be forthcoming which may connect him with the crime. This is true of suspected transmission of gonorrhœa. One of our colleagues informed me of a case in his experience in which a man was charged with this crime, and had, at the same time, conveyed the contagium of gonorrhœa to the woman. He was examined, but although no sign of discharge from the urethra could then be seen, the lips of the meatus had that pouting, red, swollen appearance so characteristic of specific urethritis. He was placed in a cell under observation. It was observed that he always urinated before the visit of the surgeon and thus washed out the urethra; thereupon, all facilities for performing this act having been taken away, and his clothes being entirely removed, the discharge quickly made its reappearance, which ensured his conviction. Scratches upon the face or hands, or bites upon the trunk or limbs, or bruises on the legs from kicks by the female, are strong corroboratory evidence of the averment of the complainant that she resisted vigorously. Besides, rupture of the *frœnum penis* may be found, and affords, when present, good *primâ facie* evidence of the forcible intromission of the organ into an incommensurately smaller passage or canal. In one case (*vide ante*, p. 96) this was found on a man who was charged with rape of a girl, whose underclothing was saturated with blood, the floor of the lobby where the crime was committed being also covered with blood. The man, as usual, strenuously denied any knowledge of the charge, but the finding of blood in the seams of the lower front part of the body of his trousers, which bore marks of recent washing, and on the nails and soles of his boots, only too clearly pointed to the fact of his relationship to the girl. He pled guilty at his trial.

Examination of Stains upon Clothing for Spermatozoa, and of Discharges for Gonococci.—It is usually necessary, as corroborative evidence of the rape, to examine the underclothing of the person assaulted for the presence or absence of seminal stains. From a long experience of this work, we are able to state that it is not so easy a matter as the student may imagine from the ordinary accounts in books. In the first place, the underclothing of those ordinarily so assaulted is by no means characterised by its cleanliness, and indeed very often bears traces of dirty habits; consequently, the examiner may expect to see a considerable variety of stains, both of size and of composition, ranging in colour from red, brown, yellowish, to a grey. Those of a red colour are commonly composed of blood, or blood and serum, from the

menses; of a yellow or yellowish colour, from fæces, leucorrheal discharges, or urine; of a brown colour from fæces, or iron stains; while those of a greyish appearance may be due to semen. Only patient, painstaking, and repeated examinations will make anyone familiar with their composition, and with the physical appearances of stains arising from their composition.

Seminal stains, when dry, are of a greyish-white appearance, and impart a stiffened, starched feeling to the clothing. But leucorrheal discharges have nearly identical physical characteristics. Both are found in like positions on the under-garments, and therefore nothing short of careful microscopic examination will determine the difference. The attention of the examiner should be directed first to the physical appearances and characters of the stains, and where there are several, he should select at least two for examination. We have no belief whatever in any chemical test such as Lassagne's, which is based upon the known chemical fact that seminal fluid contains no albumen, and therefore no sulphur, nor even in the detection of the odour of semen by the addition of warm water to stained pieces of clothing contained in a watch-glass, for we have tried them both many times without any conclusive result; moreover, such are not required when a microscope is at hand, for if the quantity of semen be sufficient to make any response to the tests named—and that, in our experience, is rare—there will be more than enough for the convincing proof of the microscope. The stain or stains, when they are presented for examination, are usually in a dry condition, and before their constituents can be examined microscopically they must be so moistened as to secure that a portion of the constituents will pass on to the slide. The best form of procedure is as follows:—

1. Cut out, with as little handling as possible, the stains upon the cloth to be examined, keeping each stain apart in a separate watch-glass. If the stain be ample, cut a portion of it into small pieces.
2. Drop into the watch-glass, over the cloth, as many drops of a 10 per cent. solution of glycerine in water (distilled, preferably) as will be judged sufficient to thoroughly moisten the cloth.
3. Allow the whole to stand under a small bell-jar, or under cover of some kind, for a couple of hours, at the end of which the cloth will have soaked up the fluid.
4. Prepare a series of clean glass slides, and with a pair of flat-pointed forceps touch each slide with the moistened cloth, until six slides, at least, have been so treated.
5. On three of them place cover-slips. Dry the other three slides after the bacteriological fashion, by passing them slowly through the column of heated air which rises from a Bunsen, and at some distance (about ½ to 2 feet) above the flame, repeating the process two or three times, till the film is dry; treat each of the three slides in the same way.
6. Cover the film with weak gentian-violet stain, warm gently for ½ to 1 minute; wash off stain in a gentle stream of water from a wash-bottle, put on a cover-slip, and examine microscopically.
7. Use a microscope magnifying not less than 500 diameters, and examine in a suitable light.

A modified procedure may, however, have to be adopted in tropical climates. Hankin, who has had experience under these conditions, advises the following method:—Dip the piece of fabric containing the stain in boiling water for a minute; cool, place in a 2 per cent. solution

of potassium cyanide; rapidly wash in distilled water; place on a microscope slide, teaze and scrape; after removal of fabric, fix film by heat, stain with gentian-violet, and examine microscopically. He found better results from the following modified method:—Boil suspected stain for two minutes in a watery solution, containing 0·5 per cent. of tannin and sulphuric acid (1 : 1000); wash stain in a solution of one part saturated ammonia solution to 400 parts of water; immerse for five minutes in a solution of 1 : 10,000 potassium chromate and 1 : 1000 sulphuric acid; transfer stain for two minutes to a 2 per cent. solution of potassium cyanide; rapidly wash in distilled water, teaze, and scrape on slide; remove fabric; fix film by heat; stain as above; and examine microscopically.[1]

If spermatozoa are present, the above procedure will enable the examiner to detect them, and he will likely discover that the stained specimens—if the procedure has been carefully performed—will show the spermatozoa much better, and permit of their more rapid detection, than the unstained, because the staining renders them more opaque, and being coloured, the eye catches them more quickly. The difficulty of discovering them in clear, unstained fluids is due to their translucency, to overcome which manipulation of the angle of light is required. From personal experience of the foregoing method of treatment we can speak definitely of its suitability, as isolated spermatozoa may easily be picked out in the field. It is by no means difficult to distinguish a spermatozoon when it is seen entire, because of its distinct head, and long filamentous tail. Spermatozoa vary in total length from $\frac{1}{800}$th to $\frac{1}{1000}$th part of an inch, the diameter of the head being about $\frac{1}{9000}$th to $\frac{1}{10,000}$th part of an inch; in other words, the head is about one-third the size of a human red-blood corpuscle, and the tail is from five to six times the length of the head.

Semen usually contains not only spermatozoa, but also sperm cells in different stages of development, and in addition, clustered crystalline bodies, not unlike some of the fatty acids—probably cholin or lecithin. The precise character of the last we have not yet been able to determine. It has been asserted by certain writers that, in the history of the same man, there are periods when the semen contains few, if any, spermatozoa, and is mainly composed of sperm cells. We have not been able to verify this in the case of men whose functions are in a state of physiological activity. Casper,[2] however, gives a list of about a dozen persons of different ages, in whose bodies after death no spermatozoa could be found in the seminal vesicles; and other writers have recorded similar observations respecting men advanced in age.

The question has arisen—Whether an examiner would be justified, in the absence of spermatozoa, in affirming that a given stain was of seminal origin? Casper goes the length of saying "that though stains are proved to be of seminal origin when those specific zoosperms are found in them, yet that the absence of spermatozoa does not prove that these stains have not been caused by human semen." We personally act upon the view that if spermatozoa are not found in the

[1] *B. M. J.*, vol. ii., 1906, p. 1261.
[2] *Op. cit.* vol. iii., p. 294.

stain or stains, we cannot positively affirm that such stains are seminal. Neither is the discovery of spermatozoa in stains an easy matter, for the obstructive factors are many; these partly consist of the necessarily delicate manipulation which is required, the character of the fabric to be examined, and not least, the age of the stain and the usage to which it has been subjected before it has reached the hands of the examiner. Spermatozoa have been discovered long after their emission. Roussin affirms [1] that he was able to recognise them after 18 years, and others at less long intervals. It is quite clear that they may be discovered within the usual periods required for medico-legal purposes. A long experience in the examination of such stains com-

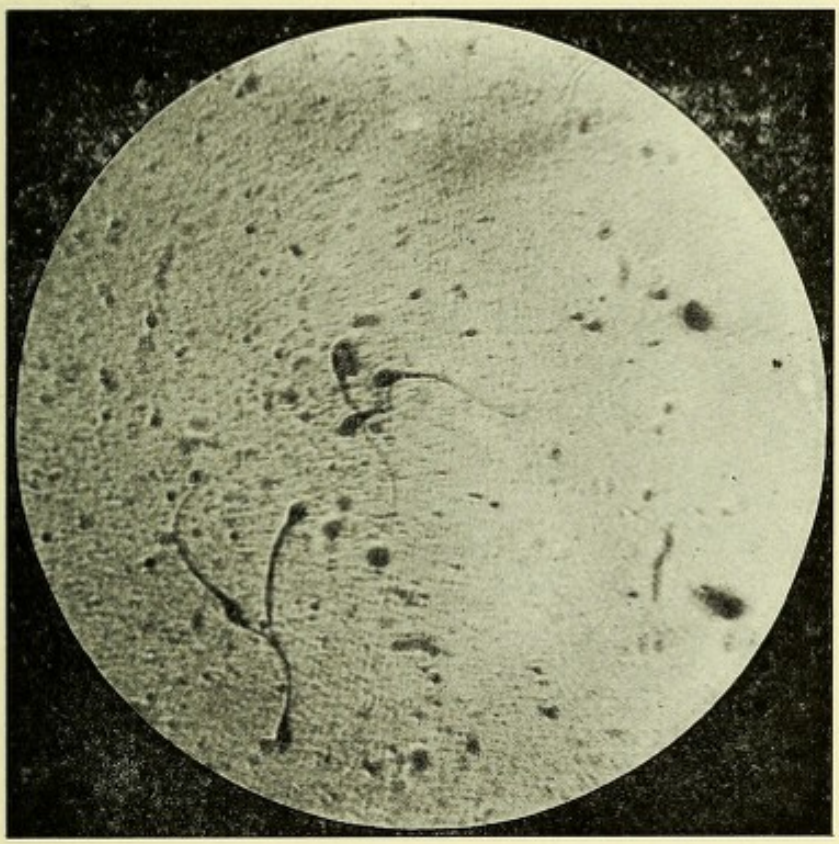

FIG. 115.—Photo-micrograph of Human Spermatozoa stained by Methyl-violet. ×500 diameters. (Author.)

pels us, however, to say that these observers must have been more than fortunate in the materials they had to examine, because we have found that undoubted seminal stains which, when moist and fresh, were found to contain spermatozoa, did not reveal them when they became dry from exposure to the air of an ordinary warmed room, even after comparatively short intervals of time. Desiccation would seem, therefore, to lead quickly to disintegration of spermatozoa. The likely source of the best evidence of spermatozoa is the sexual parts of the female, on examination soon after the alleged commission of the crime.

It is futile to attempt identification of seminal stains upon clothing by any characteristic odour, since it is likely to be masked by urinous and fæcal

[1] *Ann. d'Hyg.*, 1867, vol. i., p. 152.

odours. Neither can much reliance be placed upon chemical means. Florence affirmed that the reaction which ensues upon the addition of iodine and potassium iodide is characteristic of human semen. The reagent which he employs is composed of a solution of 1·65 grammes of potassium iodide and 2·54 grammes of iodine in 30 c.c. of distilled water, and the reaction consists in the formation of dark-brown crystals, long-shaped, rhombic, or acicular in shape when the reagent is mixed with an aqueous extract of seminal fluid. The test is to be employed as follows :—The seminal extract is made by warming the stains in a little water on the water-bath, acidifying with dilute hydrochloric acid, cooling, and adding some dry ammonium sulphate. The extract so treated is then filtered, the reagent added, and the mixed fluid then subjected to microscopic examination. Richter [1] believes that the reaction which happens is due to cholin, either normally present in semen, or formed in it by the decomposition of lecithin, which is commonly found in urine.

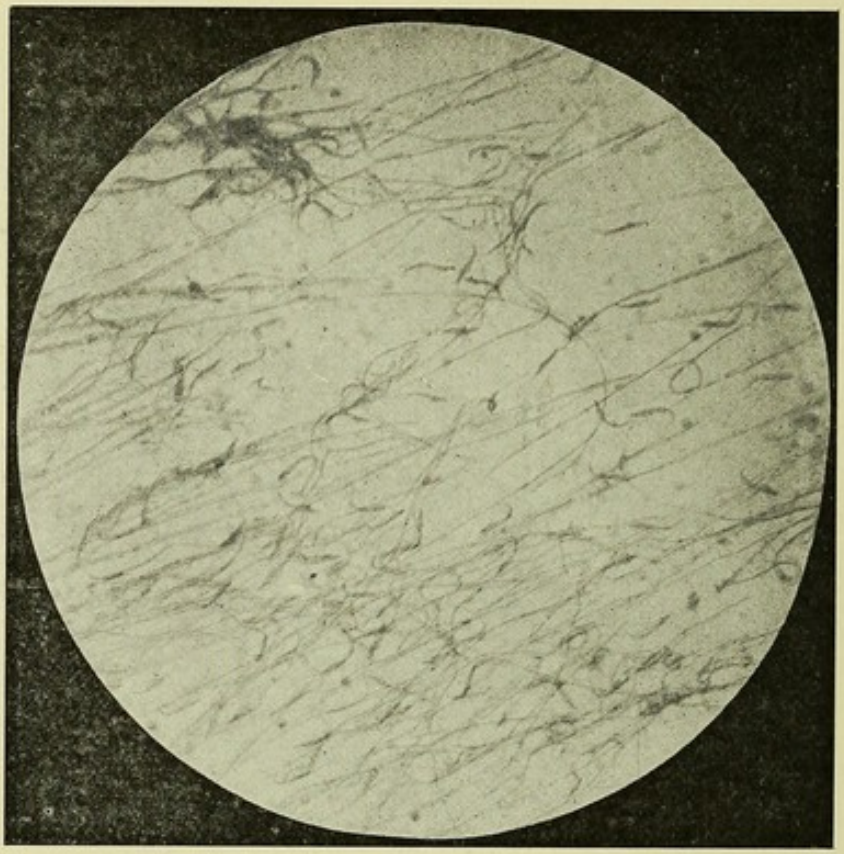

Fig. 116.—Photo-micrograph of Spermatozoa of Rat. ×500 diameters. (Author.)

Kippenberger [2] finds that the reaction is formed with the seminal discharges of a large variety of animals, in addition to that of man, and also that it takes place with menstrual blood, or even, at times, with normal blood. We believe that the presence of crystals of cholin or lecithin in a suspicious stain is almost characteristic of human semen, apart from the discovery of spermatozoa; but the observation must be more fully confirmed before this can be made to rank in importance with spermatozoa themselves.

Within the last few years another spermatic reaction has been suggested by Barterio, which depends on the fact that when a saturated solution of picric acid is mixed with fresh or dried or dissolved semen, certain crystals are formed which, when examined microscopically, appear as slender yellow-tinted rhomboid needles with obtuse angles, sometimes crossed longitudinally by a line of refraction or as ovoid crystals when the angles are rounded off.

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[1] *Wien. klin. Wochenschr.*, 1897, p. 569.
[2] *Zeit. für Untersuch. der Nahr. und Genussmittel*, 1898, p. 602.

Among the observers who have tested the reaction are Galto [1] and Levinson.[2] The former after having experimented with saliva, urine, blood, pus, milk, and other animal fluids found no such reaction as with human semen. He also found negative results with the semen of the horse, rabbit, ox, and dog, and with fluid from the seminal vesicles, epididymis, testes and prostate gland. The latter observer tested for the reaction with the milt of the sturgeon, whiting, pike and other fish, but found a negative result. He also tested undoubted samples of human semen to discover, if possible, whether or not the formation of crystals depended on the presence of spermatozoa. Unlike the former observer, he obtained a good reaction in two cases in which by massage secretion was expressed from the prostate gland, and he thinks it not unlikely that the substance which enables the reaction to take place is contained in the prostatic fluid. In two cases of azoospermia the reaction was negative, but in others, where sperm threads were absent, the reaction was positive. Further experience of the test is necessary, therefore, before its value or non-value can be determined.

But the attention of the examiner must not be confined to the kind of stains mentioned; it is important, especially in cases where there has been recent rupture of the hymen, that blood-stains should also be examined for spermatozoa, as they may pass from the body of the female in the blood which flows from the breach in the hymen. Leucorrheal stains are characterised by the abundance of cells of squamous epithelium, and if the discharge has been muco-purulent, by pus cells in addition, the multiple nuclei of which can be rendered apparent by treatment with weak *liquor potassæ*.

Spermatozoa cannot readily be mistaken by a skilled observer for anything else, provided whole spermatozoa are visible, and as in no case, unless an unmistakable spermatozoon is present, would an examiner be justified in affirming its seminal origin, it matters little whether its flagella or tail is confused with a fibre of hair or wool, or that of any other fabric. It cannot be often enough repeated that the presence of spermatozoa of an indubitable character must be established to identify positively the stain with semen, and that no man would be justified who proceeded on such an examination unless he were skilful enough to recognise easily the difference between spermatozoa and fibres, or anything else. There is one organism which has been decribed by M. Donné [3] as simulating in appearance that of a spermatozoon, and which is figured by him in his work. According to that observer, the head is much larger and contains granular matter, and from it several ciliæ branch off—characters which differentiate it at once from the spermatozoon. We have sought for this organism many times in the vaginal mucus of many women, but have entirely failed to discover it.

Examination for the Gonococcus of Neisser.—Since it has been proved without doubt that this micro-organism is the cause of gonorrhœa, the medical examiner is now provided with a means of distinguishing between vaginal discharges which, clinically, are practically identical. It is not difficult to stain appropriately some of the discharge in the usual bacteriological method. If a thin film of the purulent material be put on a slide and dried, be covered with Löffler's methylene-blue stain for one minute, and then washed till most of the blue colour

[1] *Rif. Med.*, Nov. 3, 1906.
[2] *Berl. klin. Woch.*, Oct. 8, 1906; *B. M. J.*, vol. i., 907, s. pp. 9 and 29.
[3] *Cours de Microscopie*, Plate ix.

disappears, and, thereafter, be counterstained with watery eosin for between 20 and 30 seconds, the kidney- or bean-shaped cocci will become easily seen by a $\frac{1}{12}$th inch oil immersion objective. The diagnostic characters of this micro-organism are its shape, and its disposition in distinct pairs in each pus cell. In order to make the diagnosis absolutely certain, cultural tests should be employed. The gonococcus can be cultivated with success in a mixture of two parts fluid agar in albuminous urine, or one composed of two parts agar, one part of human urine, and 5 per cent. per volume of egg-albumen; or the pus may be sown on agar plates streaked with fresh human blood. It may be differentiated from the *diplococcus urethræ communis*, which though larger

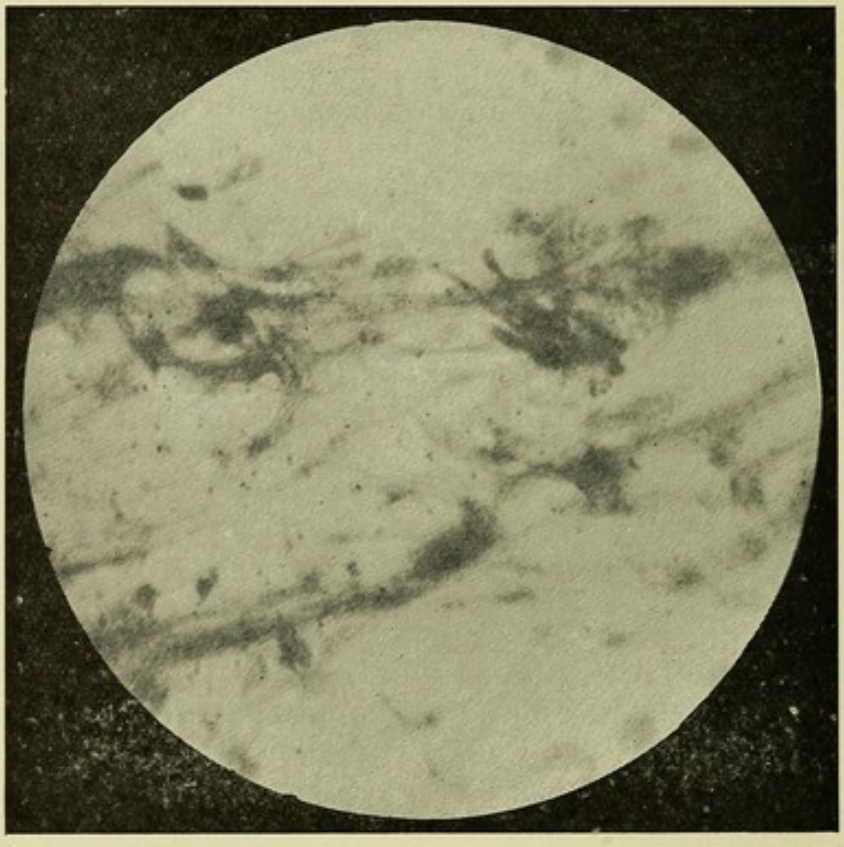

Fig. 117.—Photo-micrograph of Gonococcus in pus from Gonorrhœa. ×1200 diameters. (Author.)

than the gonococcus might be confused with it, by its absence of growth in alkaline gelatine, a medium upon which the latter grows freely.

But Rape may be committed upon the dead as well as the living, and evidence of the crime may be found upon the dead body. It will be the duty of the examiner to determine, if possible, whether the female died from the effects of the assault combined with the rape, or whether she died from the violence and was violated sexually afterwards. Each case must be decided upon its own special merits, with special reference to the character, situation, and severity of the wounds found upon the body, and to the local violence with respect to direction of blood-flow. In a case tried at the Carlisle Summer Assizes, 1889—R. *v.* Kerr—the prisoner was charged with murder in respect that he had committed the crime of rape upon a woman, the cause of whose death, however, was not the injuries thereby produced, but the

entrance of vomited matters into her larynx produced by the violence offered. Locally, however, there were two lacerations found in the vagina, in addition to a mark of excoriation on the abdomen and blood on the genitals externally. The most damning point in the circumstantial evidence—for it was wholly circumstantial—was that the knees of the prisoner's trousers were soiled with mud corresponding to that of the place where the assault was committed, and adherent to the mud were some red-coloured woollen fibres resembling those which partly composed the fabric of the woman's petticoat. Although the prisoner averred that the woman had given assent, he was found guilty. In the Léotade case, the principal facts of which are narrated by Sir James Stephens,[1] the body of the girl bore marks of a violent attempt at rape, which however was unsuccessful because the girl was not mature, and in addition, of violence to the head which had been caused by a broad blunt instrument. In the St Cyr case, also dealt with by the same writer,[2] it would appear as if the female victims were first killed, and ravished afterwards. Indeed in some of the cases recorded, it is almost inconceivable how the extensive genital injuries could have been produced, except by the forcible intromission into the vagina of instruments other than the male organ, which injuries in themselves, because of their shocking brutality, almost indicate demoniacal possession in the assailants. The following case is somewhat unusual :—

At the Circuit Court, Glasgow, 1905, a coloured man named Liffey, a Basuto, was charged with having on Aug. 11, on a road near Larkhall, ravished the wife of a miner, and assaulted her, beat her, stabbed, and cut her on the neck with a knife, and murdered her. It appears that deceased left her house about 9 P.M. to obtain at a shop an article for her husband, and that soon after a boy came to the house, and told the husband that his wife was lying on the road ; that the husband found her there, bleeding from a wound in the neck, and insensible, and that she died a few minutes after having been brought home. It was proved by witnesses who saw the act of rape, that when they went up and lighted a match to see who the persons lying on the ground were, the prisoner rose to his feet and ran. Recognising the prisoner, and seeing blood on the woman's face, they pursued prisoner, but they lost sight of him near a pit-head. When arrested, the hands and forehead of accused were covered with blood, and his knees were skinned and ruffled. He was found guilty, was sentenced to death, and was executed. The medical evidence was that in addition to the wound on the neck, there were marks of throttling on the neck, that death was not due to the neck wound, but rather to asphyxia. There was no local evidence of sexual violence.

There are some general questions which may arise in a charge of rape regarding which a few words must be said.

I. *Can a healthy, adult Female be violated by one Man ?*—Casper answers this question in the affirmative on the basis of a case the facts of which he records,[3] and of which the following is a summary :—a man persuaded a young woman of five-and-twenty to accompany him in the dark into a public park. He there tried to violate her, and ultimately seized her round the body, flung her to the ground, threw her dress over her head, and at last effected his purpose. The hymen, on examination, was found to be completely torn. Her statement was confirmed

[1] "Criminal Law of England," p. 318 *et seq.*
[2] *Ibid.* p. 345 *et seq.*
[3] *Op. cit.* vol. iii., p. 311.

by the fact that the police, who hurried to the place because of her cries, found her assailant in the condition of actual satyriasis.

There can be little doubt that the violation may be effected in a case where the woman physically resists until worn out, or even where, because of the excitement and resistance, she faints. But one must not be guided to a general opinion from a particular case. The foregoing illustrates the actual accomplishment of the act in one case, and its possibility in others. At the same time, a medical witness would only be justified in offering an opinion on this point after careful consideration of the whole facts of the particular case regarding which his opinion is asked, for he must bear in mind that so long as a woman is in complete possession of her senses, it does not require great physical strength to deny entrance to her body by the disposition of her limbs. Where the act is accomplished, one is forced to the conclusion either that she has become physically worn out and incapable of further resistance, or that there has been temporary loss of consciousness. Where marked disproportion of age, size, and apparent strength in favour of the female are present, a charge of rape is very likely, and rightly, to break down, because consent is likely to have existed. In most cases of this kind, however, such questions are not likely to be asked of a medical witness, because the judge and jury are quite able to form their own opinions on sight of the supposed victim and assailant. The business of the medical witness is to decide from the appearances on the body of the female whether carnal knowledge of the woman has been effected forcibly and against her will, and the Court will form its own opinions on the other point. Nor has the medical witness anything to do with the previous character of the woman; the effect of a bad character upon the issues of the case is one for the Court and jury alone to decide.

II. *Is it possible for a Woman to be violated during ordinary Sleep without her Knowledge?*—The answer to this, upon which all medical jurists are agreed, is that it is highly improbable in the case of a *virgin*. We should say that it is impossible, because of the pain attendant upon a first coitus. It is further agreed that it is not impossible, although extremely unlikely, in the case of women accustomed to sexual intercourse. This latter answer is based upon certain cases which, in our opinion, however, do not entirely warrant its finding. At the same time it has been established in the High Court of Justiciary of Scotland that it is possible for a man to have coitus with a woman during her sleep.

A man named Sweenie was convicted, June 18, 1858, on the charge of "wickedly and feloniously having carnal knowledge of a woman when asleep and without her consent, by a man not her husband"; and a man named M'Ewan or Palmer, at Dumfries Circuit Court, September 26, 1862, on the same charge.[1] The Criminal Law Amendment Act, 1885, section 4, last subsection, enacts and declares that any man who induces a married woman to permit him to have connection with her by personating her husband shall be deemed guilty of rape. A case, based upon the charge of having carnal knowledge of a woman when asleep, or in a state of insensibility or unconsciousness from the effects of intoxicating liquors, was tried before Lord Ardmillan in the High Court of Justiciary, on November 20, 1871, in which two men were implicated, but after trial, the charge against the accused was found not

[1] Irvine, vol. iii., p. 109; 31 *Scottish Jurist*, 24; Irvine, iv., p. 227.

proven. The woman was found dead the morning after the outrage. In our experience, we have only known one attempt made of this kind, and under the following circumstances. A young married woman, M. H., was the wife of an ironworker, who went to work at 4 A.M. every morning, and who, not to disturb his wife on going out, left the door on the latch. The prisoner, who was a fellow-worker and who was acquainted with these facts, tried to personate her husband by entering her bed, but the woman, awaking when he tried to have coitus, raised the alarm, whereupon the man fled. On examination, we found her to be pregnant six months but not to have sustained any injury.

Cases of violation of females during a state of unconsciousness in fits, in a faint, or in hysteria, and under the influence of anæsthetics have been duly recorded. That the act may be accomplished under such circumstances goes without saying. It is unfortunately true that medical men and dentists, by reason of their professional work, are liable to have baseless charges of this kind preferred against them by certain women after the administration of chloroform or other anæsthetic. This is well established, although the reason for it is not so well understood. We have been informed by the police authorities of a division, within which is a large hospital, that such charges are by no means uncommon, and that having investigated several of these, they have found them absolutely without foundation.

As illustrative of the risk to the medical practitioner, the following case will be instructive.[1] A medical man was charged with criminal assault on a girl. According to the evidence the girl was hysterical. The prisoner met the allegation with emphatic denial. He was found not guilty. Mr Justice Channell said it was his usual practice not to comment on the verdicts of juries, but he felt it his duty to state that he never tried a case which left less doubt in his mind. There could not be the slightest doubt of the prisoner's innocence, and it was only justice to him to say so.

III. *Can a Woman become pregnant from an Act of Rape?*—Assuredly she can, is the only answer. Anyone acquainted with the factors of conception is well aware that, under apt circumstances, conception will follow whether the female be consenting or not. Apart from rape we are acquainted, moreover, with the facts of a case in which impregnation occurred from mere contact of the male organ and emission, without any attempt at penetration sufficient to injure or affect the hymen. We delivered the woman, who was married to the offender —her lover—later, on the fact of her pregnancy being established.

Procedure in Examination of Cases of Alleged Rape.

In proceeding to the examination of persons in connection with a charge of rape, there are certain hints which will prove of service to the inexperienced.

I. With Reference to the Female. When the charge of rape is laid with the police, the practice in Scotland is that a medical man—the police surgeon of the division of a city, or of the town—is asked to examine the complainant, who, by laying a charge, is presumed as willing to afford all evidence, even to the examination of her person, with a view to the detection of her assailant. The medical examiner should ask no questions as to the commission of the crime, except as to the time when the alleged assault took place. Then the following

[1] *B. M. J.*, vol. ii., December 17, 1898.

points, in addition to the time and place of examination, and the name of any other female present thereat, ought to be noted :—

(*a*) The general physical appearance of the female ;
(*b*) The presence or absence of marks of violence upon her body ; their character, and their position, when present ;
(*c*) The presence or absence of marks upon the external clothing, where the assault is alleged to have taken place out of doors;
(*d*) The condition of the genital organs, with respect to : (1) presence or absence of blood ; (2) signs of bruising, or other injury, of vulva ; (3) presence, or absence of hymen, and if present, its condition with respect to laceration ; (4) if lacerated, the extent and direction of the rupture ; (5) the existence or absence of menstruation ; and (6) whether from the appearances of vulva and vagina, the female has been habituated to coitus.
(*e*) With a pipette as described, to obtain some vaginal fluid for microscopic examination ;
(*f*) If a muco-purulent, or purulent discharge be present, to secure some in sterilised capillary tubes for bacteriological examination ;
(*g*) Examination of the underclothing for stains, wet or dry, having the physical appearances of semen, if such are present ;
(*h*) Secure the garment for further examination of stains for spermatozoa.
(*i*) If spermatozoa are found in the stains, preserve the specimens found for future reference, if required.

II. With Reference to the Male. After cautioning him of the possible results of the proposed examination, and apprising him of his right to give or withhold his consent, after consent has been given in the presence of a third party, attention ought to be given to the following points :—

(*a*) Any, and if so, what, appearances of violence are present upon his face or neck, or more locally in the neighbourhood of the external genitals ;
(*b*) Condition of the male organ itself : (1) with reference to marks of injury, such as scratches, or rupture of frœnum ; (2) marks of blood, etc. ; (3) marks or stains of blood upon clothing, trousers especially, or boots.
(*c*) His physical conformation.

In the examination of the dead body of a female upon whom it is suspected this outrage has been committed, the kind and extent of physical examination will be very much the same as in the living body.

SODOMY, PÆDERASTY, AND BESTIALITY

It is apparent from a perusal of the Scriptures of Chapter xx. of Leviticus, 13–16 verses, that unnatural crimes between man and man, man and a beast, or a woman and a beast, have existed from very early times in the world's history. According to the Mosaic law, such persons and the animal with whom the abomination was practised were to be put to death. According to the law of Scotland even now the offence is a capital one, only it is the usual practice for the prosecutor to restrict the pains of law. According to the 24 & 25 Vict. cap. 100, sect. 61, the punishment is limited to penal servitude for life, or for any term not less than ten years ; and in terms of section 11 of the

Criminal Law Amendment Act, 1885, any male person who, in public or private, commits, or is a party to the commission of, or procures or attempts to procure the commission by any male person of, any act of gross indecency with another male person, shall be guilty of a misdemeanour, and shall be punished by imprisonment for a term of not more than two years, with or without hard labour. The law applies to both the active and the passive agent, if the latter be a consenting party.[1] This unnatural crime is, perhaps, more common than is supposed, but charges frequently break down before trial for want of lay or medical evidence. Attempt to commit the act is also a crime. Two men were tried at the Glasgow Circuit Court, Sept. 1877, on the charge of attempt. One pleaded guilty, and was sentenced to one year's imprisonment. Of the few cases in which we have made examination of the accused parties for this alleged crime, in one only was there evidence sufficient to justify the statement that the crime had been committed. The history of the case, briefly, was this :

Two young men, one of them married, lured a boy into a private place on some pretence, and while the married prisoner held the boy, the other prisoner unclothed the boy and committed the act. On examination of the boy, we found four recent linear lacerations of the anal mucous membrane radiating in an outward direction, with evidence of bleeding, which unmistakably pointed to forcible penetration of a foreign body and consequent distension. The men were convicted in August 1897, at the sitting of the High Court in Glasgow. A most remarkable case is recorded [2] in which a male masqueraded in female dress for several years of his life, playing the parts of an actress, and had been the passive partner in coitus *per anum*. The *anus* was found wider and larger than ordinary, its *introitus* was smooth instead of being puckered, indicating the use to which it had been put.

On the continent of Europe, if we may judge from the amount of attention the subject receives at the hands of medical jurists, this unnatural crime seems to be more common, at least is more detected, than in this country. Several cases are recorded by Tardieu, Casper, and others. But even in our own country the cases of R. *v.* Boulton and Park, tried before the Court of Queen's Bench, in 1871, and the still more recent case of Wilde, show that it exists also in populous centres, especially in shipping and garrison towns, where compulsory celibacy, by reason of occupation, prevails.

The lesions which ought to be looked for by the examiner are of the following character :—

(*a*) Recent lacerations of the mucous membrane of the anus ;
(*b*) Dilation of anus and absence of puckering of anal *introitus*, in habitual cases ;
(*c*) An infundibuliform-shape of the anal *introitus* ;
(*d*) The presence of old lacerations, as indicated by cicatrices.

But without condescending upon details, this unnatural crime may be committed in other ways which leave no such lesions behind them, and consequently in many cases the crime either goes undetected, or fails in being established for want of evidence. Where an offence is established, it is usually by the evidence of persons not medical.

[1] Hume, vol. i., p. 469 ; Brown, vol. ii., p. 671.
[2] *London Med. and Physical Jour.*, Feb. 1833, p. 186.

Of Bestiality little need be said, since in most of the cases the culprit is caught in the act, and therefore there is no need for medical opinion. Any evidence of a medical kind must either be supplementary to that of eye-witnesses, or be purely circumstantial. When of the latter form, it usually consists in finding upon the person of the accused evidences of contact with the animal, as hairs, etc., which correspond with those of the animal in question.

It is desirable to adduce only one illustrative case.

At the Circuit Court, Glasgow, Feb. 1909, a man was tried for bestiality with a mare in Kirkcudbrightshire. A pair of trousers which accused was wearing at time of apprehension, and an envelope containing hair cut from the hinder parts of the mare, duly labelled by the police, were transmitted to us for examination and report. Stains consisting of mammalian blood were found in the fork of the trousers, as also a hair, which on microscopic examination and measurement was found to be similar to the hairs in the envelope. Certain other whitish stains on the trousers were examined and some were found to contain squamous epithelium, others a leguminous starch. The hair in the envelope was found to be in adherent masses from a glutinous matter. Microscopic examination showed plentiful squamous epithelium but no entire spermatozoa. The alleged act was committed on December 26, and the hair had been kept dry from that time till date of examination, about a month later. The accused pled guilty and having been previously convicted of a similar crime, was sentenced to a long period of penal servitude.

It appears that when fluid from the neighbourhood of the genitals of the mare was examined at the time by a local medical man, spermatozoa were then found.

CHAPTER XV

DIFFERENTIAL DIAGNOSIS OF STATES OF INSENSIBILITY

THERE is no part of the work of the divisional surgeon of police, or of the medical practitioner who may be called by the police, more difficult than the diagnosis of the cause of insensibility of persons who are either brought to the police station or are found in the public streets in an unconscious condition. "Drunk or Dying" is a favourite headline of the morning newspaper, under which are recorded the facts of a case in which a man has been apprehended on the charge of being drunk and incapable, but who has been found to be suffering from fracture of the skull, or other causative factor of partial or complete unconsciousness.

From what causes may this condition of partial or total unconsciousness arise? It may be due to (*a*) Natural disease, as cerebral hæmorrhage, epilepsy, embolism of the brain, uræmia, or an ordinary attack of syncope; (*b*) Accident, producing fracture of the base of skull, or concussion of the brain; (*c*) The effects of poisons, such as opium, belladonna, or alcohol.

In order to ascertain the cause, the examiner will naturally inquire concerning the history of the case, and where such is obtainable, it is most helpful in many of them. But unfortunately it too often happens that there is no further history forthcoming than that the person was found unconscious. Under the latter circumstances, therefore, an opinion can only be arrived at by a process of exclusion, and by a careful balancing of all the evidence.

(A) Causes of Insensibility due to Disease.

We must therefore review, first of all, what are the characteristics of those states of insensibility which proceed from natural disease, and which are more or less rapid or sudden in their onset.

I. *Cerebral Hæmorrhage.*—The points to be noted are the following —viz.

(*a*) It generally occurs in persons above the age of forty; it must not be forgotten that fatal cerebral hæmorrhage may, however, occur in younger persons. Fatal cases in young women, aged 20 and 26 respectively, have been recorded.[1] It may also occur after protracted epileptiform convulsions in young persons.
(*b*) It more frequently happens in men than in women;
(*c*) Its onset may take place under any circumstances;
(*d*) The symptoms begin somewhat abruptly—the person may fall suddenly to the ground, or collapse in his seat if he be sitting—and unconsciousness, more or less complete, quickly supervenes;

[1] *B. M. J.*, vol. i., 1907, pp. 1580 and 1364.

(*e*) The symptoms comprise the following:—A pale or flushed face; stertorous breathing; the facial muscles will be drawn to one side, which is that opposite to the paralysed side; there is hemiplegia, usually; the pupils may vary in condition; they may be unequal, or they may both be abnormally contracted, where the cerebral hæmorrhage is extensive in area, or if it be situated in the *pons Varolii*; the temperature at first may be sub-normal, but later it rises above the normal.

With respect, however, to the age of onset, the examiner must be on his guard owing to the fact that in rare instances apoplexy may come on at an unusually early age; for example, a case is recorded [1] in which a lad of sixteen died from extensive cerebral hæmorrhage, and one in which a girl aged nine and a half years died from extensive cerebellar hæmorrhage.[2] Besides, it may supervene in a prolonged epileptic attack in those comparatively young.

II. *Epilepsy.*—Insensibility, lasting for a variable period, always succeeds the convulsive stage of an attack of epilepsy—*grand mal*—and it is generally profound while it lasts. Should the person be seen before the conclusion of the convulsive seizure, or should the information be obtainable from an intelligent eye-witness, the examiner will receive help in his diagnosis. The points in its natural history to be noted are these:

1. It occurs at all ages, and it is expressive of different causative conditions;
2. Immediately after the convulsive stage of attack the face and lips are more or less livid; there may be bloody froth at the mouth; the tongue may be found more or less severely lacerated from having been bitten, or cicatrices from former lesions may be found thereon;
3. The pupils are dilated during the convulsive stage and for some time thereafter;
4. The element of time will clear up the diagnosis, by the person gradually returning to consciousness, unless cerebral hæmorrhage has supervened.

The dilatation of the pupils is a valuable means of detecting the professional mendicant who trades upon the sympathies of unskilled onlookers by simulating a fit, for though he may imitate fairly closely the convulsive features of the attack, and even produce frothing at the mouth by a piece of soap artfully concealed between his cheek and gum, he cannot at will dilate his pupils when his eyelids are shut.

III. *Embolism of the Brain.*—This attacks also the young and old. A person apparently in good health, in making a little more than usual exertion, falls suddenly to the ground in a semi-unconscious state which may gradually deepen into almost total insensibility. The points to be noted are these:

1. Sudden onset of unconsciousness, at first not so marked as later;
2. In the young, a rough cardiac murmur—usually mitral—may be found on examination, indicating rheumatic endocarditis;
3. Hemiplegia of right side of body, because of blocking of left middle cerebral artery;
4. In the old, there will be evidence of atheromatous or calcareous degeneration of arterial coats, best seen and felt in temporal artery, and in the brachial artery at inner side of arm just above elbow.

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[1] *B. M. J.*, vol. i., 1896, p. 785.
[2] *Ibid.* vol. ii., 1903, p. 368.

IV. *Uræmia.*—This condition is most usually found in elderly persons, or those who have reached middle life. Points to be noted are as follow :—

1. Age of person ;
2. Evidence of anasarca, of œdema of feet, or puffy, relaxed, or pouchy appearance of skin of lower eyelids ;
3. Signs of enlargement of left heart, and thickening of internal coats of main arteries ;
4. *Pupils are much contracted* ;
5. Examination of urine will likely reveal the presence of albumen.

V. *Hysteric Coma.*—The manifestations of hysteria in women are most varied, and occur sometimes from the most trivial causes. The characters of an attack are these :

1. The woman throws herself to the ground, and her body is thrown into convulsive movements of a markedly *inco-ordinate* character, and foam often appears at the mouth ;
2. On the cessation of the convulsive stage, unconsciousness supervenes ;
3. According to Charcot—who denominates this hystero-epilepsy—the temperature during a fit rises only one or two degrees, while in real epilepsy it rises from five to six degrees ;
4. After a variable time consciousness returns, which may be expedited by gently compressing the nostrils between the finger and thumb and covering the mouth with the flat of the hand for about 30 seconds, so as to prevent respiration.

VI. *An ordinary Faint.*—This is comparatively common in crowded places of resort and in public places, and its appearances are so familiar and so evanescent that they need not be discussed. Syncope, however, in elderly persons is a much more serious affair, and is characterised, in addition to partial unconsciousness, by a weak, irregular, and almost imperceptible pulse. Such conditions should never be regarded lightly, especially in elderly persons, and prompt measures must be taken to stimulate the heart, and by postural treatment, to restore the function of the brain.

(B) Insensibility or Unconsciousness arising from Injuries.

I. *Fractures of the Skull, especially of the Base.*—The history of a case in this connection is all-important, but it is often awanting. Evidence of the presence of fracture will likely be found in the following particulars :—

1. The presence of marks of violence on the scalp, and depression of part of vault of skull ;
2. Complete unconsciousness ;
3. The presence of the following signs—viz. hæmorrhage into the orbit or conjunctiva, or free bleeding from the nose, where the fracture is situated in the *anterior* fossa ; bleeding or the escape of a serous fluid from one or other ear, from fracture of the petrous portion of the temporal bone, where the fracture of the base is in the *middle* fossa ; absence of the foregoing external signs, in fracture limited to the posterior fossa ; the only positive sign, when the fracture involves the *foramen magnum*, is extravasation of blood, into the posterior wall of the pharynx.
4. The condition of the pupils varies in different cases ;
5. The temperature is, at first, sub-normal.
6. There may, or may not be, hemiplegia.

II. *Concussion of the Brain.*—This condition also follows injury.

1. The patient is partially or completely unconscious. If the effects be due to pure concussion only, the patient will likely be able to be roused ; but if laceration of the brain substance and accompanying hæmorrhage be present, the coma will be profound ;
2. Symptoms of shock are present. The body is cold, face is pale, and the temperature is sub-normal ;
3. The pupils are usually contracted, but mobile.

The examiner must be careful to remember that injury may produce laceration of brain and hæmorrhage without any external lesion being found on the head, except upon careful and deliberate examination.

(C) Insensibility due to Poisoning.

I. *Opium.*—It depends at what stage of the case the person is found what the symptoms will be ; for example, shortly after the taking of the poison the patient may be roused ; later, however, that will be impossible, because of the profundity of the coma.

Symptoms are as follow :—

1. The patient is either somnolent but capable of being roused, or deeply comatose and unable to be roused ;
2. The pulse is either full and bounding, or slow and weak ;
3. The face is either flushed, or pale, and the lips livid ;
4. *The pupils are markedly contracted and immobile* ; indeed, the contraction may be to the size of a pin-head ; or one pupil only may be contracted, and the other irregular in shape or more or less normal in size, due to old eye-disease ;
5. The temperature, normal at first, becomes sub-normal in the later stages ;
6. The breath may, or may not, have the odour of opium, depending upon the preparation which has been taken.

II. *Belladonna.*—This form of poisoning is more rarely seen than that of opium or alcohol ; but its symptoms are fortunately characteristic. They are these :

1. The patient is more or less unconscious, but may at first be roused ;
2. *The pupils are widely dilated and immobile* ;
3. The face is flushed, the eyes appear staring, and they give the person a startled appearance ;
4. There is fussy, rambling muttering, or even more excited delirium, which, in odd cases, becomes almost maniacal ;
5. The utterance is thick and often inarticulate, because of the parched condition of the mucous membrane of mouth ;
6. The temperature continues normal until the further stages, when it becomes hyper-normal.

III. *Alcohol.*—Abuse of alcohol is probably the most common cause of coma in police practice ; " dead drunks " are comparatively common. The casual observer may erroneously conclude that alcohol is the cause of the unconsciousness from observing the odour of alcohol in the breath of the patient, while it is simply due to the fact that a sympathetic bystander has attempted to administer some stimulant to the unconscious person. Indeed, our experience is that a marked odour of alcohol from the person is rather an indication of a more serious cause of the unconsciousness than otherwise, because the odour of alcohol, as such, is not so often perceivable after an interval of time as is commonly

believed. This we affirm from fifteen years' observations. In 1876, the late Sir Benjamin Ward Richardson in his Cantor Lectures on "Alcohol" devoted himself to the consideration of points of difference in the diagnosis between alcoholic poisoning and apoplexy, and he affirmed, as a general distinction, that in the former the temperature was sub-normal, and in the latter it was hyper-normal. He therefore thought that the two conditions might be distinguished by thermometric observation. As a matter of fact, however, sub-normal temperatures are found in apoplexy (at first), and in opium poisoning, as well as in alcoholic poisoning. The temperature of alcoholic poisoning is well illustrated by a series of fifty cases taken as they came into the police station and recorded by Macewen.[1]

Temperature of Alcoholic Poisoning

Fifty Cases

Number of Observations		Temperature in Rectum
2	at	98·2°
14	from	97° to 97·9°
15	,,	96° to 96·9°
12	,,	95° to 95·9°
5	,,	94° to 94·9°
2	at	93·4°

We have found sub-normal temperatures constantly in "dead drunks," occasionally in cases of apoplexy, and, not infrequently, in cases of opium poisoning; hence we are bound to conclude that the thermometric test alone cannot be relied upon for diagnosis.

But the behaviour of the pupils, as shown by Macewen, and which has been confirmed by the author,[2] is a sign which can be relied upon. If we take up a series of authors who treat of this subject, we shall find that some[3] declare that the pupils are contracted in alcoholic poisoning, and others that they are dilated. Both are partly right and partly wrong, in respect that the pupillary condition depends upon whether the sufferer has been lying undisturbed or not for a time. If an alcoholic person, completely unconscious, be allowed to lie unmolested for half-an-hour, and his pupils be then examined, they will be found *contracted*, but if any external stimulation be applied to the body, such as moving the person, pulling the hair of the face, or slapping him, the pupils will be seen to gradually *dilate*, while he remains all the time completely comatose; then if he be allowed to lie quiet again for ten, fifteen, twenty, or thirty minutes—for the time differs in different cases—the pupils will be found to have returned to their originally contracted condition. It is this contraction and dilatation which is the characteristic pupillary condition of alcoholic cases, and, moreover, it is one which differs so much from those states of unconsciousness in which the pupils are contracted and fixed, or dilated and fixed, that it becomes a most valuable factor in diagnosis. Personally we have used

[1] *Glas. Med. Jour.*, Jan. 1879. [2] *The Lancet*, 1879.

[3] Woodman and Tidy, *op. cit.* p. 498; Guy and Ferrier, *op. cit.* 5th edit., p. 546.

this test from 1878, since it was indicated to us by Macewen, and we have not found it to fail in normal circumstances. The only conditions in which it does not respond are where from previous operation, or disease, the pupil has been altered in shape, or has become fixed from adhesions in iritis. *The Lancet*,[1] commenting upon the statements of Macewen, concluded by saying that "the test must have a larger trial before it can be finally accepted." That has been applied by the author during a police practice of some eighteen years, and has been found absolutely reliable, in cases of pure alcoholic coma. Our experience, however, includes several peculiar cases of combined causes, such as alcohol and apoplexy, alcohol and fracture of the skull, alcohol with epilepsy, and alcohol with uræmia, all of which disturbed the usual incidence of the pupillary phenomenon. A correspondence commenced in *The Lancet* in January 1879, in which various writers expressed their dissatisfaction with the statements of books on this subject,[2] and in which we took part. Hughlings Jackson[3] records a case in which a man, aged 21, was known to have imbibed "a vast quantity of intoxicating liquor." He was profoundly unconscious, and his pupils were contracted to the size of a pin's head. In this case it was observed that "pulling the ear and hair of the left side of face dilated both pupils, and that, at the same time, the face became flushed." In this connection the following references may be consulted:—

Med. Times, vol. ii., 1878, p. 630.—Observer—Dr George Johnson.
The Lancet, vol. i., 1868, p. 589.
B. and For. Med. Chir. Review, vol. ii., 1867, pp. 261-2.—Mitscherlich.
Ibid. p. 317.
Ranking's "abstract," vol. i., 1859, p. 35.—Richarz of Endernich.
Med. Times, vol. i., 1871, p. 360.—Hughlings Jackson.
Ibid. 1868, p. 498.
Ibid. vol. ii., 1860, p. 236.—Cooper Rose.

The examiner must also take note of any evidences of carbolic acid poisoning, which rapidly produces unconsciousness, because of its adoption as a favourite suicidal poison. (*Vide* Carbolic Acid.)

The main objects of an examination in cases of Insensibility are twofold: (1) to arrive at a diagnosis so that appropriate treatment may at once be employed; (2) to put the patient in the best conditions for recovery, by removal to an available hospital or other suitable place where the symptoms may be closely watched. In all cases of doubt, the latter course, when possible, is the best and safest for all concerned. The following particulars ought to be attended to in the examination of an unconscious person—viz. (*a*) Condition of pupils; (*b*) Age of the person; (*c*) Bodily Temperature; and (*d*) Progress of the Symptoms.

As a preliminary point in this examination, it is advisable to permit the sufferer to remain in perfect quiescence for at least a few minutes before examining the pupils.

A. The pupils may be found (*a*) normal, (*b*) both contracted, (*c*) both dilated, or (*d*) variable—that is, one contracted and the other dilated. It is important to note that the size of the pupil even in healthy sub-

[1] Vol. ii., 1878, p. 709.
[2] Gale, *The Lancet*, vol. i., 1879, p. 35.
[3] *Med. Times*, vol. i., 1876, p. 498.

jects varies; some have smaller pupils than others; consequently, contraction or dilatation is a comparative condition. Next, the mobility or immobility of the pupils to light should be noted. If the pupils are normal in size, note the presence or absence of conjunctival reflex, find if the person can be roused, and if partially so, what is the mental condition when roused.

I. If the pupils are contracted, then we know that the insensibility may arise from :

1. Concussion of brain ;
2. Opium poisoning ;
3. Alcoholic coma ;
4. Uræmia ;
5. Hæmorrhage into the *pons Varolii* ;
6. Physostigmin poisoning.

(A) Where the pupils are much contracted and immobile :

(*a*) Opium poisoning ;
(*b*) Hæmorrhage into *pons Varolii* ;
(*c*) Uræmia ;
(*d*) Physostigmin poisoning :—

(B) Where the pupils are contracted, but are mobile on stimulation of person :—

(*a*) Alcoholic poisoning.

II. If the pupils are widely dilated :

1. Belladonna or Atropin poisoning ;
2. Epilepsy (comatose stage) ;
3. Uræmia (late stages) ;
4. Cerebral Hæmorrhage ;
5. Impending asphyxia.

III. If one pupil is contracted and the other dilated (note whether any disease of eye is apparent) :

1. Fracture of Skull (localised) ;
2. Previous disease of eye (fixation of iris).

B. The Factor of Age may be of guiding value. As has been already indicated, apoplexy and uræmia are usually present only in persons in late adult life ; epilepsy and embolism or thrombosis of brain, at any age ; and poisoning by opium or belladonna, fractures of skull, or concussion of brain, also at any age. Apoplexy may be verified by the presence of hemiplegia, and the distorted appearance of the face ; uræmia, by the presence of limited dropsy, thickening of arteries, high tension pulse, and albumen in the urine ; epilepsy, by the bloody froth at mouth, or evidences of cicatrices on tongue ; embolism of brain in the young, by the presence of hemiplegia, and a rough mitral murmur. Injury to the skull or brain, or concussion of brain, may be suspected by the presence of evidence of injury on the scalp, which may not, however, amount to more than contusion, although there may be conjunctival ecchymoses, free bleeding from the nose, or from one ear.

C. Take the temperature of the body *per rectum*. This, while it may afford good evidence of the gravity of the case, will not of itself enable us to differentiate between causes.

D. The factor of time is very valuable. In some cases, prompt action must be taken, in others no harm will arise from delay, provided

the person, in the meantime, is being carefully watched in a room with a temperature of from 60° to 70° F. It is not bad practice in cases of doubt to wash out the stomach with the siphon-tube, because, while it will do no harm to the patient in any case, it may give early evidence of the use of poison by the odour of the washings. This element of time will, of itself, clear up a case of epileptic or hystero-epileptic seizure, many cases of concussion, and, also, of alcoholic coma. Where the pupillary conditions point to the likely use of opium, belladonna, or alcohol, the appropriate treatment is to freely wash out the stomach until the washings return clear and odourless, and, thereafter, in the case of opium, to keep the patient wakeful, and in the case of alcohol, to wrap him in blankets, and place him on a mattress before a good fire, in order to restore the animal heat and induce perspiration. For the further details of treatment of persons poisoned with these substances, we must refer the reader to the section of this book dealing with Toxicology.

In every case of doubtful or difficult diagnosis, the patient, we repeat, ought if possible to be removed to hospital, or be kept under close, unremitting, medical supervision; for, after all, there is no more perplexing duty than the differential diagnosis of these states of unconsciousness, as the following cases taken at random from our case-book will indicate:—

I. A. C., an elderly man, brought to the police station, was examined at 5.45 P.M. He was unconscious—did not respond to ordinary stimulation; pupils were contracted to size of pin's head, and were fixed; pulse 84; he was very cold and tremulous; temperature sub-normal. After some time, he was roused sufficiently to drink some hot tea, to which, ultimately, he was able to help himself, although he tended to lapse into somnolency. He remained lying in blankets in front of a fire, and for some hours could be easily roused. At 10 P.M. he again became unconscious; the pupils again became contracted; the breathing became stertorous and Cheyne-Stokes in character; and the pulse irregular and weak. By this time discoloration had developed over left cheek and left eye-lid, with slight swelling of upper right eyelid. On account of his weak condition, we remained beside him from 10.30 P.M. till 2.15. A.M. At 1.30 A.M. his urine was drawn off, and was found free from albumen. He remained unconscious till about 8 A.M., when consciousness partly returned. At 10.50 A.M., when he was shaken and spoken loudly to, and was asked if he were thirsty, he replied, "Yes, sir!" and took a drink. He again lapsed into unconsciousness, was sent to the Town's Hospital, where he died, never having regained consciousness. During the time he was conscious, he informed the police that he had come in from the country that afternoon with some weeks' wages in his pocket, that he met two men who invited him into a spirit-shop to have a drink, that he had porter, and that on coming out he began to feel "queer," and that he remembered nothing in the interval. His money was all gone. He was found in this insensible condition in a back close in a street not far from where he had the drink. The opinion we formed of his condition was that he had been drugged by opium, that this was succeeded by manifestations of uræmia, although no albumen was found in the urine, and that he ultimately died of apoplexy. No post-mortem examination was made.

II. H. D. *ætat* 38, insensible. On examination of eyes, the right was found atrophied and shrunken, while the left gave the alcoholic reaction. He was kept warm and watched. He recovered.

III. H. M. *ætat* 23, was examined at 7.10 P.M. She was completely unconscious. The pupils were moderately dilated and fixed. At 8.30 P.M. pupils were found contracted but to dilate on stimulation, again contracting after twelve minutes. This case was puzzling until her mother, who found her in the

police station, stated that she was an epileptic with a strong craving for drink, which she satisfied whenever she could. She was found in a back court. The combination of epilepsy and alcoholic coma accounts for the strange behaviour of the pupils.

IV. A. P. *ætat* 36, was brought to the station at 6 P.M., for breach of the peace. At 8 P.M. she was seen by the officer on duty to be quite right. At 10.20 P.M. she was found unconscious in her cell, and there was no response to stimulation. On examination, the pupils were found much contracted and immobile. She was evidently suffering from opium poisoning. Her clothing was minutely searched, but no phial or packet was found on her person. As her breathing was regular and the pulse good, instructions were given that she should simply be watched. As there was a protected fire burning in the cell, instructions were further given that the ashes should be carefully examined in the morning, which, on being done, revealed a half-ounce phial. She confessed that she had swallowed twopenny-worth of laudanum shortly after the officer had visited her cell at 8 P.M., and that she had thrown the phial in the fire thereafter.

V. J. H. *ætat* 42, was found insensible on the street. The right ear and right cheek were swollen and ecchymosed ; there was a contusion about 1½ inches in diameter in left temporal region, and blood was issuing from the left ear. The pupils were normal and sensitive to light. He was removed to hospital where he died next day.

VI. W. M. *ætat* 30, found in back court deeply comatose. Alcoholic pupils. Stomach washed out, gave odour of methylated spirit. He recovered. Confessed to being a confirmed methylated spirit drinker.

VII. VIII. IX. In each of these, one pupil was dilated to double the extent of the other, and in each case there was evidence of head injury by wound or contusions found upon scalp.

These cases, taken at random, indicate the problems which have to be dealt with, and the foregoing chapter is intended merely to be helpful to students in their diagnosis ; for all who have had any experience in dealing with such cases know the great difficulty, indeed, the impossibility, sometimes, of being able at once to arrive at a conclusion. Indeed the main object of the chapter is to warn the young practitioner against hasty diagnosis.

CHAPTER XVI

LUNACY IN ITS MEDICO-LEGAL ASPECTS

While the practitioner of medicine is not expected to be as familiar with the law of lunacy as the practitioner of law, it is necessary for his own intelligent and legal action that he should be familiar with those parts of it at least, by which his own relations to the person of unsound mind are regulated, and moreover, should have such a general knowledge of procedure that he may advise his clients in a general way how to initiate procedure. His relationships with the public will doubtless bring him sooner or later into close contact with cases of idiocy, of inebriety, or forms of lunacy or mental unsoundness, out of which he may be required : (1) to certify as to mental unsoundness ; (2) to pronounce an opinion regarding the testamentary capacity of persons ; (3) to pronounce an opinion as to the ability of a prisoner to give instructions to counsel for his defence or to plead to a given charge, by reason of mental unsoundness ; and (4) to certify in other contingencies, such as in the appointment of a curator to an estate, the holder of which is of unsound mind.

Before considering these, it will be necessary to discuss the law of the subject, in order that an intelligent conception of duty may be attained.

I. *Laws as to Lunacy in Great Britain and Ireland.*

A. England. The Acts of Parliament which deal with lunacy in England, are the following :—

39 & 40 Geo. III. cap. 94 (1880).
46 & 47 Vict. cap. 38 (1883).
47 & 48 Vict. cap. 64 (1884).
49 & 50 Vict. cap. 25 (1886—Idiots and Imbeciles Act).
53 & 54 Vict. cap. 5 (1890).

B. Ireland—

30 & 31 Vict. cap. 118.
38 & 39 Vict. cap. 67 (1875).
53 & 54 Vict. cap. 31 (1890).

C. Scotland—

20 & 21 Vict. cap. 71 (1857).
21 & 22 Vict. cap. 89 (1858).
25 & 26 Vict. cap. 54, sect. 14 (1862).
34 & 35 Vict. cap. 55 (1871).

D. Common to England, Scotland, and Ireland—

The Inebriates Acts.
42 & 43 Vict. cap. 19 (1879).
51 & 52 Vict. cap. 19 (1888).
61 & 62 Vict. cap. 60 (1898).

The three Acts to be construed together.

It will clear the ground if we dispose first of all of the Idiots Act (49 & 50 Vict. cap. 25), which, however, does not extend to Scotland or Ireland. An idiot or imbecile is one whose mental condition is defective only in a simple respect without active insanity, which defect has either existed from birth, or from a point of time shortly thereafter. If such a person is to be put under care, he must be placed in an institution which is registered for the purpose under the above Act. His reception must be accompanied by :

(1) A medical certificate which bears that the person therein named is an idiot, or an imbecile, from birth, or otherwise, and one who is capable of receiving benefit from the care of the institution into which he is to be received ; (2) a statement by the parent or guardian, or other person who is charged with the duties of such relationship, respecting his condition. No judicial order of any kind is required. After admission, the person may be retained in the institution, with consent of the Commissioners in Lunacy, until he has attained full legal age.

PROCEDURE IN ENGLAND RESPECTING LUNATICS

Procedure for the Detention of a Private Insane Person in an Asylum.

This is to be found in the Lunacy Acts of 1884 and 1890, with relation to England. The procedure depends upon certain circumstances—viz.

(*a*) Whether the person is living in family with his friends ;
(*b*) Whether the person is not under proper care or control ;
(*c*) Whether the person is being cruelly treated or neglected by his relatives or those in charge of him ;
(*d*) Whether the person is wandering at large.

(A) Procedure where the Person is living in Family with his Friends.

There are three ways in which his detention may be effected—viz.

(1) By Judicial Order on Petition ;
(2) By an Urgency Order ;
(3) By an Inquisition in Lunacy.

I. *By Judicial Order on Petition.*

The first is the mode most commonly adopted. This essentially consists in presenting to the proper judicial authority the following documents—viz.

I. A petition by the wife or husband, or parent, or other relative of the person named ; if by any other person than a near relative—where nearer relatives are living—then the reasons why it is presented by the signator and not by the nearer relative must be stated in the petition. The petition must contain all the particulars necessary—viz.

1. (*a*) Full name ; (*b*) age ; (*c*) occupation ; (*d*) postal address of petitioner ;
2. (*a*) Full name ; (*b*) address ; (*c*) occupation of insane person ;
3. Relation of signator to insane person ; or, if no relation, the reasons for signing petition ;
4. A declaration that signator is not related to, or connected with

either of the persons signing the certificates of lunacy, in the relationships of husband, father, father-in-law, son, son-in-law, brother, brother-in-law, partner or assistant; or, in the case of a female signator, in the opposite relationships.

5. An undertaking that petitioner will visit insane person by himself or herself, or by someone appointed for the purpose, once every six months while under charge.

"The proper Judicial Authority" for this purpose may be (*a*) a County Court Judge; (*b*) a Stipendiary Magistrate; (*c*) a Justice of the Peace "specially appointed" by his brother magistrates "for this purpose."

II. A Statement of Particulars with reference to the history and condition of the insane person; if the said insane person has already been received into an asylum under an urgency order, the date on which the order was presented must be given.

III. Two Medical Certificates.

In each certificate (*a*) the name, designation, and address of the person must be given; (*b*) a declaration that the signator is a registered medical practitioner; (*c*) the date upon which his examination was made, and the address at which it was made; (*d*) a statement of facts indicative of insanity observed by the signator at that examination; (*e*) similar facts observed by others, whose full description must be such that their identity may easily be established; (*f*) a statement of the bodily health of the insane person, with reference to fitness for removal; (*g*) a declaration that the signator has first read Section 317 of the Lunacy Act, 1890, before granting the certificate; (*h*) the date of signature, signature itself, and the address of the signator.

IV. The Reception Order, which is signed by the Judicial Authority, who, before signing, must—

(*a*) Be satisfied with the evidence in the medical certificates;

(*b*) Or, appoint a day within 7 days of the presentation of the petition for the consideration thereof; at which diet he may, however, adjourn consideration until some subsequent day, but within 14 days of the date of the presentation of the petition; or, he may

(*c*) Visit the alleged lunatic; or,

(*d*) May refer consideration of the petition to another Judicial Authority.

If the Reception Order be signed, then it is a sufficient Order to detain the patient in the place named in the Order, and to allow of such steps being taken as are necessary, in the way of constraint, for his removal to said place.

Should, however, the Judicial Authority be dissatisfied with the evidence of insanity and dismiss the petition, then the petitioner must, in order that procedure should begin *ab initio*—

1. Make out a new petition, stating in it that a previous petition had been dismissed, and the reasons for said dismissal; and
2. He must procure from the Lunacy Commissioners "a copy of the statements sent to them of the reasons for dismissing the previous petition," and send this with the new petition. Omission to do this is a misdemeanour according to section 7 subsection 4 of the Act.

II. *By Urgency Order.*

This method is adopted where, either for the welfare of the alleged lunatic, or for the public safety, it is expedient to place forthwith the insane person under care and treatment; or where the previous method is difficult to carry out. The Urgency Order must be signed by a near relative; it must be accompanied by a Statement of Particulars, and by one medical certificate. The Order may be signed before or after the medical certificate, and it may be made after or before a petition for such an Order is presented; if made *before*, the fact must be stated in the petition; if after the petition has been presented, a copy must be sent forthwith by the petitioner to the Judicial Authority. An urgency order remains in force for 7 days, or until the petition is finally disposed of. The qualified medical practitioner who signs the certificate must have examined the alleged insane person within two clear days before.

III. *By Inquisition.*

This method is had recourse to where there is difficulty anticipated in dealing with the property of the insane person. The original procedure by this mode was slow, cumbrous, and expensive; now, it is possible of achievement, by virtue of the Lunacy Act of 1890, by a much easier, more rapid, and less expensive process, as all the necessary powers for granting to any named person full control over the property of any lunatic or person of weak mind, either from disease or age, are vested in a Judge of Lunacy.

(B) Where the Person is not under Proper Care, or Control;

(C) Or is cruelly treated or neglected.

The duty of reporting such a case falls upon any constable, relieving officer, or overseer of any parish within 3 days of his knowledge of the fact of the person's insanity. The Report must be *made on oath* to a "justice of the peace," who is a "Judicial Authority" under the Act. The justice shall then direct two medical men to visit and examine the alleged lunatic; and otherwise shall proceed as if the information on oath were a petition for a Reception Order. Upon the certificates of the medical examiners being received by the Judicial Authority, he shall, if satisfied with the evidence of insanity, make an order for removal of the lunatic to a duly recognised institution.

(D) Where the lunatic is "wandering at large."

In this contingency, the like procedure to that in (**B**) and (**C**) is followed.

The following general remarks are applicable to the foregoing:—Should the relatives, after the detention of the insane person in a given institution, desire his removal from that institution to their own keeping, or to another institution, the following are the steps necessary to be taken—viz.

1. To apply to the visitors of the asylum in which the patient is residing, for permission to take the patient under their own charge;
2. To apply to the Commissioners in Lunacy for consent to remove the patient to the other institution named by them.

Or the relatives may, if they appear at the inquisition of lunacy

held by the Judicial Authority, receive an Order from said authority to have the patient placed under their own care.

Differences in Procedure between Pauper and Non-Pauper Lunatics.

The procedure in the law of England in obtaining the detention of a pauper patient differs in certain points which must now be mentioned, which, for convenience of comparison, are put in parallel columns.

Pauper Patient	Non-Pauper Patient
1. Proceedings are initiated by a relieving officer, or overseer of a parish, by notice to a Justice of the Peace.	1. By relatives, by petition to a Justice of the Peace, who is a "Judicial Authority" in terms of the Act.
2. The Justice may cause the patient to be brought before him, or he may visit the patient, but he *must* examine the patient personally.	2. The Justice cannot cause the patient to be brought before him, but may visit him. He is not required to examine him personally.
3. One medical certificate only is needed, given by a qualified medical man named by the Justice for this purpose.	3. Two medical certificates are required, given by medical men called by the relatives or friends of the patient.
4. The execution of the Reception Order may be suspended for 14 days by the Justice, and, upon a medical certificate of the unfitness of the patient for removal, for any indefinite time.	4. The Reception Order remains in force for 7 days only; if the patient be not taken into the asylum within that period, it becomes *invalid*.

Voluntary Patients

Persons may voluntarily desire their own retention in an Institution to protect themselves against the risk of an attack of mental illness, which they feel or may think, is impending. In such cases, they must apply to the Commissioners in Lunacy, or to two Justices, for permission to enter an asylum which is named, as a voluntary patient.

PROCEDURE IN SCOTLAND

The Acts which regulate procedure in lunacy in Scotland are (*a*) 20 & 21 Vict. cap. 71 (1857), entitled "An Act for the Regulation of the Care and Treatment of Lunatics, and for the Provision, Maintenance, and Regulation of Lunatic Asylums in Scotland"; (*b*) 21 & 22 Vict. cap. 89 (1858), entitled "An Act regulating the Reception, etc., of Pauper Lunatics in Poorhouses"; (*c*) 25 & 26 Vict. cap. 54 (1862), entitled "An Act to make further Provision respecting Lunacy in Scotland"; and (*d*) 34 & 35 Vict. cap. 55 (1871), entitled "The Criminal and Dangerous Lunatics (Scotland) Amendment Act, 1871."

It is necessary that the practitioner should be acquainted with the main provisions of these Acts, and in particular of 20 & 21 Vict. cap. 71 (1857), and 25 & 26 Vict. cap. 54 (1862), which may be called the Lunacy Act of 1857 and the Lunacy Act of 1862 respectively. Of these the following provisions of the Act of 1857 may be briefly cited:—

Section 4 deals with the constitution of the Board of Lunacy; s. 9 with the powers of the Lunacy Commissioners; s. 10 places all public asylums under the Act; s. 11 gives power to Commissioners to

institute inquiries, summon witnesses, and examine these on oath; s. 17 defines the duties of Commissioners to visit lunatics in prisons, poor-houses, etc.; s. 21 gives power to the Secretary of State to appoint one or two medical persons to be deputy Commissioners; s. 24 ordains that the Board shall cease five years after passing of the Act, the Commissioners thereafter to be Inspectors in General of Lunacy; s. 25 gives power to the Sheriff to visit and inspect asylums, and s. 26 gives like powers to Justices of the Peace; s. 27 enacts that private asylums are to be licensed by the Board; [s. 34 empowers a Sheriff to grant orders for reception of lunatics into asylums on medical certificates, etc., but this section was repealed by s. 14 of the Act of 1862]; s. 35 ordains that medical certificates of lunacy are to specify the facts on which an opinion of insanity has been formed. We quote this section. "Every medical person signing any certificate under or for the purposes of this Act shall specify therein the facts upon which he has formed his opinion that the person to whom such certificate relates is an insane person, an idiot, or a person of unsound mind, and distinguish in such certificate facts observed by himself from facts communicated to him by others; and no person shall be received into any asylum or house in terms of this Act under any certificate which purports to be founded only upon facts communicated by others."

Section 36 gives power to amend said orders and medical certificates; s. 37 enacts that copies of orders, medical certificates, etc., are to be transmitted by superintendents of asylums to the Board; s. 38 ordains that no medical certificate shall be granted without examination. The following are the words of the section:—"If any person shall grant any such certificate or statement as aforesaid without having seen and carefully examined the person to whom it relates, at the time and in the manner specified in such certificate, with a view to ascertain the condition of such person to the best of his knowledge and power, he shall be guilty of an offence, and shall for every such offence be liable to a penalty not exceeding fifty pounds; and if any person shall wilfully and falsely grant any such certificate to the effect of any person being a lunatic, the person so granting such certificate shall be guilty of an offence, and for every such offence be liable in a penalty not exceeding three hundred pounds, or be liable to imprisonment for any period not exceeding twelve months."

Section 39 provides penalties for receiving patients in unlicensed houses; s. 41 gives power to commit under care any person for the purpose of temporary residence only, not exceeding six months, under certificate of a medical person, whose certificate shall be in the form of Schedule G annexed to the Act. The following is the form of certificate laid down in Schedule G:—"I, *A. B.*, a medical person duly qualified in terms of the Act, 20 & 21 Vict. cap. 71, certify, on soul and conscience, that *C. D.* [*name and design the patient*] is afflicted [*state the nature of the disease*], but that the malady is not confirmed, and that I consider it expedient, with a view to his recovery, that he should be placed [*specify the house in which the patient is to be kept*] for a temporary residence of [*specify a time not exceeding six months*]."

Section 43 gives power to the Board to order the examination of lunatics in private houses; s. 45 ordains that a medical person shall be

resident in every asylum licensed for 100 patients or over, and regulates the frequency of medical visitation in asylums of not less than 100 patients; s. 47 gives facilities, subject to the regulations in force in asylums, to ministers of religion and friends of patients to visit patients, and s. 48 empowers the Board to grant orders for access to patients; s. 71 enacts that it shall not be competent to any person not qualified in terms of this Act as a medical person to practise or to be employed or to grant any certificate under the provisions of this Act; "*nor shall it be competent to any medical person who shall have any pecuniary or patrimonial interest or concern with or in any asylum or house in terms of this Act, or any copartnership or participation of profits with any superintendent of any such asylum or house, or whose father, brother, or son shall be superintendent of any such asylum or house, to practise or to be employed, or to grant any certificate under the provisions of this Act,*" under a penalty not exceeding fifty pounds, or to be imprisoned for any period not exceeding three months; "*provided always, that any medical person may practise, be employed, or grant certificates under this Act in or with reference to any asylum or house not being an asylum or house in or with which such person or his father, brother, or son is so interested or connected as aforesaid: provided also that nothing in this enactment contained shall prevent the medical officer of a district asylum from granting certificates with reference to any lunatics of the district to which such asylum belongs.*"

Section 81 deals with the appointment of judicial factors on estates of lunatics; [s. 85 empowers the Sheriff to commit dangerous lunatics, but this section is repealed by section 15 of the Act of 1862]; s. 87 make provisions for procedure in cases in which insanity stands in bar of trial, and s. 88 for cases of lunatics acquitted of a criminal charge on the ground of insanity; s. 92 deals with the liberation of a lunatic by relations or others from an asylum. "It shall be lawful for any person, having procured and produced the certificate of two medical persons approved by the Sheriff of the recovery of any lunatic, or bearing that such lunatic may without risk of injury to the public or to the lunatic be set at large, and also an order from the Sheriff for the liberation of the lunatic, to require the superintendent of the asylum in which such lunatic is to liberate such lunatic, and such lunatic shall be liberated accordingly; and it shall in like manner be lawful for the Board upon being satisfied by the certificate of two medical persons whom they think fit to consult of the recovery or sanity of any person confined as a lunatic, to order the liberation of such person; and, previous to the liberation of any such person by order of the Board or Sheriff, eight days' notice in writing shall be given of such intended liberation to the person at whose instance such lunatic was detained, or in the absence of such person, to the nearest known relative of such lunatic, and in the case of a pauper lunatic, to the party or parish by whom the expense of maintenance of the lunatic was defrayed."

Section 99 deals with the punishment to be inflicted on asylum officials and attendants for mal-treatment of any lunatic.

The Lunacy Act of 1862 having repealed two sections of the Act of 1857, these shall now be noted in the first instance. Section 14 repeals section 34 of the 1857 Act. It reads as follows:—"The Sheriff of any

county in Scotland may grant an Order for the reception into and detention in any asylum, lunatic ward of a poorhouse, or house as before provided, of any lunatic, if such lunatic be resident or be found within such county, or if the asylum, lunatic ward, or house mentioned in such Order be situate within such county; but no such Order shall be granted unless upon a Petition subscribed by the party applying for the same, accompanied by a Statement of Particulars in the form of Schedule (C) to the Act 20 & 21 Vict. cap. 71, annexed, and setting forth the degree of relationship or other capacity in which the petitioner stands to such lunatic, and also accompanied by Certificates in the form of Schedule (D) annexed to said Act, bearing date within fourteen clear days next preceding the date of Petition, under the hands of two medical persons having no immediate or pecuniary interest in the asylum in which the lunatic shall be placed, but one of whom may notwithstanding be the Medical Superintendent or consulting or assistant physician of such asylum; and such orders shall be in the form of Schedule (E) to the said Act annexed; and no superintendent of any such public, private, or district asylum or house shall receive or detain any person as a lunatic therein unless there shall be produced to and left with such superintendent such Order by the Sheriff dated within fourteen clear days prior to the reception of such lunatic, or if such Order be granted by the Sheriff of Orkney and Shetland within twenty-one clear days prior thereto; provided that the superintendent of any public, private, or district asylum may receive, and detain therein, for any period not exceeding three days and without any Order by the Sheriff, any person as a lunatic, whose case is duly certified to be one of emergency by one medical qualified person as aforesaid." This Act defines a "medical person" as any person registered as a practitioner in medicine and surgery, pursuant to the Act 21 & 22 Vict. cap. 90. Section 15 repeals section 85 of the Act of 1857. It reads as follows:—"When any lunatic shall have been apprehended, charged with assault or other offence inferring danger to the lieges, or when any lunatic shall be found in a state threatening danger to the lieges or in a state offensive to public decency, it shall be lawful for the Sheriff of the County in which such lunatic may have been apprehended or found, upon application by the Procurator-fiscal or inspector of poor or other person, accompanied by a certificate from a medical person bearing that the lunatic is in a state threatening such danger or in a state offensive or threatening to be offensive to public decency, forthwith to commit such lunatic to some place of safe custody; and the Sheriff shall thereupon direct notice to be given in some newspaper circulated in the county within which such lunatic was apprehended or found, of such commitment, and that it is intended to inquire into the condition of such lunatic on an early day to be named, and shall also direct notice of the application to be given to the inspector of poor of the parish within which the lunatic has been apprehended or found (where the application is not presented by the inspector of poor of such parish), and such further notice as he shall think fit; and if the inspector of the parish does not within twenty-four hours undertake to the satisfaction of the Sheriff to make due arrangements for the safe custody of such lunatic, the Sheriff shall accordingly proceed to take evidence of the condition of such lunatic,

and upon being satisfied that he is a lunatic and in a state threatening danger to the lieges or offensive to public decency, he shall commit the lunatic to an asylum; and an Order authorising the superintendent of the asylum to which the lunatic may be committed to receive the lunatic, and authorising the transmission of the lunatic to such asylum, shall be granted by the Sheriff in respect of every such commitment; and such lunatic shall be detained in such asylum until cured or until caution shall be found for his safe custody, in which last case it shall be lawful for the Sheriff upon application to that effect and on being satisfied as to such caution and the safety and propriety of such custody, to authorise the delivery of the lunatic to the person so finding security." The remainder of the section deals with the question of expenses and to whom chargeable.

Among the other sections of this Act, other than those which deal with criminal lunatics, the following deserve mention :—section 6 makes provision for allowing persons to enter asylums voluntarily. If any person desirous of entering an asylum shall make a declaration to that effect before the Sheriff of the County in which the asylum is situate, and shall produce to the Sheriff a certificate by a medical person that his reception into and treatment in such asylum or house would be beneficial to his case, and a written consent by the superintendent of such asylum or house to receive him, it shall be lawful for such Sheriff to grant an Order for his reception into such asylum or house, which shall be a sufficient warrant to such superintendent to receive him and to subject him to the rules and regulations of such asylum or house. Section 16 provides that on application of the person at whose instance a lunatic is detained in an asylum, the Board may authorise his removal or liberation on probation without an Order of the Sheriff; and section 17 enacts that the superintendent of any asylum or house shall give intimation of the recovery of a lunatic to the person at whose instance such lunatic is detained, or in the absence of such person to the nearest known relative, and in the case of a pauper lunatic to the person or parish by whom the expenses of his maintenance is defrayed. If after fourteen days from the despatch of said intimation the person to whom such intimation was transmitted does not take steps for the liberation of said lunatic, the superintendent shall intimate the facts to the Board, who may direct inquiry into the circumstances, and if satisfied that the lunatic has recovered or may safely be liberated without risk or injury to the public or himself, may order his discharge forthwith.

The 21 & 22 Vict. cap. 89, otherwise the Lunacy Act of 1858, was a short Act amending the Act of 1857 with respect to the reception, etc., of pauper lunatics in poorhouses.

The schedule which is in use under the Act of 1857 for taking the necessary steps for the detention in an asylum, and which, moreover, remains in the keeping of the superintendent of the asylum after the order for detention has been granted by the Sheriff, consists of the following distinct parts—viz.

I. The Petition to the Sheriff or his Substitute by the near relative of the alleged insane person, for authorisation to convey the alleged person to a given asylum, the date of which Petition must be within 14 clear days following the dates of the medical certificates.

II. The Statement of Particulars regarding the patient, which must be signed by the petitioner :

SCHEDULE C. Lunacy Act, 1857.—*Statement of Particulars*

Form of Statement to be lodged with a Petition to the Sheriff for the Reception of a Lunatic

1. Christian name and surname of patient at length.
2. Sex and age.
3. Married, single, or widowed.
4. Condition of life, and previous occupation (if any).
5. Religious persuasion, so far as known.
6. Previous place of abode.
7. Place where found and examined.
8. Length of time insane.
9. Whether first attack.
10. Age (if known) on first attack.
11. When and where previously under examination and treatment.
12. Duration of existing attack.
13. Supposed cause.
14. Whether subject to epilepsy.
15. Whether suicidal.
16. Whether dangerous to others.
17. Parish or union to which the lunatic (if a pauper) is chargeable.
18. Christian name and surname and place of abode of nearest known relative of the patient, and degree of relationship (if known), and whether any member of his family known to be or to have been insane.
19. Secial circumstances (if any) preventing the insertion of any of the pabove Particulars.

I certify that to the best of my knowledge the above particulars are correctly stated.

Dated this day of One thousand nine hundred and .

[*Signature of Person applying.*]

III. and IV. Medical Certificate (No. 1), and Medical Certificate (No. 2), which must bear the following statements :—

(*a*) Declaration of the name, medical qualifications, and address of the signator, and of the fact that he is in actual practice ;

(*b*) Certification on *soul* and *conscience* that the signator on the date and at the place given, personally and separately from any other medical practitioner, examined the person named in the certificate, and that he is of opinion that the person named is of unsound mind and ought to be detained under care and treatment ;

(*c*) A statement of the facts indicative of insanity which the signator himself has observed in the patient ;

(*d*) Other facts indicative of insanity which have been communicated to the signator by others, whose names, designations, and addresses are fully given, so that their identity may be easily established ;

(*e*) The signature, medical qualifications, and address of the signator, and date of signature.

SCHEDULE D. Lunacy Act, 1857.—*Form of Medical Certificate*

I, the undersigned [*here set forth the medical qualifications entitling the reason certifying to grant the certificate*], and being in actual practice as a

[*physician, surgeon, or otherwise as the case may be*] do hereby certify on soul and conscience that I have this day at [*here insert particulars as to place*] in the County of separately from any other medical practitioner, visited and personally examined *A. B.* [*here insert designation and residence, and if a pauper state so*], and that the said *A. B.* is a lunatic [*or an insane person, or an idiot, or a person of unsound mind*], and a proper person to be detained under care and treatment, and that I have formed this opinion upon the following grounds—viz.

1. Facts indicating insanity by myself [*here state the facts*].
2. Other facts (if any) indicating insanity communicated to me by others [*state the information and from whom*].

(Signed) [*Name and medical designation and place of abode*].

Dated this day of One thousand nine hundred and .

The Certificate of Emergency which is found accompanying the other documents is not a scheduled certificate, but its terms are as follow :—

CERTIFICATE OF EMERGENCY

I, the undersigned [*here set forth full name of certifier*], being [*here set forth the qualifications of the certifier*] hereby certify on soul and conscience that I have this day at [*here set forth particulars as to place of examination*] in the County of , seen and personally examined [*here designate the patient and his residence*] and that the said person is of unsound mind and a proper patient to be placed in an asylum.

And I further certify that the case of the said person is one of Emergency.

[*Signature.*]

Dated this day of One thousand nine hundred and .

It will be obvious to the reader that the certificate of emergency may only be filled after one ordinary certificate of insanity has been duly filled.

V. The Order of the Sheriff for transmission and reception of the lunatic, in which that Judicial Authority sets forth,

1. His name and judicial office ;
2. The fact that a petition and medical certificates have been produced to him which state that the alleged lunatic is of unsound mind, and that he ought to be detained in an asylum ;
3. Order for detention of the person named ;
4. Date ; and signature of Sheriff.

This order is addressed to the superintendent of the asylum, named in the order, in which the person is to be detained under care and treatment.

In Scotland, the alleged lunatic, in cases where there are risks to his own safety, or to that of the public, may be committed upon *one* medical certificate—the Certificate of Emergency as it is termed—which authorises the detention of a patient in an asylum for a period not exceeding 3 days without an order from the Sheriff. (*Vide ante.*)

The procedure in pauper and non-pauper cases is essentially the same, except that in the former it is initiated by the poor-law authorities. In the case of a lunatic "wandering at large," the Procurator-fiscal initiates the procedure for his detention by instituting an inquisition in lunacy before the Sheriff, and the lunatic is committed upon the certificates of two medical practitioners who have been named by the Sheriff on petition of the Fiscal. (*Vide* p. 481, sections 35, 36, 37, 38.)

Incipient and Unconfirmed Insanity.—The law with respect to the

keeping in private unregistered places of persons suffering from incipient, ill-defined, and unconfirmed insanity, differs materially in Scotland from that of England. In England, no one can take charge of any alleged lunatic or person of unsound mind except by virtue of an order by a Judicial Authority. By section 315 of the English Act of 1890, anyone who does this without an Order shall be deemed guilty of a misdemeanour, and is liable to a penalty not exceeding £50. This would seem to include such persons as hysterical women, drunkards, eccentrics, and other persons on the borderland of insanity. In Scotland, on the other hand, by section 41 of the 20 & 21 Vict. cap. 71, such persons may be put under care in private houses. (*Vide* p. 479.)

In March 1899, a deputation of English alienists waited upon the Lord Chancellor to state the hardships of this part of the English law, particularly as several harassing prosecutions had been made against medical practitioners who kept one or more "queer" persons as boarders. The Lord Chancellor said that he was entirely in sympathy with the clauses of the Scots Act, although he thought the period of six months named therein to be too long. In respect of cases of non-confirmed insanity, he was quite with them as to their suggested alteration of the law, and he would try to give effect to their suggestions. Section 315 of the English Act which controls the keeping of cases of unconfirmed insanity reads as follows :—

"(1) Every person who, except under the provisions of this Act, receives or detains a lunatic, or alleged lunatic, in an institution for lunatics, or for payment takes charge of, receives to board or lodge, or detains a lunatic, or alleged lunatic, in an unlicensed house, shall be guilty of a misdemeanour, etc. (2) Except under the provisions of this Act it shall not be lawful for any person to receive or detain two or more lunatics in any house unless the house be an institution for lunatics or a workhouse. (3) Any person who receives or detains two or more lunatics in any house, except as aforesaid, shall be guilty of a misdemeanour."

From this section, as it stands, no person—medical or other—is entitled to keep for payment any lunatic or alleged lunatic. Therefore, medical practitioners who do this, do it at the risk of prosecution, of which several cases that have already occurred may be cited. Possibly the outstanding case is that of R. *v.* Reichardt,[1] in which the defendant—a medical man—was charged with contravening the above section of the Act, inasmuch as he had kept under his care and treatment a lady who had formerly attempted to commit suicide by poison, and who, moreover, while in Dr Reichardt's care, escaped from a window and deliberately drowned herself. This was a warning case, and a verdict was returned for the defendant. In another case, the prosecution obtained a verdict against a male nurse who was taking care of a young man who was said to be of unsound mind ;[2] and in a third case a medical man was likewise charged on three actions of the same kind, and had to pay £10, 10s. toward the cost of the first action, and the court fees of the others, which were withdrawn.[3]

[1] *B. M. J.*, vol. i., 1899, Jan. 14.
[2] *Ibid.* vol. ii., 1898, Dec. 17.
[3] *Ibid.* vol. i., 1900, p. 1322.

PROCEDURE IN IRELAND

This is regulated by similar provisions to those of England, although laid down in different Acts of Parliament, and consequently, it need not be detailed further.

MEDICAL CERTIFICATES OF LUNACY

From what has preceded, it will be obvious that the medical certificate plays the most important part in a petition for the detention of an idiot or an imbecile, or of a lunatic or person of unsound mind; indeed, without it, a successful petition, as the law stands, would be impossible; it is, in short, the pivot upon which the whole process turns. Since, then, the power of committing to an asylum a person alleged to be insane rests in the hands of the medical practitioner, it behoves each member of the profession not only to make himself conversant with the signs and symptoms of insanity and other allied mental conditions, but also to exercise this duty in the most conscientious and painstaking manner. From the absence of the appearance of sufficient care in certification, medical men have had law-suits brought against them, and, in some cases, have been cast heavily in damages where the plea of wrongous committal on the strength of certificates given by them has been attempted or made. It is only necessary to give two cases to illustrate the risks to which members of the medical profession were exposed before the passing of the Act of 1890—viz.

(1) Weldon *v.* Semple, 1878; and (2) Mrs X. *v.* Drs Whittle and Hutchinson, and Mr Mould, 1884.[1] Since in both of these the mode of certification and the relevancy of the certificates were in question, they will serve as illustrations of points to be discussed in the text.

The facts of Weldon *v.* Semple are, briefly, these :[2] Mr Weldon, husband of the plaintiff, in 1878, called on Dr Forbes Winslow to consult him regarding the mental condition of his wife. From statements made by him, Dr Winslow was of opinion that an inquiry ought to be made, and if Mrs Weldon were found insane, that she might be confined in his private asylum. Mr Weldon was himself unable to sign the order of committal owing to the fact that he had not seen his wife within the legal period—in fact, had not seen her for three years. Sir H. de Bathe did so, however, having called on Mrs Weldon within the required period. Dr Winslow thereupon asked Drs Semple and Rudderforth, friends of his, to visit the plaintiff (which they did on April 14 of that year, at her residence, the property of her husband), and to examine the lady respecting her mental condition. Accordingly, together, these gentlemen paid the visit—first, making a joint examination, and then a separate examination, the one leaving the room while the other examined alone. The interval of absence during the separate examinations, they averred, was at least a quarter of an hour, while the plaintiff swore that it was not more than five minutes. The result of this examination was that they signed certificates of lunacy. On the strength of these and of the order for committal, Dr Winslow's secretary, with nurses, came to her house to remove her to the asylum, but was frustrated by friends of the plaintiff. Mrs Weldon then took to a place of hiding for a month, during which time only the order of committal remained in force. In 1885, she raised an action against Dr Semple for false certification of insanity and for trespass, and asked damages to the extent of £1000. The case was tried in July

[1] *B. M. J.*, vol. ii., 1884, p. 392.
[2] Paper by Author, *Glasg. Med. Jour.*, Sept. 1886.

of that year before Mr Justice Hawkins and a jury, and the trial lasted several days. Mrs Weldon conducted her own case, and did so with considerable ability. The defendant in the witness-box swore that what he did was done honestly, without malice or malicious motives of any kind, and that in signing the certificate he believed her to be insane. The jury, however, returned a verdict for the plaintiff, and awarded for false certification damages of £1000, and for trespass further damages of £20.

(2) The other case was an action for libel and conspiracy against Drs Whittle and Hutchinson, practitioners in Liverpool, and Mr Mould, of the Royal Lunatic Hospital, Cheadle, Manchester; against the former for having signed certificates of lunacy of the plaintiff, and against the latter for having received her into the asylum on the strength of these certificates. The action was tried before Mr Justice Cave and a special jury, and occupied five days in hearing. The following is a brief history of the plaintiff. After the death of her first husband, her children were in 1874, by reason of her drinking habits, removed from her care by an order of the Court of Chancery, she being held unfit to take charge of them (as trustee under her first husband's will). In 1877, she was confined in an asylum, and was there for three years. During this period, it being considered improbable that she would recover, a petition was presented to the Lord Chancellor for an inquisition, which being held, resulted in her being found insane, and a committee was appointed on her estate. In 1880, she was liberated from the asylum on probation. After her liberation, one of the defendants with another practitioner certified that she was then sane, and the finding of the inquisition was set aside. Soon after this, however, symptoms of insanity of a glaring character presented themselves, and she was certified by the defendants in the above action as being insane, and was received into Cheadle Asylum on the strength of these certificates. These certificates were rejected, however, by the Commissioners in Lunacy as being too weak, and she was discharged, but was again committed on fresh certificates granted by two Manchester practitioners. Mr Justice Cave ruled that the defendant, Mr Mould, must be excluded on the ground of privilege, and although he summed up strongly in favour of the other defendants, it took the jury two hours to find a verdict accordingly.

What does the law demand of the medical practitioner who signs a certificate of lunacy?

I. In England:

A. (*a*) He must not be related to the petitioner (where petitioner is a man) as father, father-in-law, son, son-in-law, brother, or brother-in-law.

(*b*) He must not be a partner or assistant of the other signator;

(*c*) He must not be the person under whose charge the alleged lunatic is to be placed; nor can he be the usual medical attendant of an insane person in a "single-patient" house, if he has signed the medical certificate upon which the Reception Order or Urgency Order is based.

(*d*) He must not be a person who is interested in the payments on account of the patient, or in the profits of the institution in which the alleged lunatic is to be placed.

B. (*a*) The examination upon which the certificate is founded must be made within a period of *seven clear days before the presentation of the petition*; or within *two clear days, where an Urgency Order is used*;

(*b*) It must be made "separately from any other practitioner";

C. (*a*) The terms of the certificate must be definite and clearly expressed, and it must contain sufficient evidence of the insanity of the person named in it as will be convincing to any average intelligent individual.

(*b*) One of the certificates ought to be given by the usual medical attendant of the alleged insane person, or, if not, the reason why should be stated ;

(*c*) That before granting the certificate in England the signator has read over section 317 of the Lunacy Act of 1890.

Presumably with the object of answering the " separate " examination above referred to, the blank schedules of certificates are printed on two separate forms.

In Scotland, however, both are on the same schedule.

II. In Scotland :

A. (*a*) He must not be related to the superintendent of the asylum or house into which a patient is to be placed, as son, brother, or father. (20 & 21 Vict. cap. 71, s. 71.)

(*b*) He must not have any pecuniary or patrimonial interest or concern with or in the asylum or house into which a patient certified by him is to be placed, nor have any copartnership or participation of profits with the superintendent of any such asylum or house. (s. 71.)

B. (*a*) He must examine a patient before granting a medical certificate of his lunacy within 14 days preceding date of petition to Sheriff (s. 38) ; and, according to the Schedule of the Act, he must be in actual practice.

(*b*) His certificate must bear that on a date and at a place named he personally and separately from any other medical practitioner examined the person named in the certificate.

C. The certificate must specify the facts on which an opinion of insanity has been formed, (*a*) as ascertained by himself from examination of the lunatic, and (*b*) as ascertained from others.

What is meant in law by an examination made " separately from any other practitioner " ?

Obviously, the intention of the Legislature is that the statements made by the certifiers, as they have the force of statements made upon oath, shall have all the cumulative force of concurrent testimony by each examiner separately noting facts in the person examined which are indicative of unsound mind. Mr Justice Hawkins in Weldon *v.* Semple, although he was speaking before the current Act of 1890, which, however, in no wise differs in this respect from the previous Act, said on this point, that the object of the statute was that the medical men should be independent and that they should make separate examinations ; and speaking of the facts of that case he added : " The statute requires separate examinations by the medical men, and [here] they both go together—as gross an evasion of the Act as could be conceived " ; and, again in his summing up : " anything more calculated to excite suspicion could not be supposed than both the doctors meeting and going together " ; in short, he made it clear that, in his view, the defendant had not made a separate examination as required by law. It may therefore be concluded that the absence of, or the semblance of the absence of, a separate examination by the medical certifiers would not only vitiate their certificates, but would render them liable to an action of damages for false certification. It is, at the same time, a common practice, dictated by prudence and expediency alike, for the

medical attendant to call to his aid in such cases a specialist in mental diseases, and for both to meet at the house of the patient; and it is obvious, that in order that the consultant should properly apprehend the case, the previous history and present condition of the patient should be fully explained to him before he examines the patient. According to the above ruling, it might be held to be unstatutory that both of these should sign certificates under such circumstances. Therefore it would be a safer course to pursue were the consultant first separately to examine the patient, and the usual medical attendant to do so later on the same day or on the following day. Such a procedure would not only conform to the spirit and letter of the law, but it would, at the same time, give both the patient and the family attendant more unequivocally the benefit of the special knowledge of the consultant. If medical men proceeded to the duty of lunacy certification with a clear conception of the importance of the act they were about to perform, their *bona fides* would seldom be questioned, as the absence of it would seldom be apparent.

But the certificate must be definite and sufficient as to its terms. The certificate is a legal document, and in it must be embodied the identity of the signator and also, it may be, of other persons; therefore careful attention must be paid in this regard, because technical error arising from want of identity will invalidate a certificate. For example, if the signator omitted to give the necessary identity of the persons who have provided him with the "other facts observed by others" such a certificate would be null and void, since upon the facts so given him he has partly established his opinion of the insanity of the person named in the certificate.

Probably there is no more common fault in such certificates than imperfectly- or improperly-expressed data upon which the insanity of the person is determined, or from which it may be deduced. The certifier ought always to bear in mind that it is not enough that he himself is convinced of the insanity of the person, but that he should put down such facts as he has observed of the insanity or unsoundness of mind of the person named in the certificate in such a way as will carry conviction to the mind of the average intelligent person. It is not sufficient to say that the person is labouring under delusions which the certifier may himself know actually are delusions, but he must state that he has inquired into the truth or reality of the patient's statements and has proved them to be unfounded; for example, it would not be enough to state of a person in humble circumstances as evidence of delusion, that he or she says, "I have had a telephone message, or a letter from the king"; for although he may himself know that this is a delusion, he must state that he has made inquiry on the point and that the statement is quite groundless, which will establish the statement to be a delusion. If a patient said, however, that he had received a letter from God Almighty, the statement by itself would prove its delusional character. Moreover, it is by no means uncommon for certain patients, usually women, to make such assertions as that their husbands are unfaithful to them, or that their children have been turned against them by their father. Such a statement in a certificate would, in itself, be no proof of insanity, for it might reasonably be true; therefore, it must be

stated that inquiry reveals the very opposite, or that it is not true in fact. As a general premiss, it may be laid down that no statements which fall within the sphere of verification ought to be stated as evidence of insanity unless and until they have been proved not to be existent in fact, and this proof be stated in the certificate. Further, no language should be used in the certificate which is capable of conveying to different minds other reasonable meanings than that intended by the user. It is not proper to use such words as "incoherent," "irrational," "morose," "wild," or such phrases as "curious in manner," or, "behaves absurdly," since there are no standards by which the average mind can grasp the precise meaning intended to be conveyed, and the words themselves convey no precise meaning of the facts intended to be conveyed. The certifier should, therefore, state facts which of themselves exemplify the condition, and should cite instances of incoherency, irrationality, moroseness, wildness, or absurdity of behaviour, or singularity of manner in the mind or conduct of the patient. This enables any other person to infer from the stated facts the qualities of mind devious from normal which the patient exhibits. It is a good rule, in addition, to use in the certificate the names of persons instead of pronouns. For unmitigated blundering in composition, the following, which is given by Mercier,[1] would be difficult to beat:—"Mrs B—. sister to the patient—states that she has an idea that she can make their fortunes by electricity, has attempted suicide, religious mania, dirty habits, craving for drink, smashes all she can get." Plain, short sentences are always better than long complicated ones, as the facts emerge more quickly and more easily; and a narration of the facts makes more apparent upon the face of the certificate that the examination has been made with care and that pains have been taken.

Protection of Practitioner.—For some time prior to 1890, many medical men refused to sign certificates of lunacy, because of the actions which had been laid against members of the profession and which were productive of great vexation in many instances; they, therefore, declined the risks.

In October of the same year, an action for libel was raised—Somerville *v.* Dr Cooper Rose and Mr H. Cooper—based on the allegation that on Oct. 10, 1882, the defendants had signed a certificate of lunacy carelessly regarding the wife of the plaintiff. It was shown that this lady had acquired the habit of taking various kinds of sedatives and in large doses, and it was owing to the effects of these that the certificates of lunacy had been granted. Under supervision, and deprived of these drugs, the lady made rapid recovery.

It was argued for defendants that right to sue was barred by 8 & 9 Vict. cap. 100, s. 105. The Lord Chief-Justice agreed, and gave judgment for defendants.[2]

This was fortunately recognised by the Legislature, in the passing of the Act of 1890, and in section 330, sub-section (1), it was enacted that—

"A person who before the passing of this Act has signed or carried out or done any act with a view to sign or carry out an Order purporting to be a Reception Order, or a certificate that a person is of unsound mind, and a person who, after the passing of this Act, presents a petition for any such order, or signs or carries out or does any act with a view to sign or carry out an order purport-

[1] "Lunacy Law," p. 29. [2] *Lancet*, vol. ii., 1889, p. 974.

ing to be a reception order, or any report or certificate purporting to be a report or certificate under this Act,or does anything in pursuance of this Act, shall not be liable to any civil or criminal proceedings, whether on the ground of want of jurisdiction or on any other ground, *if such person has acted in good faith and with reasonable care.*"

Further, to protect a medical signator against vexatious litigation, the next sub-section was added to the foregoing—viz.

"If any proceedings are taken against any person for signing or carrying out, or doing any act with a view to sign or carry out such an order, report, or certificate, or presenting any petition as in the preceding sub-section mentioned, or doing anything in pursuance of this Act, such proceedings may, upon summary application to the High Court, or a judge thereof, be stayed upon such terms as to costs and otherwise as the Court or judge may think fit, if the Court or judge is satisfied that there is no reasonable ground for alleging want of good faith or reasonable care."

While, however, such enactments as the foregoing will not prevent the raising of actions, the medical signator who has conformed in his duty to the requirements of the law may calmly view the proceedings, knowing that the law will interpose between him and a vexatious litigant.

In the first case tried after the passing of the Act—Toogood *v.* Wilks (Queen's Bench Division, 1889)—Mr Justice Field ruled that the burden of proof that there was no reasonable ground for alleging want of good faith or reasonable care in certification fell upon the defender. In this case, by reason of good faith having been proved, the Judge stayed the action. The law, therefore, on this point would appear to be that the medical defendant in such an action must prove to the Court that he has performed his duty in good faith and with reasonable care. So also in Mason *v.* Marshall, Shaw, and Gauchard (Bristol Spring Assizes, 1888), which was tried before the relief section of the Act of 1890 was passed, the Judge dealt with this question by asking the jury to answer the following queries—viz. Did the defendants sign the certificates negligently and without care ? Was the plaintiff's conduct, behaviour, and appearance such as to induce the defendants to believe the plaintiff to be of unsound mind and a person to be detained under treatment, and were the acts of the defendants honestly performed in that belief ? Was the plaintiff at the times in question [when the certificates were signed] of unsound mind, and a proper person to be taken care of and detained under treatment ? The jury answered all the queries for the defendants, and thus the action fell.

Cases for alleged wrongous certification of insanity are, fortunately, relatively rare in Scotland.

The most recent case was that of Purves *v.* Dr Carswell and Dr Gilchrist. It was an action for alleged wrongous certification by the defenders, and the damages asked for against each of the defenders was £10,000. It was heard before Lord Pearson in the Court of Session in Nov. 1905, and after a long proof was decided in favour of the defenders. The history of this case and its sequel are worthy of consideration.

The pursuer in the action was certified to be insane by these two doctors in September 1903. At that time pursuer was a Trinity pilot, and was earning annually between £400 and £600. The petitioner for his reception into an asylum was pursuer's wife. There had been domestic differences between husband and wife, one of these being that his wife had refused to cohabit with him, although living in the same house. Some months later, while in the

asylum, pursuer through his law agents petitioned the Sheriff for his liberation. The Sheriff issued a warrant to two medical men, of whom we were one, authorising them to proceed to the asylum and examine the pursuer or petitioner, and to report to the Court *quam primum*. After examining petitioner and other persons, we reported in terms of section 92 of the Lunacy Act, 1857, that petitioner might without risk of injury to the public or to the petitioner be set at large. The petition for liberation was resisted by the wife. After evidence was heard on both sides, the Sheriff pronounced in favour of the liberation of the petitioner, and he was accordingly liberated. After liberation, petitioner found that he had lost his employment. He thereupon raised the action in the Court of Session against the medical persons who had certified his insanity, with the result recorded.

On April 16, 1907, he deliberately shot at and severely wounded Dr Carswell, for which he was tried at the High Court of Justiciary in Glasgow on July 2 of same year. As will be seen (*vide* p. 269), the Crown, at the pleading diet held on June 23, contended that the accused should not be asked to plead to the indictment on the ground that accused was insane, the Procurator-fiscal producing certificates by two medical men that accused was insane. This was resisted by the accused. At the trial, where accused was permitted to plead, he pled not guilty.

Among other evidence, that of the medical men who had granted the certificates of insanity was given. Accused gave evidence on his own behalf, and said he felt very much the stain put upon him by the certification of insanity, that he felt he was a sane man, that while he knew he was committing an illegal act in shooting the doctor, he thought it the only way left him to ventilate his wrongs, having no money. He would sooner do ten years in prison than go to a lunatic asylum. The judge reminded the jury that it was for them to say whether accused was insane, or otherwise that he was really responsible for his act. The jury returned a verdict of guilty as libelled, but without intent to do grievous bodily harm. He was sentenced to a term of imprisonment.

But there are practitioners who shrink at all hazards from actions at law, and who, therefore, will avoid such duties as may subject them even to the publicity which the raising of an action invokes. For such there are but two remedies — viz. (1) to decline the duty of lunacy certification under all circumstances; or (2) to ask and receive from the relatives or guardians of the person regarding whom they are to certify, a writing of indemnity against costs consequent upon any action which might be raised out of the manner in which they have performed the duty. This might be a reasonable demand in some cases; but, after all, when the total number of certifications is contrasted with the small number of legal actions, the risk of certification is indeed but very small.

NOTIFICATION OF DEATHS OF POOR INSANE PERSONS IN ASYLUMS

There is one other medico-legal fact which must be noticed. By virtue of a General Order of the Local Government Board of England which came into operation on Dec. 1, 1900, every death of every poor person of unsound mind in any workhouse, or asylum, must be notified to the Coroner of the district within 48 hours after the death, and, in addition, that the notification shall be accompanied by a statement signed by the Medical Officer, containing the following particulars:— (*a*) name, sex, and age of lunatic; (*b*) whether married, single, or widowed; (*c*) the apparent cause of death; (*d*) the time of, and any

unusual circumstances attending the death ; also a description of any injuries known to exist at the time of death, or found subsequently on the body of the deceased ; (*e*) the duration of the disease of which the lunatic died ; (*f*) the names and descriptions of any persons present at the death ; (*g*) whether or not mechanical restraint was applied to the deceased within seven days previously to death, with its character and duration, if so applied. For the purposes of this order, the expression " lunatic " means an idiot or person of unsound mind.

TESTAMENTARY CAPACITY

In a previous chapter we discussed the conditions necessary to be present in a person who disposes of his estate by a will which, on emergency, is to be written by a medical man, the attendant of the testator. (*Vide* p. 99.) It is only necessary to repeat that, whenever possible, such an office should be declined by a medical man when the services of a legal practitioner are procurable, and that it should only be undertaken under the most exceptional circumstances. The duty of giving evidence of the testamentary capacity of any given testator usually falls upon medical witnesses, although it is not confined to them. It has been said that in the case where a medical man has signed as a witness to a will he *ipso facto* certifies of the testamentary capacity of the testator. We can hardly think that this is the law, since all that the signature involves is testification of the reality of the signature of the testator. In all legal documents where anyone acts as a witness, he does no more than testify to that fact, for he may not be —and the fact does not affect the validity of the signature—acquainted in the least degree with the contents of the document which has been signed. There is perhaps a sense in which the adhibition of the signature of a medical man as witness may be taken as confirming the capacity of the testator, but not the legal sense.

In cases of disputed wills in which the ground of action is the incompetency of the testators to make such wills, doubtless the evidence of the medical attendants of the testators will prove of the greatest value. It is therefore advisable for medical men, in order to maintain an attitude free from the semblance of bias or partiality, to avoid being witnesses to signatures of testators.

In order that a will be valid—from the medico-legal point of view —the testator must be in possession of a " sound and disposing mind." But this sound and disposing mind may be quite consistent with certain departures from sanity, and it may be inconsistent with an absence of insanity as such in the ordinary sense, where for example, by reason of degenerative changes in the brain of an old person, the mind has become weakened and facile. While medical men are not specially interested in the definitions of this sound and disposing mind as given by different judges, they must take them into consideration in forming a judgment in any given case as to whether or not a given testator shows evidence of this state of mind. If, then, such legal definitions be reviewed, it will be found that the following are the points to be

considered as characteristic and definitive of the absence of a sound disposing mind—viz.

(*a*) Idiocy or imbecility, congenital or acquired early in life;
(*b*) Impairment of mind by old age;
(*c*) Impairment or enfeeblement of mind by illness;
(*d*) The presence of insanity.

This was the definition of Lord Penzance in the case of Smith *v.* Tebbett,[1] "While it might *a priori* be assumed that in such states the disposing mind would be affected, yet the law admits that there may be sufficient intelligence remaining, although reduced from an average standard, for the legal exercise of the disposition of an estate." This is well exemplified in many legal decisions of cases in which the testators were the acknowledged subjects of delusions, sometimes of the most glaring character. It is therefore apparent that the law allows of considerable latitude in the interpretation of the mental state with reference to testamentary capacity. The test in any case resolves itself into this: Was the testator when he made the will in possession of sufficient intelligence so to do? According to Mr Justice Erskine, in the case of Harwood *v.* Baker tried before the Judicial Committee of the Privy Council, the testator must exhibit the following qualifications—viz.

(*a*) A knowledge that he is giving his property to a person or persons named;
(*b*) That he knows and comprehends the extent of his possessions;
(*c*) That he comprehends the nature and effect of his act in its bearings on the claims of others, which have had his consideration.

Thus it works out that the problem which the medical witness has to satisfy and solve, is, Whether a given testator is in such a mental condition, by reason of natural incapacity, old age, illness, or insanity, rendered incapable of comprehending that he is willing away his property to a certain person or persons, of knowing the extent of his estate, and of understanding the nature and effect of his act with relation to the natural claims of those excluded from the will. The only means at the command of the medical witness to answer this problem are the acts and sayings of the testator, not only in connection with the single act of testamentary disposition, but with reference to the acts of his daily life and his communications with those around him. And however we may view the presence or absence of any cause which might tend to mental enfeeblement or impairment, its extent and its effect can only be judged in the end by the sayings and doings of the testator. But viewed in a narrower aspect, it will have to be considered, even in the presence of evidence of mental impairment in one direction, whether that so impairs the mind that the impairment determines, and prejudices the ability to rightly perform, the act of disposal of his estate. It is quite admitted, as has been said, by Courts of Law that the existence of mental unsoundness in certain directions is no bar to a sound testamentary disposition.

[1] L. R., 2 P. & D., p. 400.

The following illustrative cases we take from our case-book :—

1. M. B. *v.* J. M. and Others.

The estate involved in this case was £30,000.

This action was raised on the following, among other, issues :—

"Whether on or about October 23, 1901, J. M., jr., was weak and facile in mind and easily imposed upon through intoxication, and whether the defenders, with whom the said J. M., jr., resided, or the other defenders, or one or other of them, taking advantage of said weakness and facility, did by fraud or circumvention impetrate from the said J. M., jr., the trust disposition and settlement bearing said date to the lesion of pursuer."

It was shown to the Court that for about twenty years the testator had constantly abused himself with alcohol, with the possible exception of a short period while he lived abroad ; but before he went abroad, and after his return home, he was more or less constantly under the influence of alcohol, and for some months before his death was practically continuously under the influence of intoxicants ; that while in that state he behaved in an unseemly and, sometimes, outrageous manner, was restless both in body and in mind, acted recklessly, heedlessly,and spent his money freely, and generally conducted himself in a manner inconsistent with his station in life. A short time before his death, the amount of liquor supplied testator was five dozen bottles of beer and two gallons of whisky.

The whole history of this young man pointed to his being a dipsomaniac. He became nervous, unable to sleep and excitable, for which he had to be prescribed bromides and chlorobrom. He died from the combined effects of *delirium tremens* and pneumonia. There was further evidence to show that before, at, and from the time of impetration of the will in question, testator was not in a fit conditon mentally or physically to make a sound disposing testament.

After hearing the evidence for the pursuer, defenders agreed to reduction of the will on a compromise most favourable to pursuer.

2. A. H. C. and Others *v.* J. S. and Another, trustees of deceased testator.

The testator, a young man, had pursued for a series of years habits of drinking, but had had intermittent spells of sobriety. During the whole of the time since attaining his majority he managed his affairs himself. He was alleged to have had during the period in question, on more than one occasion, epileptiform convulsive attacks, and to have had on one occasion, at least, an attack of *delirium tremens.*

On July 24, 1902, being ill, he executed a trust disposition and settlement of his estate, amounting to £6000 or thereby, giving the necessary instructions for preparing the same to the representatives of an old-established firm of solicitors. Within twenty-four hours thereafter he died. It was averred by the pursuers that deceased was at the time he executed the deed wholly incapable of understanding the nature and effect of the provisions of the deed, that he never assented to it, that it was hastily prepared on the instructions of the beneficiary—the defender—that the deed was not duly executed in the presence of the testator, and that he was really incapable of adhibiting his ordinary signature to the deed, owing to his being in a comatose condition.

Two medical witnesses, one of whom had seen testator four or five times during his last illness in the absence of his usual medical attendant, gave it as their opinion that, on the forenoon of the day on which the will was made, testator was in a state of delirium, chattering and muttering to himself continually, that by 11 P. M. of that day he was unconscious, and that he remained in that condition until his death the following day. They were of opinion, that he was not fit to make a will, although they thought it not improbable he might be roused, or that he might rouse himself, to full consciousness for a short time. A priest gave evidence that he had seen testator that morning early, that testator was perfectly conscious at that time and knew what he was doing, that he saw testator again half-an-hour after mid-day just after the two doctors had had a consultation over the patient, and again in the evening about 11 P.M., when he administered the Sacrament, testator being then, in his opinion, conscious, and able to follow and following the administration of the Sacrament.

The defenders, the trustees, denied the averments of pursuers. It was explained that the law agents who drew up the will in question were the agents on the estate of testator's father, that they also looked after the estate

of the testator himself, that they had been asked to send urgently someone to the house where testator resided to make his will, that two senior and capable clerks had been so sent along with the messenger, that these three persons being in the room with testator, he then and there gave definite and positive instructions regarding the terms of his will which were taken down in scroll, then extended in another room, and that the document so extended, after having been read over to him clause by clause, was signed by testator in the presence of these three persons as witnesses. In our perusal of the precognitions of these and other witnesses with a view to giving evidence, one fact emerged which indicated to us that the testator was quite alive to what was being done during the preparation of the will. One of the legal persons who took instructions from deceased was slightly deaf, and he took down in writing wrongly a phrase used by the testator. When the scroll was being read over to make sure that they had his exact wishes, the testator, on hearing the wrong phrase read, corrected it. From a review of the precognitions and a consideration of the facts given in evidence for the pursuers and heard by us in court, we gave evidence for the defenders. After hearing the whole evidence, together with the summing up of the judge, the jury pronounced in favour of the defenders, and therefore the will stood.

3. P. *v.* M. The pursuer in this case was the brother, and the defender the husband, of the deceased testatrix.

In a testamentary writing executed on a sheet of notepaper in Sept. 1901, the testatrix bequeathed her estate amounting to over £30,000 to her husband. She had no issue by her marriage with defender. Pursuer was her heir-at-law and sole next-of-kin. It was averred by pursuer that from a time shortly after her marriage until her death in Nov. 1902, a period short of three years, testatrix had become the victim of the alcoholic habit, and that from about two months after marriage she drank inordinate quantities of alcohol daily; that about six months later she began to suffer from convulsive fits, and that these recurred with greater or lesser frequency until her death; that in consequence of this constant inordinate drinking her bodily and mental health was so impaired that at the time she wrote the holograph settlement she was not of sound disposing mind, was, indeed, in a weak and facile state of mind and easily imposed upon, and that the defender, taking advantage of the said weakness and facility, obtained the said writing by fraud and circumvention.

The said writing was as follows :—

(Address)
25th Sept. 1901.

∧ *P*—— or

I, *M*—— *H*—— ∧ *M*——, wish all my property, personal and otherther-wise (*sic*) to go to my husband *H*—— *M*—— after my death. In case ~~case~~ (*sic*) the trustees think this is done compulsilory (*sic*) I say it is done of my own free will, unknown to *H*——.

M—— *H. M*——.

Witness (Here follows name and address of witness).
Witness (Here follows name and address of witness).

This is all corrected by my own self.

M—— *H. M*——.

The issues at the trial were :

(*a*) Whether the writing, dated September 25, 1901, of which No. — of process was a photograph, was not the deed of the deceased M—— H—— P—— or *M*—— ?

(*b*) Whether on or about the 25th day of September 1901, the deceased M—— H—— P—— or M—— was weak and facile in mind and easily imposed upon, and whether the defender, taking advantage of her said weakness and facility, did by fraud and circumvention obtain or procure from the said M—— H—— P—— or M—— the said writing to the lesion of the said M—— H—— P—— or M—— ?

It was shown for pursuer in evidence that the deceased testatrix up till the time of her marriage was practically a total abstainer from alcohol, and that

from two firms alone there had been supplied to her house, from May 18, 1900, till Nov. 14, 1902, 1144 quart bottles of brandy, whisky, champagne, port, sherry, claret, and liqueurs, in addition to 236 bottles of cyder, 15 of stout, and 12 of beer. The domestic servants spoke to her continuous drinking habits during practically the whole period of her married life, and to the fact of her taking convulsive fits. They also gave evidence respecting her lapses of memory. A professional nurse, called in the night before the death of testatrix, said that she was informed by the servants that no doctor had seen her for two or three weeks before. She insisted on having a doctor called, to which defender said he had sent for his brother, a medical man, who lived in the country. Defender never told her that testatrix had been drinking, but she saw it for herself. Testatrix died the next day in a convulsive fit. In short there could be no room for doubt that testatrix, during her short married life, had become the slave of alcoholic intemperance.

We were asked to examine the precognitions of witnesses, the testamentary writing, and other documents written by testatrix before and shortly after her marriage, for our opinion as to the soundness of her disposing mind.

In addition to the foregoing facts, there were, in our view, evidences in the testamentary writing itself of mental disturbance, indicating that the writer at the time of writing was in an excited and nervous condition. That was indicated by the following facts :— (*a*) the writing itself was irregular, unsteady, and uneven, (*b*) that simple words were misspelled, and (*c*) other internal evidence. The testatrix had received a liberal education, and might be expected to be able to spell ordinary words, at least. But lest she was imperfect in spelling, we compared a number of letters written by her shortly before marriage for purposes of comparison with the testamentary writing. These letters exhibited freedom in writing, fairly regular lining, and no indecisiveness in beginning words. There were instances of misspelling, as, for example, where "e" took the place of "a" in a word ending with "tance"; but there were no such mistakes as were evident in the testamentary writing. The mistakes in the latter were : "othertherwise" for "otherwise," on the third line of the original writing, and "compulsilory" for "compulsorily" on the second last line. In addition, we found the word "case" repeated twice, thus "case ~~case~~," in the third last line, and the interpolation of her maiden surname on the first line. It is possible, although difficult, to conceive that a woman writing such a document as this might be more than usually nervous and excited, and might thus make mistakes. That view is dispelled, however, by the fact that she testifies to have looked over the writing to see if it was right, by adding the words "This is all corrected by my own self," showing that she had overlooked the misspellings.

Besides, looking at the document from a psychological point of view, it seemed to us that there probably was some reason operating at the time in the mind of the writer to cause her to be so anxious to impress or enforce the view that she wrote the document unsubjected to any influence ; for she was not satisfied with stating "it is done of my own free will unknown to *H*——," her husband, but she seems to think it necessary to add as a postscript : "This is all corrected by my own self." Why such precautions should have been thought necessary by testatrix is difficult to comprehend unless upon the assumption that she, or someone prompting her, believed that the circumstances under which the writing was made could not unreasonably be looked upon as unusual, and, therefore, as suspicious of ascendancy on the part of someone. It is also noteworthy, that although testatrix apparently went out of her way to call herself by her full name by interpolating in the first line her maiden surname before her married surname, she only signed herself as M—— H—— M——, and not M—— H—— P—— or M——.

All these points cumulatively went to the formation of the opinion we expressed in evidence that the testatrix at the time of writing the document in question was in a state of mental perturbation and instability, the cause of which was in all likelihood her long-continued over-indulgence in alcohol and her then present state of intoxication.

After hearing the evidence of many witnesses, and after the charge of Lord Kyllachy, the jury returned a unanimous verdict for the pursuer on the second issue, and for the defender on the first issue ; the verdict therefore being that the will was the writing of the deceased, but that it was impetrated from the

testatrix by fraud and circumvention by her husband. The will, therefore, was reduced.

4. J. M. and Others *v.* E. H. M.

In June 1902, we were asked by the solicitor and the medical attendant of Mrs J. L. or M. to visit her and examine her as to her mental ability to give instructions for the execution of a will. From that examination we arrived at the opinion that she was unable to give intelligent instructions for making a will, that she was mentally unfit to conduct the management of her affairs, and that steps should be taken for the appointment of a *curator bonis* for that purpose. That opinion was founded on (1) her inability to express her wishes partly owing to partial aphasia, the result of organic brain disease following upon cerebral hæmorrhage some time before, which had also produced partial paralysis of her right side and a tremulous condition of the left side of body, (2) her grave defects and lapses of memory, together with her inability at times to recognise persons whom, from her long knowledge of them, she ought to have known, (3) her inability to account for expenditure of her moneys, (4) her apathy and indifference to conversations affecting her interests, and (5) the marked instability of her emotions, rendering her very liable to act on sudden impulses. She then resided with one of the pursuers. Some time later, she went to reside with the defender. On Jan. 20, 1903, she executed a will in which the defender was appointed trustee on her estate, and after declaring the destiny of small legacies, testatrix left one-half of her estate to defender, and the other half among her other three daughters, the pursuers.

On May 26, 1903, a petition for appointment of *curator bonis* on her estate was presented to the Court of Session by the defender, accompanying which were two medical certificates, one of which was granted by the medical superintendent of a lunatic asylum, and the other by her then medical attendant, who was, however, not the same person who had attended her for years before. In both of these certificates it was certified that Mrs J. L. or M. was incapable of managing her affairs by reason of defective memory, of being facile, easily persuaded, and unable to sustain her attention for any time to one subject, of being the victim of organic disease of the brain, shown by a paretic condition of the right side of her body, partial aphasia, and of her emotional instability. She died on Sept. 4, 1904, aged 79 years.

The above action for reduction of the will was raised in the Court of Session and was tried before Lord Johnstone, the Lord Ordinary, on Nov. 25, 1905, and following days. In his judgment, of date Jan. 13, Lord Johnstone found that on Jan. 20, 1903, when the will was made, Mrs J. L. or M. was not of sound disposing mind, that six weeks before the execution of the will Mrs J. L. or M. was not and had not been for a considerable time of testamentary capacity, and that six weeks after the execution of this will, she was again and continued till the end of her days in the same state. In his judgment, Lord Johnstone submitted the evidence, medical and other, to critical examination. He noted that the will was executed on Jan. 20, 1903, that the medical expert called for defenders had not seen the testatrix prior to that date, but that within six weeks after the date of the will arrangements had been made for calling him to see testatrix. He did not see her, however, till May 9, 1903, when he gave a certificate certifying that she was incapable of managing her own affairs, based on the facts already enumerated which he had found on two separate examinations, conditions parallel to those found a year before, by the chief medical witness for the pursuer. Yet he offered the opinion in court that the recovery of the testatrix was quite possible. Apart from this, his Lordship thought the evidence of the lay witnesses, among others of two lawyers, who had separately and unknown to each other been called in prior to the date when a will was made, to undertake that duty, was of the greatest value. These gentlemen declined to undertake the office on account of the opinion they had formed from conversations which they had had with testatrix that she was unfit to give proper instructions for a will.

The decision of the Lord Ordinary was appealed against, and on December 15, 1906, the Second Division recalled the judgment of the Lord Ordinary, declaring the will to be a good will.

5. Mrs C. B. or M. and Husband *v.* J. C. B. and Another.

The female pursuer and the defender, J. C. B., were children of the deceased father the codicil of whose will was in dispute.

In the condescendence for pursuer, it was stated that the testator, their father, was a retired pilot, and that he died on or about October 22, 1904, in West Sussex County Asylum, Chichester; that the cause of his death, as certified by the medical superintendent of the asylum after a post-mortem examination of the body was "Organic Disease of Brain—years. Cerebral Cyst—over three months"; that the deceased left a will, dated Sept. 26, 1899, by which he bequeathed his whole estate, with the exception of certain small special bequests, to his wife, who predeceased him, and after his death, equally between pursuer and defender; that he also left a codicil, bearing to be dated Feb. 4, 1904, by which he appointed an executor to act under his will, but said appointment was ineffectual because the codicil was not validly executed; that he also left the codicil now sought to be reduced, which was written on the same sheet of paper as his said will, and was in the following terms:—"I, J—— T—— B——, the maker of this will, having advanced my daughter E—— H—— B—— from time to time the sum of £1250 (twelve hundred and fifty pounds sterling) desire that at my decease that the above-mentioned shall be deducted from her share of the estate. To the above I place my signature.

"[Here follows signature, address, and date]."

It was further condescended that the deceased was at the date of his death under curatory in respect of his mental derangement, and had been confined in the said Asylum since August 1904; that at the time of his death he was 63 years of age; that he had on two previous occasions been confined in a lunatic asylum, first in 1884 for eleven months in the Royal Asylum, Gartnavel, Glasgow, and again in the same place, from April 29, 1901, till February 11, 1902; that prior to his confinement on the second of these occasions he had been for some time very violent and dangerous to the lieges, one of his acts being to shoot firearms from the window of his kitchen at imaginary persons in the street; that on Feb. 11, 1902, his condition had so far improved that he was allowed out of the asylum under charge of pursuer, but the asylum authorities refused to grant a certificate of his recovery, stating that they did not expect the improvement to be permanent; that, thereafter, deceased for some time lived alone with pursuer, who kept house for him and was then unmarried; that towards the end of 1903 a change for the worse in his condition became apparent—he became excited in his manner and conversation, and untidy in his dress and person, became suspicious of and conceived a hatred for the pursuer to whom up till that time he had been much attached, on several occasions and without any foundation he accused pursuer of theft and of having tried to poison him, until, ultimately, about Feb. 8, 1904, his behaviour and conduct towards her becoming so threatening and violent, she was compelled hurriedly to leave his house.

It was further averred that the alleged codicil of March 1, 1904, was not the deed of the deceased; that at the date of its execution and until his death, he was insane and suffered from insane delusions; that, in particular, he suffered from insane delusions of which said codicil was the outcome; that in the codicil he stated he had from time to time advanced to pursuer the sum of £1250, whereas in point of fact he had not advanced any such sum, the only advance being a sum of £450 which on Feb. 17, 1902, he placed in bank in her name as a gift, in pursuance of an intention formed by him in the end of 1900 to acknowledge her attentions to himself and to pursuer's mother.

The pleas-in-law were: (1) The codicil sought to be reduced not being the deed of the deceased, the pursuers were entitled to decree or reduction as concluded for; and (2) the said codicil, having been executed by the deceased while insane and as the result of insane delusions, the pursuers were entitled to decree of reduction as concluded for.

The papers placed before us for an opinion regarding the testamentary capability of testator were: (*a*) Extracts from the Case-books of the Glasgow Royal Asylum with reference to the admission thereinto and condition of deceased testator while resident in that asylum in 1884 and 1901; (*b*) Excerpt from the Case-book of the West Sussex Asylum respecting his admission to that asylum and his condition while there in 1904; (*c*) Excerpt from the Pathological Register of the same institution, giving particulars of the post-mortem examination of the body of deceased; and (*d*) Precognitions of pursuer and other persons who knew deceased during his life.

The first showed that at the time of admission to the Glasgow Royal Asylum on the first occasion deceased was in a state of mania, was intensely suspicious and had delusions. He thought there was a conspiracy against him to do him injury. On the second occasion, one of the reasons founded upon for his incarceration was that he had been discharging loaded firearms from the windows of his house into the street at imaginary persons. He had the belief that his deceased wife was not dead but was merely hidden from him, he requested that imaginary telegrams be sent and replied to, he was restless, excited, and noisy, and thinking himself on board ship gave nautical orders in a loud voice to imaginary persons.

When admitted to the West Sussex Asylum on August 5, 1904, he was found to be rambling and irrational in conversation, thought himself to be the subject of persecution by Government spies who were continually tracking him. He declared that being on the pier at Bournemouth and seeing some suspicious craft in the "offing," he felt it to be his duty to warn the nation that there was some mischief afoot. He also accused his daughter of robbing him. By September 2 signs of right facial paralysis appeared, and on October 12 he had marked right hemiplegia. He became comatose, and died on October 22.

The post-mortem examination of the brain revealed flattening of the convolutions of the left hemisphere on removal of calvarium. On removal of the organ for detailed examination, a bulging was observed over the lower halves of the ascending frontal and ascending parietal convolutions of left hemisphere, which, rupturing during the process of removal, there escaped from them about four ounces of a sticky, straw-coloured, clear fluid. Dissection showed that the source of this was a smooth-walled cyst in the substance of the brain between the inferior halves of the ascending parietal, ascending frontal, and supramarginal convolutions, and the lateral ventricle. In parts the brain tissue forming the walls of this cavity (which was about the size of a Tangerine orange) had a yellow gelatinous appearance, of which microscopic sections showed marked destruction of brain tissue.

From these facts, we gave it as our opinion that deceased had suffered from organic disease of the brain of such a character as prevented him being of a sound disposing mind at the time when the codicil sought to be reduced had been signed.

After evidence for the pursuer had been heard, an arrangement was arrived at with defender, it being agreed that pursuer should pay back into the estate the £450 which had been given her by the testator during his life, and that thereafter the whole estate should be divided between the parties equally, each party paying their own expenses, and the codicil of consent being reduced.

6. Thoms and Others *v.* Thoms' Trustee and Others.

The plea-in-law in the condescendence of pursuers in this case was as follows:—"That the said Trust Disposition and Settlement of Mr Thoms of 16 March, 1903, and the nine testamentary writings of date 7 Dec., 1896, 26 Dec., 1897, 10 October, 1898, 7 June, 1899, 19 October, 1899, 4 Nov., 1899, 7 August, 1900, 25 Sept., 1900, and 29 October, 1901, and each of them, should be reduced in respect (1) that Mr Thoms was not at the dates thereof of sound disposing mind, and that the said documents are not his deeds; and (2) that the said Trust Disposition and Settlement of 16 March, 1903, and the nine testamentary writings of the dates aforesaid, and each of them, were impetrated from Mr Thoms while he was weak and facile in mind and easily imposed on by the defender M—— by fraud and circumvention, and by taking advantage of said weakness and facility, to the lesion of Mr Thoms and of the pursuers."

Mr George Hunter MacThomas Thoms, advocate, whose will was in dispute, was for many years Sheriff of the Counties of Caithness, Orkney, and Zetland, and in virtue of that office was Vice-Admiral of the islands of Orkney and Zetland. His testamentary history was, briefly, as follows:—In March 1893 he made his first will, in which, after payment and distribution of numerous smaller legacies, he bequeathed to his nephew, one of the pursuers, the residue of his estate, heritable and moveable, but only on condition that he should use and constantly retain the name "MacThomas" before his surname of Thoms, and failing his compliance, the same was to be left to another nephew, also one of the pursuers, on the same condition, whom failing to a cousin, and whom

failing, one-half to University College, Dundee, for bursaries to be called the MacThomas Thoms Bursaries, and the remaining half to the Faculty of Advocates, to be called the MacThomas Thoms Bequest. Reduction of this will and codicil thereto attached was not sought.

Between the date of that will and codicil and March 1903, testator added no fewer than nineteen other codicils, making and revoking bequests. In some of these codicils, he left money to and made other provisions for, his valet, valet's wife, and daughter, left money to the Kirk Session of Saint Giles' Cathedral, Edinburgh, and to the Provost and Magistrates of Kirkwall, a sum of £1000 to aid in the restoration of St Magnus Cathedral there. Of all these codicils those sought to be reduced dealt with legacies of money to or with other provisions for his valet, M.

On March 16, 1903, he made a new will by which all former testamentary writings were revoked. In this will, he bequeathed a total sum of £6600 to the Kirk Session of St Giles, a liferent lease, free of rent, of his house in Edinburgh, with the furniture and furnishings, and an annuity of £100 a year, to his valet and his wife and the survivor of them, to one nephew the estate of Aberlemno, in liferent, for his liferent use only, on condition that he shall use and constantly retain the surname already mentioned, and declaring that if he fail to do so, the liferent in his favour was to cease, and to the other nephew, on similar terms, the subjects in Dundee known as "The Crescent," with power to the liferenter to grant feus of said property, so far as the same was still unfeued, and to the Provost and Magistrates of Kirkwall, the residue and remainder of his estate, including the estate of Aberlemno, the property of "The Crescent," Dundee, and the house in Edinburgh, after release of the liferents of the same, to be applied by the said Provost and Magistrates to the restoration and repair of the cathedral of Saint Magnus in Kirkwall, and for the erection of a stained-glass window in his memory, said window to be put in the great east window of the cathedral.

The pursuers asked that this will should be reduced in its entirety for the reasons given in the plea-in-law.

In the condescendence, the pursuers averred that the testator was born in 1831, and died on October 25, 1903, aged 72 years. Testator was never married, and he was of very eccentric habits. He used to carry a pair of tawse in his pocket, and to apply them to the children of his friends and relatives. He had elaborate rules printed for the conduct of his domestic servants, imposed fines upon them for infraction of these rules, and likewise upon himself, and the household cat. He kept what he called a "laughing waistcoat," a garment with elastic gussets, which he wore when he went out to dine and on other occasions, and was in other ways eccentric in conduct. About the year 1888 he conceived the idea, said to be baseless in fact, that he was the chief of the clan MacThomas of Glenshee, and thereafter he assumed the name of MacThomas, called himelf "Ye MacComish," and frequently referred to his chieftainship. He added or caused to be added to a book entitled "Memoir of the Family of MacCombie," certain chapters, and caused it thereafter to be published with the title of "Memoir of the Families of McCombie and Thoms," of which he kept copies to give to his friends. He was very proud of this supposed connection, and desired his nephews to recognise the connection and continue it.

In his will of March 1893, he gave the following direction regarding the disposal of his remains after death:—"I wish to be buried from St Giles' Cathedral in the Metropolitan Cemetery, Morningside, in a wicker or other slight coffin, so as to have a chance to be in early at the general scramble at the resurrection," and, later, in a testamentary writing, dated Feb. 20, 1896, he gave the direction: "I wish my remains to be cremated. . . . The residuum will be put in a jar in the Ladies' Vestry at St Giles'," said vestry having been added to that cathedral at the testator's expense. Testator informed the pursuer that he would succeed to the estate on condition that pursuer assumed and used the name of MacThomas, and his desire was that pursuer would at once assume and use that surname, which the pursuer did.

In the spring of 1891, testator had a very severe illness, during which for many weeks he was nursed by a professional nurse. He never fully recovered from the effects of that illness, and from that time till his death he got gradually weaker both bodily and mentally. He became affected with creeping paralysis,

and for nearly ten years before his death, required the constant attendance of a man-servant. About six or seven years before his decease, he had ulcerations of his head and body. He was exceedingly irritable, and his speech became very defective and difficult to understand.

In Nov. 1895, the valet, who became a legatee, entered his service, and remained with him till his death. This valet acquired a great influence and ascendancy over him, and he became master of testator's actions. He had full access to and read all testator's private correspondence and testamentary writings, and in some instances, because of the knowledge so acquired, informed prospective beneficiaries of the legacies they would receive. In several of the holograph codicils to the will of March 1893, and in the will of March 1903, legacies were left to the said valet, his wife, and daughter.

In April 1900, testator removed from his house in Edinburgh to another smaller residence at the persuasion of this valet, whose wife was made housekeeper, with the assistance of their daughter and a maid—all it was averred for the purpose of getting testator more under the power of the valet. The valet was said to have conceived a great dislike to and hatred of testator's relations, and thereupon began to instil an unfounded suspicion of and aversion to said relatives in testator's mind ; and in particular, fostered in the mind of the testator a belief that the pursuer was an idler, and did not wish to practise his profession, but was waiting for and relying on his prospective succession to the estate of testator.

It was further averred that for some years before his death, testator was under the insane delusion that he was a poor man, while the fact was that he had an annual income of nearly £3000, two-thirds of which he annually saved. At his death he left estate of a value exceeding £80,000. His will of March 16, 1903, altered his relations to the pursuer. Instead of making one of them his residuary legatee, testator merely gave pursuer a liferent only of the small patrimonial estate of Aberlemno, and to the other pursuer, a liferent of the property in Dundee, while leaving to the Provost and Magistrates of Kirkwall property and estates to the value of over £60,000, to be applied as already described. It was averred regarding this bequest that "no person of sound disposing mind would have made a bequest of so large an amount for such purposes," seeing that said cathedral was at the date of the will—and at the time of this action— in a good state of preservation.

The pursuers, therefore, sought reduction of the will of March 16, 1903, as well as of the nine testamentary writings specified in the plea-in-law, on the grounds that " testator had been so weakened by protracted illness that he was not at any of said dates of a sound disposing mind, and he was incapable of understanding the effect of the said Trust Disposition or testamentary writings. He could hardly move any part of his body ; he could not stand without support ; he suffered from chronic gout and creeping paralysis, as well as from a malignant disease ; he was covered with running sores, and could scarcely speak ; he could not maintain a rational conversation ; and he was under the several insane delusions before mentioned."

It will be observed that the allegations, put shortly, were that between the time of making the first will in 1893 and some of the codicils following thereupon, and the time of making the will of 1903, something had happened to testator to prevent him being of sound disposing mind.

All the documents in the case were placed before us for an opinion, from the medical point of view, whether testator was of a sound disposing mind at the time he made the will of March 16, 1903. It seemed that the questions to be answered were :

(1) Was the testator so weak in mind and so facile on December 7, 1896, the date of the first testamentary writing, the recession of which was asked, that testator was incapacitated from making a sound disposition ? and

(2) Was the testator of unsound mind, weak or facile of mind, or generally incapacitated to make or to give instructions for making the Trust Disposition and Settlement of date March 16, 1903 ?

Answers to these questions could only be given after full consideration of (*a*) the precognitions of witnesses who knew intimately, and who were in constant relationship with, the testator, (*b*) the conduct, habits, and eccentricities of testator, and (*c*) his capability to transact business affairs.

The precognitions of those who knew testator well, including his medical attendant, his amanuensis, personal friends and intimate acquaintances, revealed nothing of any belief in any decadence of testator's faculties, while acknowledging his increasing bodily weakness and inability to move about without assistance. His trustee, who had had several years' intimacy with testator, and who received his instructions to make both wills, as well as those who attended at the residence of testator to witness the signing of the will, stated they did not see any abatement of mental clearness, although they had occasionally, from defective articulation, difficulty in following all he said. The medical history of testator, besides, as given by his medical attendant of the past twenty years, was one of chronic gout and another ailment, but that there had not been any organic brain disease or aphasia or paralysis.

Regarding his eccentricities, we arrived at the conclusion that they were merely evidences of a man who desired to be thought witty or funny, that his rules for his household were probably so elaborate on the principle that the spinster's children are paragons of good behaviour, that his alleged assumed relationship with an ancient family and his pretension to the chieftainship of the clan MacThomas were but common human weaknesses not limited among mankind. There is abundant evidence in heraldic literature and in genealogical trees of the existence of like delusions. As regards his instructions respecting the mode of disposal of his body, it was but another example of the proverbial saying, that only a Scotsman jests with death and after. It was at best, however, but grim humour. The allegation that testator thought himself a poor man could not, in our view, be proved. Testator was receiving at periodic intervals dividends on stocks and shares, rents from his properties, and other moneys, with which he had regularly to deal, and with which he dealt. His household expenditure, although economical, could not be regarded as parsimonious, nor could be, because he limited his subscriptions to charitable and other objects after he resigned his legal office, be reasonably deemed to be penurious. His many testamentary writings might, perhaps, had he not been a lawyer, been looked upon suspiciously like an evidence of delusion ; but being a lawyer, they ceased so to be, because history has shown that it is only a lawyer who is apt to betray weakness in this direction, since to a lawyer it is a costless hobby.

His large bequest to Kirkwall for the restoration of the cathedral might be unexpected to pursuers but was not to several friends with whom he had talked on the subject of repair and restoration ; moreover, in one of the many codicils to the will of 1893, he had already made a bequest for that purpose. Besides, the cathedral was in his old Sheriffdom.

As to his business capability there was the strongest evidence that he was a competent, shrewd, and able business man even up to a month before his death. The defenders produced a printed volume, extending to 317 pp., which contained his business and other letters from November 1897 till October 1, 1900. Several of these letters dealt with very intricate subjects involving a clear knowledge of minute details, with banks, law-agents, and others, relative to the management of his estate, all indicating that testator's mind was clear, active, and acute. Moreover his amanuensis, who had been with him for some years up till his death, testified in court that he could remember the smallest details with great accuracy, and that up to within a month of his decease he dictated practically every letter which he wrote for him. There could not have been, in our view, more valuable evidence than this of the mental capability of the testator, and we utilised it in our evidence in court.

Evidence was given on February 6, 7, 8, 9 and 10, 1905, by a large number of witnesses on both sides.

The Lord Justice-Clerk in his address to the jury said :

A man was able to dispose of his own property, but his testamentary powers were limited by the legal rights of his family, who had a right to certain portions of his property, and could choose to claim their legal rights or take under a will. But it was only wife and children who were in that position. A testator was the master of his own property so far as nephews and nieces were concerned. A man might be of sound disposing mind who was no longer able to take part in the business of life.

The first question was, Whether the will of 1903 was not the deed of the

deceased. Alternately, the jury were asked to say, Whether the deceased, being able to make a will, was weak and facile and induced by his valet to make this will. What was the character of the testator ? He posed as a funny man, but his eccentricities were coupled with irascibility of temper. He was a professional success. He was proud of his Sheriffship. His eccentricities were known to all his friends during forty years of his life. His carrying tawse was a characteristic joke. The rules for his household had been warmly recommended by many ladies. One of the rules was that the pantry must be like a paradise. The Sheriff once found a man in the pantry, and the servant girl pleaded that there could be no paradise without an Adam. The testator himself told the story and enjoyed it. Sometimes the testator slipped out of the rôle of the comedian, and got into the cap and bells of the jester. No one during the long years they knew him considered these things more than an indulgence in jocularity. He made many friendships, and he retained every one of them. No one of his friends had come forward to say that he attached any importance to these eccentricities. The question for the jury was, What was the testator's state of mind during the period in which these deeds were signed ? Had he at the time no mind to execute such a will, and was his mental state from December 1896 to March 16, 1903, that of one who was weak and facile and easily imposed upon, so that another could force his will upon him and make him do as he pleased ? His Lordship had never seen a case in which the weight of evidence was so fatal to the idea of mental incapacity. Within a short time of his death testator was occupied with business. His letters indicated that he was a clever, astute, diligent business man.

His Lordship now came to that part of the case in which it was suggested that the testator suffered from insane delusions. One of these was about the clan MacThomas. It was his Lordship's experience that once people got on the question of genealogy, and got interested in it, and wanted to make out that their ancestor was some great person, they always succeeded in doing it ; but if it was to be considered a proof of insanity that a man imagined his ancestor was the chief of a Highland clan, many people who were now looked upon as sane would be locked up in an asylum. Undoubtedly the testator had got the idea thoroughly into his mind ; but it was rather peculiar that he impressed it upon his nephews, the pursuers. They had undertaken to assume and to use the name MacThomas. Did the pursuers think at the time that the testator was insane ? If so, his Lordship should have expected they would speak to the doctor about it ; but they did not. Again it was said that testator thought himself poor. Some people said they were poor when they did not want to part with their money, especially when they were asked to part with their money for bazaars and the like ; but surely that was not to be put down to an insane delusion, and all the more when they knew that testator was aware that he was a wealthy man. Again it was said that testator was under an insane delusion that pursuer was not following his profession. He may have been mistaken in that. What he did know was that his nephew had been away for a long time in the south of England, and even if he was mistaken and acted upon the mistake that would be no ground for holding that he was under an insane delusion. It was quite clear that testator occupied himself a great deal with testamentary writings, and that, too, for a long time before he was ill. Therefore it was not the least surprising that there should be a great number of such documents in the years with which they were dealing. The question was, Did testator understand the will of 1903 when he dictated it, when he got it written out, when he examined it and made corrections on it with his own hand, and when it was being read out to him ? That was a question of fact for the jury to decide. It was not a question which depended upon doctors. If they answered that question in the affirmative, they would find for the defenders, if in the negative, they would find for the pursuers.

The jury retired to consider their verdict, and in half-an-hour returned with the following verdict :—We unanimously find that the late Sheriff Thoms was of a sound disposing mind when he executed the will of March 16, 1903, and we also find that he was not weak and facile in mind or circumvented by A. M. his valet.

APHASIA AND TESTAMENTARY CAPACITY

Of late years much attention has been given to the relation of aphasia to testamentary capacity, and to the duty of a medical attendant of an aphasic person in assisting at his will-making. The clinical manifestations of aphasia are so varied, and the mental condition of such patients so apparently helpless to the average layman, that it will be strange if such wills are not some day contested. But while in certain cases of aphasia the memory, reasoning, judgment, and volition are apparently but little, if, indeed, in any degree, prejudiced, in others there can be little doubt they are considerably affected. As a general rule, it has been found that in total aphasia (*i.e.* combined sensory and motor aphasia) the mental defects are greatest, in motor aphasia, least, and that in sensory aphasia (simple loss of memory for words, word deafness and word blindness), the impairment occupies a middle position between the two. As a general statement of the case, it may be said that the more extensive the aphasic defect the greater the mental enfeeblement, and the less the testamentary capacity of the person. But, as in mental unsoundness generally, the only relevant statement is that which has direct and particular reference to any given case. Since in certain cases the person is incapable of understanding spoken language, in other cases, written language, in certain others, both spoken and written language, and in other cases still, is unable to put down in writing his wishes, it will be obvious that *primâ facie* disabilities attach to such a person in making a will, since in the case of the person who cannot write at all, or can but imperfectly write his wishes, the only medium of communication is by signs, which, because possibly of the mutual inacquaintance of sign-interpreter and patient of the meaning intended to be conveyed, are at best but a very imperfect medium. Thus it happens that the medical attendant of the patient, because of his acquaintance with the cause of the origin, progress, and nature of the aphasic condition, is an invaluable person at the process of will-making. It is not necessary to repeat what has already been said as to the indications in a testator of a sound disposing mind, but it is necessary to draw attention to the special difficulties which surround the will-making of the aphasic individual. The law, as has been pointed out, puts a broad, liberal interpretation upon the amount of mental power necessary for the making of a will. Lord President Robertson, in a case of contested will which was tried before him and a jury in July 1898, said : " He must remind them [the jury] that they had not got to try the question whether in the general sense the woman [the testatrix] was sane or insane. The question was much more narrow and limited. It had reference to this particular will—had she enough mind to understand it, and did she understand it ? because there were many people in this world who had got what might be called a crack in them, and were really eccentric, and yet their wills were perfectly good. They might think that it was too complicated for the woman ; and if so, then they would find against the will. On the other hand, they might think, although they had heard a good deal of trash about the woman's eccentricities, that still she had enough sense to make a will, if it was a will that she could

understand. . . . They must not break the will unless they really thought that either she was unfit to make it, that she had not sufficiency of mind to make it, or that she was weak and was led into making it by other people." The foregoing may be taken as an exposition, in plain language, of the law regarding testamentary capacity of aphasics as of other persons. The law, however, has had an opportunity on more than one occasion of inquiring into the will-making power of aphasic persons. The first was that of a clergyman, the Rev. J. T. L., a man of 63 and a widower, who on the eve of contracting a second marriage became aphasic, in which condition he could neither speak nor write, yet was able to convey to his medical attendants a clear and definite impression of his intentions and desires in disposing the usufruct of £30,000 to the lady to whom he was to be married, the capital of which sum at whose death was to revert to his own family, and then to be divided fairly and equally. Probate of the will, however, was not granted, because the testator had placed his mark in the middle of the document instead of at the foot, in terms of the statute 4 Vict. cap. 26, sec. 9—the Wills Act—or of the 15 Vict. cap. 24, sec. 1—Lord St Leonard's Act—but it was apparent that but for this technical flaw in the will, probate would have been granted.[1] The second case which was reported in *The Times*, Feb. 13, 1900, and of which an account of the aphasic condition is given fully by Dr Edmunds,[2] shows how the difficulties of will-making of an aphasic patient were surmounted in the most ingenious manner. The testatrix, a lady of some force of character, accustomed to manage her own business affairs, and possessed of a large estate, became aphasic. Dr Edmunds expresses her condition thus : " In-going ideas by way of ear or eye seemed to find complete mental receptivity. Out-going ideas were completely barred for want of power to utter them either in speech or in writing." It was important that she should make a will, and she was desirous of doing so. Dr Edmunds devised a plan, which, assisted by her solicitor who was familiar with the extent and nature of her estate, was carried through with great success. As she could mentally grasp by reading short groups of words, he hit upon the device of having printed a system of bold printed cards upon which various items of her estate were named in print, duties which would follow upon her death, as appointment of executors, and a series of cards bearing the names of those persons likely to become beneficiaries under the will, and of those likely to be named as executors. By means of these cards, which she sorted out and grouped, her desires were so clearly expressed that her solicitor was enabled to draft her will, which on a second occasion was read over to her clause by clause, with the result that it received her full assent, and with some assistance she put her mark to the will, which was formally witnessed by Dr Edmunds and her solicitor. At her death, and as her will disposed of landed property and personalty to a large amount, the will had to be proved, which was done in open Court before Sir Francis Jeune, who pronounced in favour of the will and of the method adopted to arrive at the wishes of the testatrix. Sir Francis

[1] " Law Reports," Probate Division, vol. xii., 1887, p. 8.
[2] *B. M. J.*, vol. i., 1900, p. 749 *et seq.*

Jeune remarked in his judgment that " this case is not quite an easy one because, so far as I know, it represents to me, at any rate, a novel mode of arriving at the real wishes of the testatrix, and I am perfectly conscious that what is suggested to me is suggested with a great deal of force, namely, that this method, although most well intended, and in its way most ingenious, and on the whole, I think, satisfactory, leaves it open to question whether or no it does exhaust the wishes of the testatrix, because, as has been pointed out, there is the necessary limitation, namely, that the wishes of the testatrix were bound by what was to be found on the face of these cards, and it is conceivable that there may have been a legacy, perhaps to a charity, or it might be a legacy to some person not within the circle of her relations, but a friend who may have been passing through the mind of the testatrix that she desired to make but to which she was quite incapable of giving effect. Or supposing this sort of case had been set up in its extreme form, that some name of a relation was by accident omitted, and was not on a card, or in a more extreme form, if it had been shown that she had expressed at other times the fact that she had in her mind the intention of benefiting some person or object not named on these cards, I think it might be shown that these cards did not, in fact, contain the whole statement of her wishes. But taking the matter as it stands, I think I am satisfied that her wishes were fairly ascertained. Everything was done that could be done. Nothing could have been more fair and ingenious (I mean skilful ; I do not mean to suggest any kind of subtle ingenuity), more skilful than the means adopted by Mr Garrett [the solicitor] and Dr Edmunds ; and I think they did everything any human being could do ; and inasmuch as they did put all the names of her relations, and as there is no reason to suppose she desired to benefit anybody but the relatives, I think on the whole one may say the will expresses her desires." Sir Francis Jeune commented upon the fact that the testatrix had evidently desired to appoint another executor but failed to do so because she could not find his name among the cards, but he said that, by the will being read over to her, clause by clause, she had had a second opportunity of checking the accuracy of the will, had she had any desire to do so, and he adds : " I think she had quite sufficient strength of mind and knowledge of the will to lead her to disapprove of it if she wished to. On the whole I think the method was fairly and satisfactorily adopted, and I feel satisfied that the will is the real will of the testatrix." For fuller details of this most interesting case, we must refer the reader to the references given ; but it must be added that the plan adopted, if not quite perfect, was as nearly perfect as could be, for it saved the putting of questions verbally which, it could be argued in a contested case, might be a source of confusion to the testator. In cases where this verbal mode of communication is adopted, however, it is advisable to intentionally make occasional glaring misinterpretation of an impression or instruction, so that the mental action of the patient may be tested. The testamentary capacity of any aphasic person can only be measured, in short, by the character and extent of the brain lesion and its effects upon the operation of the mind with respect to receptivity.

CRIMINAL RESPONSIBILITY

This has been, and is still, a very vexed question, in respect of the divergences in the legal and medical definitions of insanity. Doubtless, the difficulties in arriving at a common solution have not been lessened by the aggressive character of medical opinion on the subject, and also by the variability of procedure practised by different judges. There are some who see in the perpetration of every barbarous and abominable crime only the operations of insane persons, and with whom the perpetration of crime is synonymous with insanity; there are others who believe that the class of criminals whose actions are actually dominated by insanity is comparatively small. They do not hesitate to say that the popular tendency to initiate reprieves of capital sentences on the ground of insanity of most notorious criminals is productive only of harm. There exists a third class, perhaps the largest, which believes that the truth lies at some intermediate point between these extreme positions, and that each case must be investigated fully and decided on its merits. This last view is the most reasonable, and is a common ground of operation for both professions of law and medicine.

Law relating to Criminal Offences and Insanity

England.—The statutory enactments with respect to insanity as it may emerge in the cases of persons charged with crime or offences are comprehended in the following Acts—viz.

(1) The Criminal Lunatics Act, 1800 (39 & 40 Geo. III. cap. 94);
(2) Trial of Lunatics Act, 1883 (46 & 47 Vict. cap. 38); and
(3) Criminal Lunatics Act, 1884 (47 & 48 Vict. cap. 64).

I. The Criminal Lunatics Act, 1800:

Section 1 was repealed by the Act of 1883.

Section 2 reads as follows:—"And be it further enacted, that if any person indicted for any offence shall be insane, and shall upon arraignment be found so to be by a jury lawfully impannelled for that purpose, so that such person cannot be tried upon such indictment, or if upon the trial of any person so indicted such person shall appear to the jury charged with such indictment to be insane, it shall be lawful for the court before whom any such person shall be brought to be arraigned and tried as aforesaid, to direct such finding to be recorded, and thereupon to order such person to be kept in strict custody until his Majesty's pleasure shall be known; and if any person charged with any offence shall be brought before any court to be discharged for want of prosecution, and such person shall appear to be insane it shall be lawful for such court to order a jury to be impannelled to try the sanity of such person; and if the jury so impannelled shall find such person to be insane, it shall be lawful for such court to order such person to be kept in strict custody in such place and in such manner as to such court shall seem fit, until his Majesty's pleasure shall be known, and in all cases of insanity so found, it shall be lawful for his Majesty to give such order," etc.

Section 3 deals with the case of any person who is discovered and apprehended under circumstances that denote a derangement of mind and a purpose of committing some crime; and section 4 gives power to the Privy Council or one of the Secretaries of State to cause persons appearing to be insane and endeavouring to gain admittance to his Majesty to be kept in custody until the insanity of such persons shall be inquired into in the manner provided in this section.

II. Trial of Lunatics Act, 1883:

The principal provisions of the Trial of Lunatics Act, 1883, are as follows:—

Section 2. (1) "Where in any indictment or information any act or omission

is charged against any person as an offence, and it is given in evidence on the trial of such person for that offence that he was insane, so as not to be responsible according to law for his actions at the time the act was done or omission made, then, if it appears to the jury before whom such person is tried that he did the act or made the omission charged, but was insane as aforesaid at the time when he did or made the same, the jury shall return a special verdict to the effect that the accused was guilty of the act or omission charged against him, but was insane as aforesaid at the time when he did the act or made the omission.

(2) " Where such special verdict is found, the court shall order the accused to be kept in custody as a criminal lunatic in such place and in such manner as the Court shall direct till Her Majesty's pleasure shall be known, and it shall be lawful for Her Majesty thereupon, and from time to time, to give such order for the safe custody of the said person during pleasure in such place and in such manner as to Her Majesty may seem fit."

(3) [Repealed by 47 & 48 Vict. cap. 64.]

(4) " All provisions in any existing Act or in any rules or orders made in pursuance of any existing Act, having reference to a person or persons acquitted on the ground of insanity, shall apply to a person or persons in respect of whom a special verdict is found under this Act."

Section 3 enacts that this Act shall not extend to Scotland, but shall extend to Ireland.

This Act repeals sect. 1 of 39 & 40 Geo. III. cap. 94 ; sect. 16 of 1 & 2 Geo. IV. cap. 33, and sect. 3 of 3 & 4 Vict. cap. 54.

III. Criminal Lunatics Act, 1884 :

The Criminal Lunatics Act, 1884, was an Act to consolidate and amend the law relating to criminal lunatics. Its main provisions are as follows :—

Section 2. (1) " Where a prisoner is certified to be insane, a Secretary of State may if he thinks fit, by warrant direct such prisoner to be removed to the asylum named in the warrant, and thereupon such prisoner shall be removed to and received in such asylum, and, subject to the provisions of this Act relating to conditional discharge and otherwise, shall be detained therein, or in any other asylum to which he may be transferred in pursuance of this Act, as a criminal lunatic until he ceases to be a criminal lunatic. (2) A person shall cease to be a criminal lunatic if he is remitted to prison or absolutely discharged in manner provided by this Act, or if any term of penal servitude or imprisonment to which he may be subject determines. (3) Where it appears to any two members of the visiting committee of a prison that a prisoner in such prison, not being under sentence of death, is insane, they shall call to their assistance two legally qualified medical practitioners, and such members and practitioners shall examine such prisoner and inquire as to his insanity, and after such examination and inquiry may certify in writing that he is insane. (4) In the case of a prisoner under sentence of death, if it appears to a Secretary of State, either by means of a certificate signed by two members of the visiting committee of the prison in which such prisoner is confined, or by any other means that there is reason to believe such prisoner to be insane, the Secretary of State shall appoint two or more legally qualified medical practitioners, and the said medical practitioners shall forthwith examine such prisoner and inquire as to his insanity, and after such examination and inquiry such practitioners shall make a report in writing to the Secretary of State as to the sanity of the prisoner, and they, or the majority of them, may certify in writing that he is insane. (5) The powers and duties conferred and imposed on any two members of the visiting committee of a prison shall be exercised in the case of a prisoner in any prison within the jurisdiction of the Directors of Convict Prisons by the said Directors or one of them, and in the case of a prisoner in any prison within the jurisdiction of the Prison Commissioners may also be exercised by the said Commissioners or one of them, and in the case of a prisoner in any prison not within the jurisdiction of such directors or Commissioners shall be exercised by two visitors of the prison or by two justices of the county or place in which such prison is situate."

Section 3. Where it is certified by two legally qualified medical practitioners

that a person being a criminal lunatic (not being a person with respect to whom a special verdict has been returned that he was guilty of the act or omission charged against him, but was insane at the time when he committed the act or made the omission) is sane, a Secretary of State, if satisfied that it is proper so to do, may by warrant direct such person to be remitted to prison, to be dealt with according to law.

Section 4 enacts that the superintendent of any asylum or other place in which any criminal lunatic is detained shall make a report not less than once a year to a Secretary of State giving such particulars as the said Secretary may require of the condition and circumstances of every criminal lunatic in such asylum or place, and the said Secretary of State shall at least once in every three years, take into consideration the condition, history, and circumstances of such lunatic, and determine whether he ought to be discharged or otherwise dealt with ; and where a criminal lunatic is conditionally discharged, a report of his condition shall be made to a Secretary of State by such superintendent at such times and containing such particulars as may be required by the warrant of discharge.

Section 5 enacts that a Secretary of State may transfer by warrant any criminal lunatic from one asylum to another, and may in like manner absolutely discharge such lunatic or conditionally discharge him on such conditions as the said Secretary may think fit ; and where a criminal lunatic has been discharged conditionally, if the conditions have been broken or the discharge revoked, said Secretary may by warrant direct him to be taken into custody and may be taken to some asylum named in the warrant.

Section 6 declares that where a criminal lunatic detained in any asylum or place is either absolutely discharged or the term of his penal servitude or imprisonment determines, the superintendent of said asylum or place shall, unless satisfied that such lunatic is now sane, take all reasonable means for his being placed under the care of some relation or friend or in some asylum or place.

Section 7 enacts that where a criminal lunatic is detained in an asylum or other place or being a prisoner in any prison is certified in manner provided by this Act to be insane, but has not been directed by the Secretary of State to be removed to an asylum, and it is made to appear to any justice of the peace having jurisdiction where such asylum or place or prison is situate, or being a member of the visiting committee of such prison, by notice signed by the superintendent of such asylum or place or by the governor of such prison, either that such lunatic is about to be absolutely discharged or that any term of penal servitude or imprisonment to which such person is subject is about to determine, and that in the opinion of such superintendent or governor such person is insane and unfit to be at large, the said justice shall examine such person and make any inquiry and take any medical or other evidence which he may deem necessary respecting him ; and the said justice, if satisfied from such examination and inquiry that such person is insane and a proper person to be detained under care and treatment, shall make an order for his detention as a lunatic in a place named in the order, and if within one month after date of said notice such criminal lunatic is absolutely discharged or such term of penal servitude or imprisonment determines, the said order shall take effect, and he shall be deemed to be a pauper lunatic. An order under this section shall be in such form as may be prescribed by a Secretary of State, and there shall be inserted in every such order, wherever possible, the name and address of one or more of the relations of the lunatic.

Section 8 deals with the provisions as to disposal and detention of persons who become pauper lunatics ; and it provides that in any case where the union or parish to which a person will, for the purposes of this Act, be *primâ facie* chargeable is in Scotland or Ireland, the justice shall report the same to the Secretary of State, who may by warrant direct the removal of such person upon his becoming a pauper lunatic to Scotland or Ireland, as the case may be ; and where such person is removed to Scotland, he shall be removed to the General Prison at Perth, and may be dealt with in the same manner as if he were a person certified in pursuance of section 23 of the Lunacy (Scotland) Act, 1862.

Section 12 enacts that a Secretary of State may make, and when made, may revoke and vary, regulations for the treatment of persons sentenced to or ordered to be kept in penal servitude or imprisonment who appear to be from

imbecility of mind either unfit for penal discipline or unfit for the same penal discipline as other prisoners.

Section 13 declares that nothing in this Act shall restrain or affect the authority of His Majesty to make any order with respect to any person for whose safe custody during His pleasure His Majesty is by law authorised to give order.

Section 18 declares that save as in the Act expressly provided, this Act shall not extend to Scotland or Ireland.

This Act repeals the whole Act, 3 & 4 Vict. cap. 54; section 21 of 6 & 7 Vict. cap. 26; part of section 38 of 16 & 17 Vict. cap. 96; part of section 2 and the whole of sections 7, 9, and 10 of 23 & 24 Vict. cap. 75; section 15 of 25 & 26 Vict. cap. 86; the whole of 27 & 28 Vict. cap. 29; section 80, so far as relates to a person imprisoned in England, of 29 & 30 Vict. cap. 109; the whole of 30 & 31 Vict. cap. 12; the whole of 32 & 33 Vict. cap. 78; and section 130, so much of sub-section 5 as relates to a person imprisoned in England, and sub-section 3 of 46 & 47 Vict. cap. 38.

Procedure.—When a prisoner called upon to plead stands mute, the Court directs a jury to be impannelled and sworn to try whether the prisoner stands mute of malice or *ex visitatione Dei*. A person is mute by the visitation of God when he is deaf and dumb or so deaf that he cannot hear the indictment when read. If the jury find that the prisoner stands mute of malice, the Court will order a plea of Not Guilty to be recorded. If the verdict is mute by the visitation of God, the further question has to be answered, Whether he is sane, and whether intelligence can be conveyed to him by signs and symbols. The issue to be tried is the state of the prisoner's mind at the date of arraignment, not at any prior time, and it is usual for the judges to require some evidence as to the prisoner's state of mind and not to rely solely upon his appearance and demeanour in the dock. The jury may find that the prisoner is not sane, and upon this the judge orders him to be confined until His Majesty's pleasure shall be known. In the meantime, the indictment "remains on the file," and on the prisoner's recovery he may have to stand his trial for the offence charged against him. The jury may find the prisoner incapable of pleading to and taking his trial upon the indictment and of understanding and following the proceedings by reason of his inability to communicate with and be communicated with by others. This is held to be equivalent to a verdict of insanity, and the prisoner is detained during His Majesty's pleasure.

The following cases are illustrative of this :—

A remarkable case was brought before Mr Justice Darling at the Central Criminal Court, London, in November 1897.[1] The facts were these: A man named Harris was charged with the crime of murder. After killing his victim, he attempted to commit suicide by cutting his throat. The effect of his self-inflicted violence was to destroy his vocal cords, so that he was unable to speak. Neither could he read or write. Hence he was unable to instruct his defence. It is the law that punishment cannot follow a criminal act (1) where the accused is found to be insane, (2) or is mute from defective organisation, (3) or where the accused cannot plead from want of an adequate interpreter or an interpreter of any kind. This man Harris being unable to speak, to read, or to write, was, to all intents and purposes, mute, and thereby unable to instruct his defence. Mr Justice Darling, however, put certain questions to the jury, in answer to which they found that the prisoner could plead to the indictment, that he was sane, that he was not then capable of instructing his defence, and that the cause of his disability was the result of his own unlawful act.

[1] *B. M. J.*, vol. ii., 1897, p. 1671; Session Papers, Nov. 26, 1897, and Jan. 12, 1898.

The judge thereupon asked the prisoner to plead, whereupon at first he merely shook his head, but on being asked a second time, he whispered "Not," and the judge ordered the trial to be adjourned till the next Sessions. He was tried at the succeeding Sessions, Jan. 12, 1898, before Mr Justice Channell and a jury, was found guilty by the jury who found that he was responsible for his actions up to the time he committed the crime, and added a strong recommendation to mercy. He was sentenced to death.

The following is also an unusual case—viz. The King *v.* The governor of his Majesty's Prison at Stafford, *Ex parte Emery.*

A prisoner, who was totally deaf and could neither read nor write, was arraigned for a felony. Upon being arraigned, he stood mute, and a jury, duly impannelled and sworn for the purpose, found that he was mute by the visitation of God. The jury were sworn again to try whether he was capable of pleading to the indictment, and they found that he was incapable of pleading and taking his trial upon the indictment and of understanding and following the proceedings by reason of his inability to communicate with and be communicated with by others. Upon this finding, the judge, acting under section 2 of the Criminal Lunatics Act, 1800, ordered him to be kept in custody until His Majesty's pleasure should be known. Held: That the finding amounted to a finding that the prisoner was insane within the meaning of the Act and that the order was properly made.[1]

The jury may find that the prisoner is sane, and notwithstanding his infirmity, able to communicate with and be communicated with. (*Vide ante.*) In this case the prisoner must plead to the indictment or a plea of Not Guilty is entered.

In the case of R. *v.* Pritchard (7 C. and P. 303), where a prisoner arraigned on an indictment for felony appeared to be deaf and dumb and also of non-sane mind, Alderson B. put three distinct issues to the jury: (1) Whether the prisoner was mute of malice or by the visitation of God; (2) Whether he was able to plead; (3) Whether he was sane or not; and on the last issue the jury were directed to inquire whether the prisoner was of sufficient intellect to comprehend the course of the proceedings of the trial so as to make a proper defence, to challenge a juror he might wish to object to, and to understand the details of the evidence.

If a prisoner who is mentally unfit to plead be by mistake placed upon his trial, if his unfitness to plead become apparent in the course of the trial, the judge may in his discretion discharge the jury.

Where on the trial of a deaf mute for felony the jury returned the following verdict:—We find the prisoner guilty on the evidence, and we also find that he is not capable of understanding and as a fact has not understood the nature of the proceedings—it was held that the prisoner could not be convicted, but must be detained as a non-sane person during the Queen's pleasure.[2] A question as to the prisoner's sanity may also and usually does arise when he is being tried upon the merits of the case. But in this case the issue is not whether he is sane or not at the time of the trial—he may be perfectly sane then—but whether he was sane at the time the offence charged against him was committed—*e.g.* in cases of epilepsy and puerperal insanity.

[1] 2 K. B., 81, 1909: Author, *The Lancet*, vol. ii., 1909, p. 142,
[2] Archibold's "Criminal Pleading," p. 221.

Formerly the form of the verdict in these cases was "Not Guilty on the ground of insanity." But now by the Trial of Lunatics Act, 1883 (*vide ante*), it is enacted that the verdict shall be "Guilty of the act (or omission), but so insane as not to be responsible according to law for his actions at the time when the act was done (or the omission made)." The prisoner is then ordered to be kept in custody as a "criminal lunatic" until his Majesty's pleasure shall be known. Such confinement is usually life-long, as statistics show that only one prisoner in one hundred and fifty obtains release from Broadmoor; consequently insanity as a defence is rarely set up except in capital crimes.

According to Kenny [1] "insanity is sometimes important in criminal law even apart from its bearing on *mens rea*. For if a man become insane after committing a crime, he cannot be tried until his recovery; and again, if after conviction a prisoner become insane (a lunatic criminal), he cannot be hanged until his recovery, for he may have some plea which, if sane, he could urge in stay of execution."

SCOTLAND.—The provisions with regard to Scotland are contained in the Lunacy Acts of 1857, 1862, and 1871.

LUNACY ACT, 1857

The following are contained in the Act of 1857 :—

Section 87 reads thus :—"Where any person charged under any indictment or criminal libel with the commission of any crime shall be found insane, so that such person cannot be tried upon such indictment, or if upon the trial of any person so indicted such person shall appear to the jury charged with such indictment or criminal libel to be insane, the Court before whom such person shall be brought to be tried as aforesaid shall direct a finding to that effect to be recorded, and thereupon such court shall order such person to be kept in strict custody until Her Majesty's pleasure shall be known; and it shall be lawful for Her Majesty to give such order for the safe custody of such person so found insane during Her pleasure in such place and in such manner as to Her Majesty shall seem fit.

"Section 88. In all cases where it shall be given in evidence upon the trial of any person charged under any indictment or criminal libel with committing any crime or offence that such person was insane at the time of committing such crime or offence, and such person shall be acquitted, the jury shall be required to find specially whether such person was insane at the time of committing such crime or offence, and to declare whether such person was acquitted by them on account of such insanity; and if they shall so find and declare, the Court before whom such trial shall be had shall order such person to be kept in strict custody in such place and in such manner as to the Court shall seem fit, until Her Majesty's pleasure shall be known; and it shall be lawful for Her Majesty to give such order for his safe custody," etc.

Section 89 provides for the case of a prisoner who exhibits insanity when in confinement as a prisoner under any sentence or under any charge of any crime or offence, or under any civil process. In such case, the Sheriff shall inquire, with the aid of two medical persons, as to the insanity of such prisoner, and if it shall be certified by such Sheriff and such medical persons that such prisoner is insane, it shall be lawful for one of Her Majesty's Principal Secretaries of State, upon receipt of such certificate, to direct by warrant under his hand that such person shall be removed to an asylum as the said Secretary of State may judge proper and appoint; and every prisoner so removed under this Act from prison to an asylum by reason of his insanity shall remain in confinement in such asylum until it shall be duly certified to one of Her Majesty's Principal Secretaries of State by two medical persons that such person has become of sound mind, whereupon the said Secretary of State is hereby authorised, if such person shall remain subject to be continued in custody, to issue to the superintendent of such asylum directing that such

[1] Kenny, "Outlines of Criminal Law."

person shall be removed back from thence to the prison or other place of confinement from whence he shall have been taken, or, if the period of imprisonment of such person shall have expired, that he shall be discharged.

Lunacy Act, 1862

In the Act of 1862 the only two sections which deal with the relation of lunacy and crime are sections 15 and 19.

Section 15, which repealed section 85 of the Act of 1857, is as follows:—"When any lunatic shall have been apprehended, charged with assault or other offence inferring danger to the lieges, or when any lunatic shall be found in a state threatening danger to the lieges or in a state offensive to public decency, it shall be lawful for the Sheriff of the County in which such lunatic may have been apprehended or found, upon application by the Procurator-fiscal or inspector of poor or other person, accompanied by a certificate from a medical person bearing that the lunatic is in a state threatening such danger or in a state offensive or threatening to be offensive to public decency, forthwith to commit such lunatic to some place of safe custody; and the Sheriff shall thereupon direct notice to be given, in some newspaper circulated in the county within which such lunatic was apprehended or found, of such commitment, and that it is intended to inquire into the condition of such lunatic on an early day to be named, and shall also direct notice of the application to be given to the inspector of poor of the parish within which the lunatic has been apprehended or found (where the application is not presented by the inspector of poor of such parish), and such further notice as he shall think fit; and if the inspector of the parish does not within twenty-four hours undertake to the satisfaction of the Sheriff to make due arrangements for the safe custody of such lunatic, the Sheriff shall accordingly proceed to take evidence of the condition of such lunatic, and upon being satisfied that he is a lunatic and in a state threatening danger to the lieges or offensive to public decency, he shall commit the lunatic to an asylum; and an order authorising the superintendent of the asylum to which the lunatic may be committed to receive the lunatic, and authorising the transmission of the lunatic to such asylum, shall be granted by the Sheriff in respect of every such commitment; and such lunatic shall be detained in such asylum until cured or until caution shall be found for his safe custody, in which last case it shall be lawful for the Sheriff upon application to that effect and on being satisfied as to such caution, and the safety and propriety of such custody, to authorise the delivery of the lunatic to the person so finding security." The rest of the section deals with the question of expenses and to whom chargeable.

Section 19 enacts that if at any time within sixty days of the expiration of the sentence of any convict or other person confined in the General Prison at Perth, it is certified on soul and conscience by two or more medical persons that they have personally visited and carefully examined the prisoner within the said sixty days, and that he is in their opinion insane, and that his insanity is of a kind which renders it advisable that he should be detained in the lunatic department of the said General Prison rather than in a lunatic asylum, it shall be lawful for one of Her Majesty's Principal Secretaries of State by a writing under his hand to authorise such prisoner to be detained in the said General Prison after the expiration of his sentence, and such prisoner may thereupon be detained accordingly; provided that it shall at any time thereafter be lawful for Her Majesty to give such order for the safe custody of such prisoner during Her Majesty's pleasure in such place and in such manner as to Her Majesty shall seem fit.

This Act repeals sections 22 and 23 of the former Act, and such other provisions of that Act as are inconsistent with this Act.

The Criminal and Dangerous Lunatics (Scotland) Amendment Act, 1871, deals mainly with the detention and disposal of criminal lunatics. Section 2 declares that where a person charged under indictment or criminal letters shall be ordered by the Court to be kept in custody until Her Majesty's pleasure shall be known, any order which Her Majesty

shall be pleased to issue in relation to the custody of such person may be varied or renewed from time to time, and it shall be lawful for her Majesty, by a Secretary of State, to authorise on terms the liberation from custody in prison or elsewhere of any person who has been ordered to be kept in custody, and if any of the conditions of such liberation are broken, any Principal Secretary of State may direct such person to be taken into custody and to be taken back to the place in which he was detained at time of liberation, or to any other place, such person to revert in all respects to the same position as he was in at time of liberation; section 4 enacts that when regarding any insane prisoner in Perth General Prison it is certified on soul and conscience by two medical persons that they have visited and examined such prisoner, and that in their opinion he is insane, but that his insanity is of a kind which can be properly treated in a lunatic asylum, it shall be lawful for a Secretary of State, in writing, to order the removal of such prisoner to any district asylum, or to any chartered or licensed asylum in which pauper lunatics are maintained in terms of any contract for such maintenance; section 5, that any insane prisoner who has been removed from Perth General Prison shall be removed back thereto on any order to that effect by a Secretary of State; section 6 enacts for a local prison and for a Sheriff or his substitute with regard to removal from prison to an asylum what section 4 enacted for Perth General Prison and a Secretary of State; section 7 enacts for a Sheriff with regard to reconveyance of a prisoner from an asylum the same power as section 5 did for Perth Prison and a Secretary of State; and section 8 enacts with regard to the interpretation of ss. 15 and 16 of 25 & 26 Vict. cap. 54, that these sections shall not be limited to pauper lunatics, but shall apply to any person so charged or found, although he may not, by receiving parochial relief, or in any other form, come within the definition of a pauper.

Procedure.—A plea of insanity in bar of trial must be stated at the first diet which is held in the Sheriff Court of the district in which prisoner is confined. If present insanity is proved, the Court will find that the accused cannot be tried, and will order him to be confined until the Royal pleasure regarding him shall be known. Although no question as to insanity is raised on behalf of the accused, the prosecutor may raise the question (Alexander Robertson, March 30, 1891. 3 White, 6; Thomas M. Brown, High Court, March 18, 1907). The Court, if they see cause, will, *ex proprio motu*, investigate whether the accused is a fit subject for trial or not. (Alison 1, 659–660.) [1]

This was the practice for over a century, but a change in procedure was made in Brown's case by a Bench of Judges after hearing arguments. (*Vide postea.*) In that case the Lord Justice-General Dunedin, in delivering judgment, said "it was quite clear from the cases cited that from a very early period it had been the practice of that Court, if it was thought expedient, to make inquiry into the state of a prisoner's sanity in order to discover whether a prisoner should or should not be asked to plead. . . . He did not see any necessity for a preliminary investigation as to the sanity of the accused, because it was open to the jury to say at the conclusion of the evidence whether he was insane at that moment, which would end the matter, that he did not commit the

[1] Macdonald, "Criminal Law of Scotland," 3rd edit., p. 431.

crime, or that he was insane when he did commit the crime. He therefore proposed that the Court should call upon the prisoner to plead." The other judges concurred.

If the jury after trial hold the accused to be insane at the time of the commission of the offence charged against him, they acquit him on the ground of insanity. If at any stage of the trial they arrive at the conclusion that accused is insane, a finding to that effect is recorded. (*Op. cit.* p. 510.) When the acquittal is on the ground of insanity, the accused is ordered to be detained in custody until the Royal pleasure shall be made known.

If a prisoner commits a crime, being then insane, and is committed to an asylum for criminal lunatics, and later recovers, he is tried on his recovery for the crime, and after evidence of his insanity at the time of commission of the offence and of his recovery, he is acquitted on the ground of insanity, but is not discharged until, on petition, he shall be liberated by the Secretary for Scotland. (*Vide postea*, Wigtownshire Case.)

The plea of insanity may be raised at two stages in a criminal charge : first, in bar of trial, and, second, in bar of sentence. The former is pleaded because the accused is incapacitated by mental defect, or unsoundness, from instructing his defence.

In the latter contingency—the plea of insanity in bar of sentence—a special plea of insanity may be put forward, and if the insanity be proved, the jury will be directed to acquit the prisoner on that ground, but the Court shall order the accused to be confined in an asylum during the Royal pleasure.[1]

By what tests ought criminal responsibility to be gauged ? If we approach the subject of criminal responsibility first of all from the legal side, we shall, perhaps, be better able to comprehend and appreciate the differences, if any, which exist from the medical side.

The presumption of the law is that every person who has arrived at the age of discretion is sane and is accountable for his actions unless the contrary is proved. The burden of proof is upon the person setting up the defence of insanity, who must not merely prove some taint of insanity but the particular and appropriate kind recognised by the law. There are many persons who have some taint of insanity who are, nevertheless, influenced by the same motives as ordinary persons. The fear of punishment has a sufficiently strong deterrent effect upon them. " They would not have yielded to their insanity if a policeman had been at their elbow," said Lord Bramwell on one occasion. For such the defence of insanity would probably be unsuccessful. But those upon whom the fears and prohibition of the criminal law have no effect, those who at the time of committing the act are prevented by disease of the mind from knowing the nature and quality of the act or from knowing that the act was wrong, are exempt from punishment. " Where the deprivation of understanding and memory is, total, fixed, and permanent, it excuses all acts ; so likewise a man labouring under adventitious insanity is, during the frenzy, entitled to the same indulgence in the same degree with one whose disorder is fixed and permanent." [2] The modern rule in cases of insanity was laid down in the set of answers

[1] 20 & 21 Vict. c. 71. [2] Beverley's Case, 4 Co. Rep. 125.

delivered by the judges in reply to abstract questions put to them in 1843, and which we shall consider in detail later.

The legal aspect of the subject may be taken with the greatest confidence from Sir James Fitzjames Stephens,[1] who, in his treatment of the subject, starts from the proposition that legal authorities have been right in " holding that the mere existence of madness ought not to be an excuse for crime, unless it produces in fact one or other of certain consequences . . . that the principle which they have laid down will be found, when properly understood and applied, to cover every case which ought to be covered by it. But the terms in which it is expressed are too narrow when taken in their most obvious and literal sense, and when the circumstances under which the principle was laid down are forgotten." He further makes the statement that the subject " is one of the greatest difficulty, and it is most imperfectly understood by medical men as well as by lawyers." Because, in the case of the former, of the want of appreciation of the different degrees of authority to be ascribed to different judicial declarations of the law, the want of acquaintance with the rules for the interpretation of these, as well as for other reasons. He sounds an excellent note in the statement that in a subject so obscure and so difficult the two professions should rather try to assist each other in its solution than to speak harshly of each other. What, he asks, is the meaning of the word mind ? He answers that it is a general name for the combined operations of sensation, intellect, emotion, and volition. Regarding this answer there should be no difference of opinion. Any aberration of the mind, therefore, must be indicated in one or other, or more than one of these functions. The difference between a sane and an insane mind will consist in the normal or abnormal existence of these mental functions. He argues rightly, that when a man either " feels, knows, believes, remembers, is conscious of motives, deliberates, wills, or carries out his determination," it is through the agency of the brain and nervous system that they can be accomplished, but the physiological bases of operation no man can formulate or define, although he may speculate regarding them ; that the brain being an organ of great delicacy is liable to a great many varied diseases—using this word in a broad sense—some of which interfere with the due performance of the mental functions, while others do not. If these diseases be reviewed with regard to the incidence of their effects, it will be found that they may be divided into two different groups—viz. (1) those which affect prejudicially the emotions, either with respect to their morbid production, their control, or their persistence ; and (2) those which affect prejudicially the operation of the intellect and will. Of the former class which affect the emotions, the effect of their operation is either melancholia, where the emotions are depressed, or mania, where the emotions are preternaturally excited. But there is a form of interference with the regulated and normal action of the will which is characterised by incontrollable impulse, and which may appear in persons, who, otherwise, look in normal mental health, but in whom, on careful inquiry, certain factors—it may be of heredity, for example—are found which may be reckoned as accountable for its genesis. It is, therefore, apparent that insanity may taint every mental function, and may

[1] " History of the Criminal Law of England," vol. ii., pp. 124-186.

exhibit itself as unnatural actions, delusions, hallucinations, exaggerated impulses, and moral insensibility.

The law recognises that insanity may be an excuse for crime committed by a person in that condition. In Sir James Stephens' Digest,[1] he puts this proposition as follows:—" No act is a crime if the person who does it is at the time when it is done prevented [either by defective mental power or] by any disease affecting his mind,

" (*a*) From knowing the nature and quality of his act, or

" (*b*) From knowing that the act is wrong [or

" (*c*) From controlling his own conduct, unless the absence of the power of control has been produced by his own default].

" But an act may be a crime although the mind of the person who does it is affected by disease, if such disease does not in fact produce upon his mind one or other of the effects above mentioned in reference to that act." It is to be noted that the parts bracketed are deemed by Sir James Stephens as doubtful law.

With respect to the legal interpretation of the term " wrong " in this connection, the criterion is not legal " right " and " wrong," but moral right and wrong. This is borne out by the equivalent phrases which have been used by judges; such, for example, as " capable of distinguishing good from evil,—capable of knowing what is proper—capable of knowing what is wicked." Besides, it must be a knowledge which is not merely general and abstract, but a knowledge which must exist with regard to the particular act under consideration.

The exposition of the law, upon which decisions are now made, was given in the answers of fourteen judges to certain questions put to them on abstract issues by the House of Lords in June 1843.[2] The cause of this step was the acquittal, on the ground of insanity, of McNaghten in 1843, for the murder of Mr Drummond whom he shot by mistake for Sir Robert Peel, for whom he had lain in wait. In that case, the medical evidence was to the effect that " a person of otherwise sound mind might be affected with morbid delusions; that the prisoner was in that condition; that a person labouring under a morbid delusion might have a moral perception of right and wrong; but that in the case of the prisoner [McNaghten], it was a delusion which carried him away beyond the power of his own control, and left him no such perception, and that he was not capable of exercising any control over acts which had a connection with his delusion." The answers which the jury gave to the questions put to them were to the effect that at the time the act was committed the prisoner did not have the use of his understanding so as to know that he was doing a wrong and wicked act, and that the prisoner was not sensible at the time he committed the act that he violated both the laws of God and man. It is impossible in our space to give all the questions and answers submitted and replied to, but the second and third questions and the kernel of the answers thereto must be given.

Question II. was as follows:—" What are the proper questions to be submitted to the jury when a person, afflicted with insane delusions respecting one or more particular subjects or persons, is charged with the commission of a crime (murder, for instance), and insanity is set

[1] *Op. cit.*, Art. 27. [2] 10 C. & F., p. 200.

up as a defence ? " and Question III. : " In what terms ought the question to be left to the jury as to the prisoner's state of mind at the time when the act was committed ? " The pith of the judges' answer was : " That, to establish a defence on the ground of insanity, it must be clearly proved that at the time of committing the act the accused was labouring under such a defect of reason from disease of the mind as not to know the nature and quality of the act he was doing, or if he did know it, that he did not know he was doing wrong."

While the answers of the judges referred to have been generally accepted in this country as the law in regard to insanity as affecting criminal responsibility, this is not true of the view on the subject in some of the British Colonies and in America. In the Queensland Code of 1899, section 27, drafted by Griffith, C.J. of that Colony, after consideration of the English authorities and of Continental and American legislation, the view of Sir James Stephens is substantially adopted : " A person is not criminally responsible for an act or omission if at the time of doing the act or making the omission he is in such a state of mental disease or natural mental infirmity as to deprive him of capacity to understand what he is doing or of capacity to control his actions or of capacity to know that he ought not to do the act or make the omission."

In the case of R. *v.* Hay (2899, 16 Cape of Good Hope Rep. Sup. Ct. 290), de Villiers, C.J., after hearing a full argument based on the law of England and of the United States and on the Roman Dutch law, laid down as the rule of that colony the following :—" (1) Where the defence of insanity is interposed in a criminal trial, the capacity to distinguish between right and wrong is not the sole test of responsibility in all cases ; (2) In the absence of legislation to the contrary, courts of law are bound to recognise the existence of a form of mental disease which prevents the sufferer from controlling his conduct and choosing between right and wrong, through he may have the mental capacity to distinguish between right and wrong ; (3) The defence of insanity is established if it be proved that the accused had by reason of such mental disease lost the power of will to control his conduct in reference to the particular act charged as an offence ; (4) The capacity of the accused to control his own conduct must be presumed till the contrary is proved."

In the State of New Hampshire, United States of America, the opinion of the Court in State *v.* Pike, as delivered by Chief-Justice Doe in 1869 (49 N. H. 402), ran counter to the rule laid down by the English judges on the " knowledge of right and wrong " test. In this connection, see also the cases State *v.* Jones, 50 N. H. 369, and Parsons *v.* State, 36 Albany Law Journal, 326.

So far back as 1863 the answers of the English judges were practically discarded in the Scottish Courts. In the case of Alexander Milne, tried on Feb. 9, 1863,[1] Lord Justice-Clerk Inglis told the jury that if they were satisfied that a person charged with murder, as was the prisoner, was the victim of insane delusions at the time of commission, they had no need to inquire whether he knew what was right from what

[1] 4 Irvine Just. Reports, pp. 301-343.

was wrong or whether he knew what was murder in the eyes of the law, or what was a punishable act.

The whole question from the legal side has been tersely and clearly put as follows :—

"In a strictly legal sense there is no insane criminal. Concede insanity, and the homicidal act is not criminal. The act of the insane, which in the sane would be criminal, lacks every element of crime. . . . A sane man, who has committed crime, may thus become insane, either before or after conviction for the crime. He may be rightfully called an insane criminal. If the insanity develops before the trial, the law would suspend his trial while the insanity continued. If the insanity came after conviction, he should be treated as an insane man, not as a criminal. The medical mind frequently views the question of insanity as one of responsibility only. To the legal mind, insanity conceded, responsibility ends. . . . If a man is clearly insane, he is not a criminal, even though 'he has within him a tendency sufficiently strong to cause him to commit offences against both person and property.' He needs care, and the State has the right, and it is its duty, to protect him from the consequences of his own mental condition. . . . It is a question of fact, usually for the jury—Is the man, or was the man, insane at the time the act was committed ? If the jury says by its verdict he was insane, then the court sends him to an asylum for the treatment of the insane. If the verdict is that the prisoner is guilty, the effect of that verdict is that he was not insane, and the court sends him to prison. If the jury err, and pronounce an insane man guilty, he comes into prison by the side of the criminal who after conviction becomes insane. But there is, in fact, a wide distinction between them—the one is absolutely innocent of crime, because he was insane at the time of the act, and he is in no sense a criminal in fact. The other, who is a criminal in the eye of the law, has a 'disturbed interval' in his sentence, much as the same mind is said, at law, to have lucid intervals." [1]

Sir James Stephens' comment upon these answers of the English judges is that the questions were put in a very general form, and that they could hardly have been meant to be exhaustive, because if they were so meant, the implication is that the effect of insanity (if any) upon the emotions and will is left out of consideration, and is not to be taken into account in deciding whether an act done by an insane person did or did not amount to an offence, which, if it were put in the form of a proposition, would be contrary to experience. The interpretation of the law, as laid down in the answer quoted, is however different in the rulings of different judges. Some adhere to its literal terms, and, logically, the medical evidence must be confined to a description of the state of mind of the accused at the time the act was done, which, in many cases, may be absolutely impossible, although an opinion might be hazarded on the point from his mental condition at the time of the examination. Other judges leave the jury to say from the evidence led whether the accused was "prevented by any disease affecting his mind from controlling his own conduct." This certainly enlarges the purview, and it permits of medical evidence being led of the mental condition of the accused at the time of examination, and, based upon that, as to whether

[1] *Medico-Legal Journal of New York*, September 1898, p. 268.

any disease then present was likely to have been present at the time of commission of the act, and to have prevented him from controlling his conduct. Again, other judges put the question to the jury, whether the accused knew the nature and quality of the act, and whether he was of sound mind. This is a still more liberal interpretation of the law, inasmuch as, by implication, a person may be insane who at the time he committed the act knew the nature and quality of the act, and, consequently, any relevant medical evidence would be admitted which bore on the mental condition of the accused. It will be obvious from the interpretation which each judge puts on the law that the range and character of the medical evidence which is permissible will be affected. Some judges will permit of the fullest medical evidence, not only respecting the mental state of the accused at the time of examination, but also bearing on the state of the accused at the time the act was done; others will only permit the medical witness to testify to the details of the interview or interviews between the witness and the accused, and not of his opinion as to the sanity or insanity of the accused, since, it is argued, that is the question which the jury is to decide; others, again, desire not a mere record of the facts of the interview, but the opinion at which the medical witness has reached therefrom. It is difficult, therefore, for a witness to know in any particular case before a particular judge what kind of evidence he is expected to offer; and there can be little doubt that a better feeling would prevail between the two professions if some more uniform practice were to be established, for it ought to be acknowledged that in matters medical the members of that profession might be expected to offer opinions from certain facts at which an ordinary judge, and certainly a jury, might be unable to arrive. The medical profession takes the law deferentially from the Bench, and surely the Bench should give deference, subject to the legal rules of evidence, to the opinions of the medical profession. It cannot be otherwise than difficult for a medical witness to understand why, in the same case, perhaps, in which he has been called upon to give opinions regarding the cause of death of a victim from violence, he or another medical witness is debarred from offering an opinion as to the mental condition of the accused person; for, after all, if it be the duty of the jury alone to form an opinion as to the sanity of the accused, should it not equally be the duty of the jury to arrive at the mode by which the violence was inflicted which caused the death?

Assuming, however, that the witness is permitted to offer such relevant evidence as will throw light upon the mental condition of the accused at the time of the examination, and, by implication, of his mental state at the time of the commission of the act, what kind of evidence would justify the witness in offering an opinion of the insanity and irresponsibility of an accused person? The existence of delusions, generally speaking, and of delusions bearing specially upon the particular crime which has been committed would be strong evidence, because their existence betokens dissociated cerebral action. A delusion may act in one of two ways: (1) either by rendering the whole mental action abnormal and oblique, or (2) by rendering certain mental actions abnormal. For example, in the case of Hadfield who attempted the life of George III. by shooting, it was stated by Erskine,

his counsel, that Hadfield imagined that he had constant intercourse with the Almighty, that he was bound to sacrifice himself, as the Saviour did, for the salvation of the world, and that he supposed, by committing this crime, that the law would put him to death, and thus the sacrifice would be accomplished. Thus he apparently knew the nature of the act he tried to do, and he knew it was wrong and punishable, because he expected to be put to death for it. In this case, therefore, this delusion so dominated his mind, that it could not be affirmed that his actions were not all more or less coloured by it, or that he was responsible for the result of his actions. On the other hand, a man may be the subject of a delusion which, under ordinary circumstances, would probably affect in some way his actions, but with which, probably, no causal connection—from his standpoint—could easily be traced with a crime which he has committed. But who shall say authoritatively and without risk of error that either, or both, of such persons is responsible or irresponsible, is sane or insane ? No one, with certainty ; because the operation of the intellect may be distorted at the time the crime was committed so that, in the ordinary process of reasoning, assuming the delusion to have existed, such logical connection as might be predicated in a normal mind cannot be traced in these. If delusions are found to exist in a person who has committed a criminal act, it would be the duty of the examiner to discover, if possible, how far the processes of ideation and volition are affected thereby, and to demonstrate the path by which he has arrived at the conclusion that the person is sane or insane. What is a delusion ? It may be defined as a perversion of judgment in which an erroneous belief has become fixed in the mind in spite of plain evidence that it is wrong, and which the person is unable to change. It is usually associated with the personality of the individual and consists of a view which he believes acts for his good or his hurt. It always implies, as has been said, the existence of some measure of disordered intellect. But while delusions are often fixed, they may, also, be more or less transitory and shifty in their character. Where such are fixed and are believed by the person to involve results prejudicial to him, acts of violence either towards himself or towards others are commonly found to accompany them. A delusion differs from a hallucination in respect that the latter is expressive of a disordered sense ; in other words, it is a perception by one or other of the senses without any external causation ; thus a person labouring under a hallucination may declare he hears voices addressed to him where no such voice has been uttered. In addition to the existence of delusions, evidence of an unsound mind may be found in obsessions, which have been defined by Macpherson[1] as " a dissociated group of ideas which suddenly enter consciousness, disturbing the ordinary course of ideation, but not involving the personality of the individual . . . and is to ordinary thought what impulse is to normal action." In other words, it is dissociated thought. Impulse is essentially a defect of volition, and is characterised by the conscious performance by the individual of an action or series of actions in spite of his will power. Sir James Stephens frankly admits that there are cases in which insanity interferes with the exercise of the power of self-control, and, if such be

[1] " Mental Affections," p. 148.

proved, that the person should be held irresponsible; and he goes further, by stating that when the time comes for the criminal law to be codified, the question would require to be raised whether it should not be stated in express terms that insanity may destroy the power of self-control. Carrier,[1] in his monograph on the subject of obsessions and impulses to homicide and suicide, discusses the responsibility of persons afflicted in these ways. He affirms that the true tests of the existence of such mental states may be summed up in the word degeneracy, and that this degenerate condition is characterised by neurotic antecedents in the progenitors, and in the physical state and psychical condition of the individual. This stigma or blemish, exhibited in one or other, or more than one, of these ways, is an essential and permanent indication of the tendency to degeneration, and lack of equilibrium in the degenerate person—in the intellect, the emotions, and in the will—is the characteristic of his condition, as shown by precocity, tenacity, intensity, and repetitiveness. Impulses are most frequently bound up with persistent possessory ideas or obsessions, of which they are the ending as the act is of the thought, and obsessions and impulses are two phenomena of the same nature, constitute the most perfect expression of inharmonious mental action, and can only be met with in degenerates. Mental instability is the necessary condition to development of possessory ideas and impulses, and may be said to be that state of tension of the cerebral centre in which a parasitic perception is installed, which, becoming intensified, usurps and dominates antagonistic perceptions. It is this form of mental unsoundness, moreover, which the law has most difficulty in recognising, because unlike other forms in which there are tangible signs, there are in this form none to be found at the time of examination, which a medical witness can put before a court convincing enough to enable the Court to differentiate between such a person and a reckless vicious criminal. The medical witness must rely upon his examination of the accused solely for his opinion as to sanity or insanity, and it will depend upon the range of the examination what evidence he may be able to offer. Carrier affirms that the examiner must take into account: (1) the mental history of the progenitors; (2) the physical condition of the person himself; and (3) the mental condition, with relation to the character of the crime which the accused has committed. Carrier emphasises the fact that the crime is purposeless or motiveless in character, that it is committed upon victims either the best beloved by the culprit, or upon those who are absolute strangers to him; that the crime itself does not exhibit the like atrocity of the act of an epileptic; that it is liable to be repeated; and that its perpetration is accompanied by complete unconsciousness on the part of the perpetrator. He builds his case of the existence of mental degeneracy upon the mental antecedents of the accused and upon the physical evidences of degeneracy which he bears upon his body—physical defects, in short—which, to be indicative of degeneracy, must present two necessary conditions—viz. that they are congenital, and that they are permanent; and, further, that such persons exhibit want of equilibrium, irregularity or asym-

[1] *Contributions a l'Étude des Obsessions et des Impulses a l'Homicide et au Suicide*, 1899.

metry, of body, or of mind, or of both. In addition, the mental history of the accused, as well as his present condition, must be exhaustively inquired into, so that from the complete examination, the examiner may be able in giving evidence to place all the facts before the Court in such a way that they may be appreciated by intelligent laymen. According to the advanced psychological school, composed of such men as Lombroso, Ferri, and Garofalo in Italy, and Broca, Bordier, Lacassagne, and Manouvrier in France, a criminal is influenced by two orders of influence—viz. intrinsic influences, or those which have their origin in himself, and extrinsic influences, or those which influence him from without; from which flow two kinds of responsibility—viz. individual responsibility and social responsibility, neither of which, they declare, exists in the homicidal degenerate.

Another form in which unsoundness of mind may present itself is what has been called Moral Insanity, which has been defined by Pritchard [1] as "a morbid perversion of the feelings, affections, and active powers, without any illusion or erroneous conviction impressed upon the understanding; it sometimes coexists with an apparently unimpaired state of the intellectual faculties." So common a manifestation is it in cases of mental unsoundness that Esquirol [2] declared it to be the "proper characteristic of mental derangement." It presents itself in a variety of ways, and the results of its operations are often very remarkable. But between the dogged, wayward, and markedly eccentric person and the victim of a slight form of moral insanity who shall discriminate, and what is the dividing line, if any? Indeed when we review the legal attitude with respect to testators who present characters which apparently fall under one or other of these forms of mental unsoundness, and whose wills, though contested on the ground of insanity, have been proved, thereby indicating that in the eye of the law such persons were in possession of a sound disposing mind, and when we consider, in addition, that between certain forms of homicide committed by persons of unsound mind, and others which seem to betray only the outcome of fiendish brutality, there is sometimes little to enable a distinction to be drawn by the average intelligent layman; and moreover, when it is remembered that the law has been created for the protection of society against crime of every kind, we can the more readily understand why there exists an appearance of contesting allegations of mental unsoundness in bar of plea or in bar of sentence. While it is the duty of the medical profession, therefore, to stand between an irresponsible criminal and the punishment which would follow, if he were not proved insane and irresponsible, and, if necessary, to educate the judges of the law and the public upon the need for broadening the legal definitions of insanity and irresponsibility, such should only be done in temperate language, since the officers of the law are desirous solely of meting out law and justice, according to their interpretations of the law.

Illustrative Cases.—The following cases, of which brief notes are given, tried before the Scottish Criminal Courts, have points of individual interest worthy of note and consideration:—

[1] "A Treatise on Insanity," 1835.
[2] *Dict. des Sciences Méd.*, vol. xvi.

1. At the High Court of Justiciary held at Glasgow, September 1902, a man was indicted on a charge of murder, he having shot another man in the throat with a revolver loaded with ball cartridge and killed him. Having made the post-mortem examination of the body of the deceased man we were in court during the trial and heard the proceedings. In the indictment was the usual list of witnesses. When the case was called the late Lord Young, who was on the Bench, asked the Advocate-Depute why there were so many medical witnesses in the case. The reply was that the Crown thought it desirable to ask two doctors whose names were on the list to examine the accused with regard to his mental condition lest a plea of insanity might be set forth in defence. His Lordship thereupon asked senior counsel for the accused if he was to found on a plea of insanity. To this counsel replied in the negative. Whereupon his Lordship said that the two doctors in question need not be called, and might, therefore, be dismissed. The facts of the shooting were clearly proved. It was given in evidence that a quarrel had arisen between accused and deceased, that immediately thereafter accused journeyed into Glasgow, bought a revolver, and returned to the shop of deceased and there shot deceased while sitting at a desk. Not a word was said by prisoner's counsel during the trial, either in cross-examination of witnesses or in his speech to the jury, which even hinted that the prisoner was of unsound mind. Lord Young, however, in addressing the jury, suggested to them that the man must have been out of his mind when he committed the act. After an absence of 25 minutes, the jury returned a verdict that the accused had committed the act with which he was charged, but that he was insane at the time. The Court then ordered the prisoner to be confined during his Majesty's pleasure.

Probably there was no one in court more surprised at the verdict than the prisoner himself.

2. At the High Court of Justiciary at Edinburgh, on Sept. 18, 1902, a man was tried before the Lord Justice-General and a jury on a charge of having murdered one of the lecturers of Surgeons' Hall and another man, by shooting them. Counsel for the defence contended that the prisoner was insane at the time of commission of the act, but he contented himself with leading that view by cross-examination of witnesses and did not call expert medical evidence. The Solicitor-General, who conducted the case for the Crown, in his address to the jury said that in view of the defence set up for the accused there were three possible verdicts before them—viz. guilty of murder, guilty of culpable homicide, or they might acquit the prisoner on the ground of insanity. Counsel for the prisoner argued that prisoner was insane, but if he had failed to prove that to their satisfaction he suggested that they should find that the prisoner had no felonious intent in his act, that he was not guilty of murder but of culpable homicide.

The Lord Justice-General in summing the case dealt with the alleged mental defect of the prisoner at the time he committed the act. He remarked that it had been said on prisoner's behalf that when he did these acts he was not morally responsible for what he was doing. His Lordship did not understand that it was disputed that the prisoner was aware that he was shooting the men to death. The jury would probably think he was aware, and, if so, the question they would have to decide was: What was the effect of the mental alienation which was said to have existed, and which, it seemed to him from the evidence, did undoubtedly exist to a very considerable extent. He would say, however, that the mere fact of a person suffering from a certain degree of mental alienation or mental delusion would not necessarily exempt from criminal responsibility, and in order to exempt from liability to punishment insanity must amount to such an alienation of reason that the accused did not know the nature and quality of the act which he had committed, or if he did know the nature and quality, was in such a state of mind that he was not aware that it was wrong. But mental unsoundness, if not of such a degree as to bar trial or exempt from punishment, might still be present in such a degree as to reduce the offence from a higher to a lower class; for example, from murder to culpable homicide. If, however, the prisoner had

mental capacity to know that his act was contrary to the law and that he was breaking the law, he was responsible. Unless they thought it was established that the accused, when he committed the act, was in such an insane condition that he was not aware of what he was doing, or that he had a total absence of control so as not to be able to give effect to his knowledge, it would be their duty to find against him on the murder charge. If they thought the evidence was such as to bring in extenuating circumstances as regarded his knowledge and his condition, they might bring in a verdict of culpable homicide. It was apparent from the evidence that the prisoner had got into a condition of ill-health, mental and physical, different from that which he had formerly enjoyed.

The jury returned a verdict of culpable homicide by a majority of one, and the prisoner was sentenced to penal servitude for life.

One of the leading Scottish newspapers commented as follows on the cases just detailed in the following terms :—" It is hardly possible to avoid contrasting the decision in the Edinburgh case with that arrived at in the Glasgow case. There is a considerable resemblance between the two cases. The accused in each case had a grudge against his victim. In each case the accused, to appearance at least, went deliberately about his crime. There the parallel ends. In the Glasgow case the counsel for the accused did not put in a plea of insanity, their contention being that the shooting was the result of an accident. In the Edinburgh case, on the other hand, counsel for accused contented themselves with pleading insanity. Yet the one was declared insane and is treated as a lunatic, while the other was found guilty and sentenced to penal servitude for life as if he were at least half sane. The difference in fate between the two men is undoubtedly due to the difference between the speeches delivered by the presiding judges. Lord Young virtually told the jury that, in his belief, the mind of the accused in the Glasgow case was off the hinge, and the jury gave their verdict accordingly. The Lord Justice-General left the decision as regards the mental condition of the accused in the Edinburgh case to the jury, contenting himself with pointing out the verdicts which necessarily followed upon certain estimates of, and deductions from, the evidence placed before the Court. Could anything show better the uncertainty of the law in regard to insanity ? When judges disagree, how is justice to be obtained ? " [1]

3. At the High Court of Justiciary in Edinburgh on December 17, 1906, a prisoner was indicted for the murder of his wife by shooting her. The defence was that the prisoner was of unsound mind. Medical evidence was to the effect that the prisoner, having once been struck with lightning and being subject to epileptic fits, would, if he took drink, be liable both to suicidal and homicidal impulses. In his charge to the jury, the Lord Justice-Clerk, before whom the case was tried, laid considerable stress on the plea of mental unsoundness as entitling prisoner to an acquittal of the more serious charge of murder. He quoted the principles laid down by Lord Deas in a case nearly exactly similar to the present case. That judge drew attention to (*a*) the unpremeditated nature of the attack, (*b*) the habitual kindness of the prisoner to his wife except when under the influence of drink, (*c*) there was but one lethal blow or wounding, and (*d*) the prisoner was of peculiar mental constitution, his mind had been weakened by successive attacks of disease, and he had probably had sunstroke followed by epileptic fits. His Lordship said further " if weakness of mind could be an element in any case in the question

[1] *Glasgow Herald*, Sept. 19, 1902.

between murder and culpable homicide, it seemed difficult to exclude that element here." The jury returned a verdict of culpable homicide, and the judge, following the precedent of the former case, sentenced the prisoner to ten years' penal servitude.

4. *Cumnock Poisoning Case.*—A man named Thomas Mathieson Brown was brought before the same court at Edinburgh in March 1907, on the charge that on Nov. 19, 1906, he sent by post to W. L. in Old Cumnock a cake of shortbread having a covering or layer of icing adherent thereto, with which icing he had previously mixed a quantity of strychnine, his intention in so sending the cake being to poison the said W. L., and said cake having been delivered to the said W. L., a portion of said cake and icing was eaten on Nov. 23 by the housekeeper to the said W. L., in consequence of which she died, and that he did thus poison her and did murder her.

The Solicitor-General, who prosecuted, put forward the plea that accused was insane and incapable of pleading. This was opposed by counsel for the accused, who asked that a plea of not guilty should be accepted. On account of the unusual course which was proposed by the Crown, the special plea was heard before several judges. The Solicitor-General said that the ordinary procedure had been followed in the case. The accused had emitted a declaration on Nov. 29 before the Sheriff, and he was committed for trial on Dec. 8. After the latter date, it came to the knowledge of the Public Prosecutor that accused was probably insane. Accused was thereupon placed under medical supervision, and reports from skilled medical men were obtained that accused was insane. At the pleading diet held in Ayr on March 8, 1907, a medical certificate having been produced to that effect, the Sheriff-substitute did not call upon accused to plead. Accused was in the same condition now as he was then. The statutory procedure came under section 87 of the Lunacy (Scot.) Act of 1857 (20 & 21 Vict. cap. 71), which enacted that where any prisoner charged under any indictment for the commission of any crime was found to be insane, such prisoner could not be charged under such indictment; but nothing was said in that section whence the information of insanity might come to the Court. If there was a doubt as to the sanity of a prisoner, then an inquiry was to be held. While no reference was made in the Act as to the particular mode by which the inquiry was to be prosecuted, the established practice of the High Court, followed for more than a century, was that the investigation should be conducted by a judge without the intervention of a jury. The same section further enacted the procedure to be followed where, after the trial had commenced, the accused having pleaded, it appeared he was insane. Founding upon quoted cases, the Solicitor-General held that he was entitled to become the channel of communication to their lordships of the doubt as to the sanity of the accused now before them. It might be said that the Crown, when they came to the knowledge that this prisoner was insane, should have stopped proceedings and should have acted under section 15 of the Lunacy Act of 1862 (24 & 25 Vict. cap. 54). He held, however, that that section did not apply in a case of this kind but was intended to apply only in cases of assault and other offences inferring danger to the public by insane persons. But this prisoner had never been outrageous nor had he exhibited at any time any evidence of homicidal tendencies; on the other hand, indeed, his demeanour had always been placid and calm, therefore the last-quoted Act did not apply in his case.

Counsel on behalf of accused urged that the course now being proposed by the Crown was improper and incompetent. Accused had been arrested on Nov. 29 in his own house where he had long resided, and in a neighbourhood where he was well known. He was charged with the crime of poisoning but he protested his innocence. Before the Sheriff, also, he did likewise. It was only after he had been in prison for 87 days that an indictment was served upon him calling upon him to appear at two different diets of court, the first at Ayr on March 8 before the Sheriff, and the second on the present occasion. In that indictment he was charged with murder. Accused was not called upon to plead at the pleading diet either directly or through a law agent, the reason urged for that being that he was insane. Counsel called the attention of the Court to the danger of an *ex parte* inquiry as to mental ability, as any law-abiding citizen might be arrested for a crime committed

in any part of the kingdom, and in answer to his plea of innocence the Crown might, as now, plead his mental unsoundness. It seemed to him that the procedure in this case was ruled by the Criminal Procedure Act, 1887, section 24, which made provision for the service of an indictment on accused persons, by section 25, which provided for two diets of Court, and by section 29, which regulated the procedure to be followed at the first diet. The Crown here had adopted the two first-named sections by serving an indictment and by calling upon accused to appear at two diets, but had failed to obtemper the procedure laid down in the last-named section in respect that accused had not been allowed to plead. His contention was that, having satisfied the provisions of the first two sections, the Crown had no authority in precedent to depart from satisfying the provisions of section 29. He (counsel) had been instructed by the accused to maintain his innocence, his instructions having been received direct from the accused, these being intelligent instructions and such as he might receive from a sane man. He therefore contended that the procedure at the pleading diet at Ayr was incompetent and irregular in respect that accused had not been permitted to plead, though willing, that the first diet being incompetent, there could be no trial, and that the Court should discharge the accused, since he could not be tried under the Criminal Procedure Act, 1887. The Lord Justice-General pointed out that the Sheriff was left in the same position as the High Court now was under the Act ; and Lord M'Laren said that a prisoner suffered no prejudice whatever by not being asked to plead in the Sheriff Court, since it was the law that whether a man pled guilty or not guilty in the Sheriff Court he could be asked, indeed was asked, in this court to plead again, and could withdraw or could modify the terms of a previous plea.

The court retired for consultation, and, on returning, the Lord Justice-General—Lord Dunedin—gave the judgment. He said it was clear from the cases cited that from a very early period it had been the practice of that Court, if it was thought expedient, to make inquiry into the state of a prisoner's sanity in order to discover whether a prisoner should or should not be asked to plead. He agreed with the view of the Solicitor-General that neither under common law nor under the Act of 1857 was there any limitation to the sources of communication respecting a prisoner's sanity, and he was satisfied that the conduct of the Crown in this case was not only justified, but was in every respect eminently proper. It seemed to him if the Crown had in their possession certificates from doctors it would not have been right for the Crown authorities to have left the Court in ignorance of what they knew. Referring to the statement of prisoner's counsel that he had received instructions from the accused such as he would have received from any sane man, and to his argument that as the prisoner had not been called on to plead at the pleading diet the subsequent proceedings were vitiated, his Lordship did not think that that contention could be sustained. His view was that accused had suffered no prejudice in not being allowed to plead before the Sheriff, and that the Sheriff having said he would reserve the matter for the consideration of the High Court, he had done quite properly. His Lordship did not see any necessity for a preliminary investigation as to the sanity of the accused, because it was open to the jury to say at the conclusion of the evidence whether he was insane at that moment, which would end the matter, that he did not commit the crime, or that he was insane when he did commit the crime. He therefore proposed that the Court should call upon the prisoner to plead. The other judges having expressed their concurrence, retired from the Bench.

The Lord Justice-General then asked the prisoner if he was guilty or not guilty, to which the prisoner replied, " Not guilty."

In the evidence it was shown that prisoner had on several occasions bought strychnine for the purpose of destroying rats in his house and premises, that the strychnine had been so employed, but no strychnine had been found either in possession of the accused at the time of his apprehension or his house when searched. The medical evidence showed that accused had been subject to epileptic fits for several years, at times did strange things and performed curious actions, but that at no time had he ever exhibited any characteristic fury after the fits. The one point which seemed to connect the prisoner with the crime was certain similarities between the handwriting of

accused and the handwriting on the label of the parcel containing the cake and a card of greeting which was contained in the tin box enclosing the iced cake. Strychnine was found in the icing of the cake only, and was not present in the substance of the cake. It was shown that the icing had been put on the cake by a non-professional hand. There was no evidence directly showing that this was the act of the accused or to connect him with the posting of the parcel, the evidence being entirely circumstantial. Neither was there any motive disclosed for accused's alleged act.

In addressing the jury on behalf of the Crown at the conclusion of the evidence, the Solicitor-General said that the jury might have at least three questions to consider, but they might have only one. The first question was: Whether or not the prisoner was now insane. If they found the prisoner to be now insane, then they had no further question to consider: they would not acquit him, and they would not convict him: they would simply find him insane, and he would be confined and be taken care of. His contention from the evidence was that the prisoner was now and had been suffering from chronic epileptic insanity. If, however, the jury took the view that the prisoner was sane, they would then have to consider whether or not he was guilty of the crime with which he was charged. No witness had seen prisoner despatch the parcel, and this was a case of circumstantial evidence—they must rely on a chain of facts all pointing in one direction or another. In his opinion that chain pointed unmistakably and unerringly to the prisoner as the man who despatched the parcel.

Counsel for accused submitted that the course adopted by the Crown was a weak and cowardly course. What right had the Crown to indict a fellow-citizen of a crime so heinous and detain him in gaol for a period of 110 days, to indict him after he had been detained for 80 days, and then at the end of a three days' trial say to them (the jury) that it did not matter whether he was guilty or innocent, and ask them to take upon themselves the responsibility of treating the prisoner as though he were guilty, and of pronouncing against him a verdict that he was in that state that he could not instruct counsel, and, further, that he was not entitled to have his innocence proclaimed? He as counsel for the prisoner had had the advantage which the jury had not had of interviewing his client, and he had received from him the clearest and most specific instructions in connection with the defence of his case. His contention was that the case of the Crown from beginning to end rested upon an unfortunate resemblance between the writing of the accused and the writing which was upon the label of the parcel. He thought there was much in the case which indicated that more than one person had been engaged in the sending of the cake. But in respect even of the handwriting, if they took the view of Dr Birch, whom he had called as his witness on handwriting, the difference of the writing on the card of greeting found in the box and on the label of the parcel pointed in the direction of a conspiracy. He argued that the whole of his client's time on the day of Nov. 19 had been completely accounted for, that from beginning to end there had been no trace of his having despatched any cake or of having mixed with it any icing, the ingredients of which contained the strychnine, and that it was an absolute and entire impossibility that the prisoner could have purchased the cake and put on it the icing during the interval of his arrival in Glasgow and his reaching the grocer's shop. Moreover, there was no motive of the slightest sort or description suggested for the accused acting as he had been charged. He therefore implored them to consider the guilt or innocence of the prisoner.

The Lord Justice-General, in charging the jury, said this was in every respect a painful case, one full of responsibility from which he could not relieve them. He could not agree with the strong remarks of the learned counsel for accused. That a dastardly crime had been committed there was no doubt, and if suspicion directed itself to the prisoner the public prosecutor could do nothing else than make such investigations as would enable him, if he thought fit, to put the prisoner on his trial. It was the immemorial practice that where the crime was murder, the person accused should for the moment be imprisoned. During the period of incarceration of the accused certain facts relative to the condition of mind of the accused came to light, so that the Crown thought it consistent with its duty to have the accused examined by men of great ex-

perience in mental diseases. The report of these men was that accused was in such a state of insanity as made it expedient for the Crown to make a preliminary investigation with the view to stopping the trial. His Lordship here reviewed the procedure at the beginning of the proceedings, which was ruled by section 87 of the Lunacy Act of 1857, by which it was put upon the jury to say whether or not the prisoner was insane. On this question he must consider what that class of insanity was. It meant the class of insanity which prevented an accused person doing what a truly sane man would do and was entitled to do—to maintain his plea of innocence and instruct those who were to defend him as a sane man would do. They had heard a good deal from prisoner's counsel about instructions. It was a good enough test, but it was not a complete test. That this prisoner was in a condition to speak intelligently upon many subjects—nay, more, to tell his counsel intelligently what he did on a certain date—not one of them could doubt. But there was grave doubt, and it was for them to consider what the effect of that doubt was, whether, knowing all they did about his history and the history of the disease, accused was in a position to do what a perfectly sane man would do—that is to say, to be certain that, on telling his counsel what he thought, he was really telling the whole story of his life and actions. It was clear beyond all doubt that accused suffered from aberrations. There was the ample testimony of the accused's own medical attendant and of the two lunacy experts, and there was no rebutting testimony adduced on behalf of the accused. On that evidence they had to come to a conclusion, and it was as much their duty to do so as it was their duty to come to a conclusion on the facts. As to the handwriting, he could not believe for one moment that they could have any doubt that it was very much alike ; but saying that it was alike was a long way short of saying that it was so certainly alike that they could come to the conclusion that a man should be held as convicted of a crime upon that testimony alone. There were dissimilarities between the two handwritings, and it was upon these that experts fastened. On the general question of similarity he was not sure that they were not as good judges as the experts. But it was a very slender proof, and the handwriting was the one point of direct evidence, and they must in their own mind be very sure that the handwriting was that of the prisoner before they came to a conclusion adverse to him. The questions he asked the jury to answer were these : (1) Is the prisoner now insane ? If they answered that in the affirmative they must not, whatever they thought, proceed to any of the other questions. If they answered that question in the negative, then they must answer the question : (2) Did the prisoner send this poisoned cake ? And then, if they answered that in the affirmative, they must answer : (3) Was the prisoner sane or insane when he did it ?

After an absence of 45 minutes the jury by a majority found the accused to be now insane. Accused was therefore ordered to be detained in a lunatic asylum during his Majesty's pleasure.

5. In April 1907, a man shot at a medical practitioner and severely wounded him in the thigh. On June 24 he was brought before the Sheriff at a pleading diet antecedent to the session of the High Court in Glasgow. Accused was indicted on a charge of having contravened Act 10, Geo. IV., cap. 38, section 2. When the indictment had been read, the Procurator-fiscal informed the Sheriff that since his arrest accused had been examined periodically by two medical men, who had certified him to be insane. A certificate to that effect he then produced, and he asked that accused be not required to plead to the indictment, and that the matter should be left for the consideration of the High Court, as had been done in the case of Brown. This was opposed by the law agent for accused on the grounds (1) that such a course was irregular, and (2) that the accused was not insane. Accused had instructed a perfectly clear defence. The Sheriff announced that he would follow the precedent established in the case of Brown. Prisoner was brought for trial before the High Court on July 2.

Lord M'Laren asked counsel for accused if accused was to be asked to plead, and on an affirmative reply being given, the prisoner was thereupon asked if he were guilty or not guilty, to which he replied "Not guilty." After some evidence had been led respecting the circumstances of the shooting, and at the conclusion of the cross-examination of the police surgeon who had examined

accused after his apprehension, Lord M'Laren asked the Advocate-Depute to make it clear whether or not he held that accused was sane, for if he was insane, why was he there ? The reply was that the jury, after hearing the evidence, might not agree that accused was insane. Lord M'Laren said he should have to direct the jury that it was clearly proved that prisoner had fired three shots at the doctor, and it seemed to him that the position of counsel was becoming reversed. He should have thought that prisoner's counsel would have tried to get him off by pleading that accused was insane, but instead of that counsel was maintaining that accused was sane and was, therefore, responsible for his actions. On the other hand, the Advocate-Depute, who prosecuted, suggested that the evidence might make out accused to be insane. Prisoner's counsel said that he had got notice that the Crown was to oppose a plea from the prisoner, but no notice had been taken by the Advocate-Depute of accused's alleged mental condition. His instructions from the prisoner were that before everything he was to be held sane by the jury. The Advocate-Depute had now stepped in with a new method of criminal procedure. The attitude of accused was that while he deliberately shot at the doctor it was for the purpose of bringing his case before the public, that while he did shoot he was very careful not to kill but merely to hurt the doctor as slightly as he could with the weapon he employed. Lord M'Laren then asked : Should not accused have pleaded guilty ? To this counsel replied that he had been given notice by the Crown that the question the Crown was to raise before the jury was, Whether the man was sane or not. The Court was to understand that instead of defending accused on the ground of insanity, he made no such plea, but that accused was responsible for his actions. The Advocate-Depute said that the view of the Crown was that prisoner was a dangerous subject, and that it was an appropriate method to deal with him as a criminal lunatic, and that steps should be taken so that he might never get out of confinement again.

Two lunacy experts averred that prisoner was subject to delusional insanity, one of them even going the length of saying that accused had been insane since the beginning of 1903 and had continued so ever since.

Evidence for the prisoner was adduced by the prison surgeon and the assistant surgeon, under whose care accused had been while in prison, as well as by a police surgeon who also examined him, by two sons, by other relatives of prisoner, and by the prisoner himself. The medical witnesses said the result of their examinations of accused was that they did not believe accused to be suffering from insane delusions. There might be what might be called delusions, but they were perfectly rational delusions, not insane delusions, as they were based on facts. The prison surgeon said he came first in contact with accused at the beginning of 1904 in connection with proceedings for the liberation of accused from an asylum. He did not find him at that time suffering from insane delusions, and from more recent examinations of accused while in prison under his care he had seen no reason to alter that opinion. In his opinion, accused was perfectly capable of pleading to this charge and of knowing the quality of the crime with which he was charged. He knew perfectly well that what he did was legally wrong and punishable. Both sons stated that the beginning of the trouble was refusal on the part of their mother to occupy the same bedroom as their father. There had been quarrels in the house on account of that. At that time they had taken the part of their mother, but they had changed their minds owing to facts which had since come to their knowledge. They had become reconciled to their father since his liberation from the asylum, which had been opposed by their mother. They had never seen anything in the conduct of their father that seemed to be irrational or insane. The prisoner then gave evidence on his own behalf. He stated that he was 55 years of age, that he was a Trinity pilot until he was certified to be insane in September 1903 ; that he was then earning annually between £400 and £600 ; that he and his wife lived happily for many years until his wife began to remain out late at night ; that he had taken her to spiritualistic meetings, but having decided that they were humbug he ceased to attend them, his wife, however, continuing to attend, notwithstanding his express desire that she should discontinue. In April 1903, his wife refused to cohabit with him. He did not know until afterwards that an attempt was being made to prove him insane. He was on the bowling-green near his house playing bowls when his little boy came and

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THE PERTH PRISON SUICIDE.

Sat 22 - 1912

Sheriff-substitute Sym held a public inquiry in Perth Sheriff Court yesterday into the circumstances attending the death of Thomas Bone (33), a native of Ayrshire, who was found dead in his cell on November 15 at the Perth Penitentiary.

Dr Sturrock, the prison surgeon, said he knew that Bone was convicted in Glasgow High Court of murdering his wife on May 8, 1908. He was sentenced to death, but the day before the execution he was reprieved. After spending a month at Perth he was transferred to Peterhead as a sane man. He understood from the prison records that Bone was reprieved on account of some peculiarity of conduct which he displayed while lying under sentence of death. In consequence of his conduct at Peterhead it was deemed advisable to remove him to the lunatic ward at Perth Penitentiary, and this was carried out on September 14, 1908. Bone was extremely difficult to manage, but improved greatly while in the lunatic department. He was subject to periodical changes, however, not as a result of insanity, but on account of his disposition, and he was treated in the ordinary hospital way. Latterly he had made the ward quite uninhabitable. Within the last month the doctor said he had learned of two very serious plots arranged by Bone, which, if not discovered, might have resulted in disaster not only to himself but other persons there. The day before his death Bone was put into a strong cell, and the last time witness saw him alive was on the morning of November 15.

Warder Sinclair said he visited Bone very often during the day before the tragedy, and got no complaints. Bone was singing, and seemed to be enjoying himself.

Dr Lyell said his opinion was that Bone committed suicide by hanging, and the Sheriff-substitute returned a verdict in accordance with the evidence.

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MURDERER'S SUICIDE IN PRISON

Herald — 20 Nov. 1912

As stated yesterday, the Perth Penitentiary has been the scene of a dramatic suicide on the part of an inmate of the lunatic ward of the prison. It is understood that the man who has ended his life is Thomas Bone, about 35 years, and a native of Ayrshire. It may be remembered that Bone was being detained during His Majesty's pleasure for the murder of his wife. On his removal to the prison at Perth Bone was put among the other inmates of the lunatic ward, but of late his condition became such that it was deemed advisable to separate him from the other prisoners. This was accordingly carried out, and for a considerable time Bone has been spending his time alone. He was carefully watched day and night by the attendants, and it is believed that a warder was in the habit of paying him a visit every 15 minutes. During one of these intervals it would appear that Bone had converted his bed sheet into a noose and strangled himself. The circumstances attending the tragedy will be brought to light in Perth Sheriff Court on Thursday afternoon at a public inquiry to be held by Sheriff-substitute Sym. The circumstances attending Bone's trial in Glasgow may be briefly recalled. Bone pleaded guilty to murdering his wife by battering her head with a huge stone, and although Lord Ardwall, the presiding Judge, suggested that a plea of not guilty should be tendered, Bone replied in a firm and resolute voice—"No; I cannot plead not guilty. I have a higher power to face than you, and for that reason I am prepared to plead guilty." Lord Ardwall insisted that evidence should be led, and this having been done the prisoner was found guilty and sentenced to death. Bone was subsequently reprieved, much against his own wish.

told him he was wanted in the house. He then gave particulars as to the presence of the two medical practitioners in the house when he arrived there, one of whom was the medical man whom he shot at, and the other a lady practitioner who attended his wife. He did not know that they had come there to examine him as to his sanity; he thought they had come to discuss certain suspicions which had been aroused owing to certain matters, and on that understanding he discussed his domestic relations with them. He was a good deal worried at this time, and he went for a holiday. On his return, on Sept. 10, he was apprehended by the officials of Gartnavel Asylum, was taken there, and remained in that asylum for four months. All the time he was there his law agents agitated for his liberation. After his liberation he lost his position as a pilot and with that his comfortable income, although he had been given a small annual allowance. He raised an action in the Court of Session against the doctors who had certified him as insane, but failed, and he had a feeling that his case ought to go before a jury. That action was tried before Lord Pearson in November 1905, for wrongous certification of insanity. He did not desire to kill the medical man nor did he desire to injure him seriously. He had practically followed him all through the day of the affair, was near him on several occasions, and could have shot him in the back, but he refrained as that might have killed him. He waited his chance till he could fire at the fleshy or lower parts of his body, where he could not do him any serious bodily harm. He knew he was committing an illegal act, but he thought it the only way left him to ventilate his wrongs, having no money. He would sooner do ten years in prison than go to a lunatic asylum. He felt very much the stain put upon him by the certification of insanity. At present he felt he was a sane man.

Lord M'Laren, in the course of his summing up, said he was bound to tell the jury that, whether they found that the accused was insane when he came to the bar, and was, therefore, unable to plead, or whether they found that he was insane at the time he committed the act charged, accused would be detained as an insane person; but upon his recovery, if it should take place, he would be immediately set at liberty by a warrant of the Lord Advocate or the Secretary for Scotland. It was for the jury to say whether the panel was insane, or otherwise that he was fully responsible for his act, that it was a rash, vindictive, and criminal act, but not under the influence of insanity.

The jury returned a verdict of guilty as libelled, but without intent to do grievous bodily harm.

Lord M'Laren in passing sentence said that accused, for reasons which he understood, was conscious of having committed a crime against the law, and had decided to take the punishment of his crime rather than be sent to a lunatic asylum. As prisoner had been found by the jury to have been of sound mind not only at present but at the time the crime was committed, he must take it that accused foresaw the consequence of his act. He (the judge) could not treat this as a case of sudden assault committed in a moment of anger, because it was premeditated. He quite believed accused's statement that he did not mean to kill the practitioner, but as to his not doing him bodily harm, everyone knew that if one fired a shot, and especially three shots in succession, into a man's body, the risks of injury to life, nay, of risks to life itself, were extremely serious. He could not in accordance with practice and with the facts of the case see his way to give a less sentence than seven years' penal servitude.

6. At the High Court of Justiciary at Edinburgh on May 20, 1907, a man was tried on a charge of having murdered on April 5, 1899, his aunt in Wigtownshire, by shooting her. Since the occurrence accused had been confined in Perth Lunacy Prison, and having recovered his sanity had been liberated, but was immediately thereafter arrested. Accused pled not guilty to the charge, a special defence on his behalf having been put in that accused was insane at the time when the crime was said to have been committed. Evidence was led respecting the circumstances of the shooting. A medical witness stated that before the commission of the deed accused had consulted him about arsenical poisoning, and said to him that his relatives were putting arsenic in his soup. Witness saw no symptoms of poisoning in accused, and formed the opinion at the time that accused laboured under delusions. He had also seen accused the day after the occurrence, and he was of opinion that

accused was quite unable to understand the character of the act with which he was then charged. Other medical witnesses, experts in lunacy, said that from a consideration of all the facts they had come to the conclusion that accused at the time was labouring under insane delusions of a kind likely to lead directly to the act charged. They had examined him recently, and they were of opinion that he was now recovered.

The Solicitor-General, who conducted the case for the Crown, said to the jury that this was a very peculiar and very unusual kind of case. After the evidence which had been led it was impossible for him to ask them to find and for them to find the accused guilty. The Lord Justice-Clerk, in directing the jury, said that accused was obviously insane at the time when the act was committed, and accordingly, if so, he could not be guilty of the act. He therefore asked the jury: (1) to find that the accused was insane on April 5, 1899; and (2) to find him not guilty on the ground of his insanity. Although acquitted of the charge in respect that he was insane at the time, and although certified to be sane at the time of the trial, accused was not allowed then and there to go free, but was remitted to the General Prison at Perth until his Majesty's pleasure was known. A petition would have to be presented to the Secretary for Scotland craving for the liberation of the man on the ground of his recovered sanity.

7. In May 1908, a man was charged with the murder of his wife, the injuries inflicted being of an atrocious character. His wife, who was living apart from him by reason of his behaviour, met the accused on a lonely road, where he attacked her, and with a large stone inflicted so severe injuries on her skull that she died almost immediately. The facts of the assault were beyond dispute. Accused was defended by counsel, one of whom was a King's Counsel. On being asked to plead, accused pled guilty. Lord Ardwell declined to accept the plea, and accused withdrew it and substituted a plea of not guilty. Two medical witnesses appeared for the Crown to speak to the mental condition of the prisoner. They had been informed of the accused's history and peculiarities, they had repeatedly examined him, and they had witnessed his demeanour in court, but there was nothing in their evidence which could be construed as inferring deficient or lessened responsibility. Counsel for accused closely cross-examined several witnesses who were friends of accused with the object of eliciting evidence indicative or suggestive of mental derangement. Lord Ardwall directed the jury that there was no room for the idea that the accused was in the eye of the law and in the present state of legal opinion not fully responsible for the act.

The jury unanimously found the prisoner guilty of murder. He was sentenced to death, without any recommendation to mercy. The condemned man was taken to the prison of Ayr, where, according to the terms of the sentence, he was to be executed. There was no public petition for a reprieve; on the contrary, local opinion was in favour of the verdict. Preparations were in progress for carrying out the execution, the scaffold had been erected, and the public executioner was in the town. In some way, however, not publicly known, the Secretary for Scotland sent a commission of mental experts to Ayr 15 days after the trial, and 6 days before the date fixed for execution, with a view to further examination of the condemned man, and to report. What these experts reported is not known, but it is a reasonable inference that from their examinations they did not find evidence to warrant them reporting that the convicted man was insane, because a respite only followed, which arrived 14 hours before the time fixed for execution, a respite not for the purpose of sending the man to a lunatic asylum, but, as events proved, for the purpose of sending him to penal servitude for life.

In the first case the peculiarity consists in the fact that although there was no plea of insanity, nor indeed any insanity, founded upon, the judge was the first and only person to suggest in his directions to the jury insanity in the prisoner. This appeared to be at the time, as it really was, a most unusual procedure. While it is unquestionably the duty and function of a judge to see that every prisoner has a fair trial,

and that nothing is lost sight of which may be put in his favour, it is the first case within our knowledge where, a prisoner being defended by senior and junior counsel, and insanity not being any part of the defence, the judge interposed his suggestions of the insanity, and therefore of the irresponsibility of the prisoner. It would almost seem as if the judge had believed that the prisoner had not been efficiently defended.

The second case differs from the first. Here there was evidence indicative of some measure of mental unsoundness; but although the judge said to the jury that the evidence led pointed to the fact that the prisoner had got into a condition of ill-health, mental and physical, different from that which he had formerly enjoyed, the jury found the prisoner guilty of culpable homicide by a majority of one.

The third case may be contrasted and compared with the case next following. The fourth case seems at first sight to be somewhat extraordinary. One cannot help thinking that the proper method of reaching the true conclusion in this case had not been adopted, while at the same time it is not easy to suggest a better. Doubtless the element of unsatisfactoriness consists in the fact that an accused man whose sanity and fitness to plead had been challenged at the beginning of the case, and who had been found to be insane at its finish, had been permitted to plead; and also, perhaps, because after being permitted to plead and after all the evidence had been led on both sides, no finding was required of the jury as to whether or not the accused committed the act charged against him. The case is further noteworthy in that it signalised a notable departure from the practice of the courts in like cases. For the previous century, when a plea in bar of trial on the ground of insanity had been put in, the practice was for the Court, without the aid of a jury, to determine the issue, irrespective of whether the plea had been put in by the defence or the question had been raised by the prosecutor. In this case, it will be remembered, the issue was raised by the Crown. The last previous case in which similar circumstances obtained was the somewhat famous case of Alexander Robertson, alias "Dundonnachie," which came before the High Court of Justiciary at Edinburgh on March 30, 1891.[1] The question of the sanity of Robertson having been raised before the court, Lord Justice-Clerk Macdonald (Lord Kingsburgh) himself determined the issue without the aid of a jury. In all the cases in which we have been engaged where the plea of insanity in bar of trial was raised by the defence, the issue was always determined by a judge alone. According to the same authority—"Where such a plea is tendered, proof in regard to it may be taken by the judge without impannelling a jury. If present insanity is proved, the Court find that the accused cannot be tried, and order him to be confined until the Royal pleasure be known. Although no question as to sanity be raised by the accused, the prosecutor may raise the question, and the Court, if they shall see cause, will *ex proprio motu*, investigate whether the accused be a fit subject for trial or not."[2]

It is not unlikely that the procedure in this case would have been in accordance with former practice had the question of the man's insanity

[1] 3 White, 6.

[2] Macdonald: "Criminal Law of Scotland," 3rd edition, p. 431.

not been strenuously contested by his counsel, who, as events showed, contented himself merely with a general denial of the averment of insanity and did not adduce any medical evidence to rebut that of the Crown. It seems clear that had the plea in bar of trial been determined by the Court without a jury there could have been no trial. As the facts are, however, we behold a prisoner whose sanity is disputed, and who is found insane at the end of his trial, being permitted to tender a plea—a circumstance which could not have happened had the issue of insanity been determined first by the Court. Apart altogether from the question of the sanity of the accused, and solely on the evidence led to connect him with the commission of the crime charged against him, we have the greatest difficulty in believing, in the light of the evidence which was led, that any jury, supposing they had had the chance of returning a verdict, could have returned one of guilty as libelled. The only connecting link, if such it may be called, was the alleged similarity of the handwriting, and it is difficult to imagine, in view of the case of Adolf Beck, which doubtless would be brought before the notice of the Court, that the jury would have convicted a man for murder on mere similarity of handwriting. It is, perhaps, true that the accused here did not suffer any substantial harm from the course adopted, because by their verdict the jury did not pronounce on the charge itself; at the same time, owing to the fact that the prisoner was allowed to plead and the trial to proceed, and evidence regarding the possible commission of the crime was adduced, the absence of a finding by the jury on the merits left the case undetermined and a certain stigma to remain on the character of the accused in the minds of the general public. It seems to us that the same effect, so far as the accused was concerned, would have practically followed had the questions submitted to the jury for answer been put in a different order. One difference probably would have resulted—viz. that if the jury had answered the second question first, and if the jury had returned a verdict of not guilty or not proven, and if they had then answered the first question in the affirmative, seeing that the issue had been raised in the commencement of the case, the destination of the accused would probably not have been a criminal lunatic asylum but a private asylum, on his friends undertaking to the satisfaction of the Court that such would be done. It will be noted that the jury had all the facts before them on which to found a verdict on the merits, but they were precluded from that course by finding a verdict that the accused was now insane. Had the questions been put in the following order such a result as has been indicated would have been possible—viz. (1) Did the prisoner send this poisoned cake? (2) Is the prisoner now insane? and (3) If not now insane, was he sane or insane when he did it? This last question, of course, could only require an answer if the jury found that the act had been committed by the prisoner. But putting the questions in the order in which they were presented to the jury by the Court, an answer in the affirmative to the first stopped the proceedings since that answer involved a finding that the prisoner was unable to instruct a defence, and, therefore, could not plead. But if in the light of the evidence adduced we are warranted in the assumption that the jury would not have returned an affirmative answer to the question, Did he send the poisoned cake?

we cannot assume that it would be good law to then ask the jury to answer the question, Was the prisoner insane now?

Had the case occurred under English procedure, the problem, we think, would have been solved more easily and more satisfactorily. On the question of the insanity of the accused being raised a jury would have been impannelled and sworn to determine the issue whether or not the accused was fit to plead. If a negative answer was returned by the jury, the accused would then be ordered into confinement to await the Royal pleasure. But if an affirmative answer were given, the jury would again be sworn to try the accused, who would be called upon to plead to the indictment, and the trial would proceed, and the jury might return a verdict. We do not pretend to be able to say, now that the former practice of the Scottish courts has been changed where the question of the insanity of a prisoner is raised by the Crown, whether the powers contained in the Lunacy (Scotland) Acts permit the question of the fitness of such a prisoner to plead to be put as a preliminary inquiry before a jury. It is quite clear, however, that a jury impannelled to try such an accused person as Brown, whose sanity is challenged by the Crown, but which challenge is resisted by the accused, can determine the issue—whether or not the accused is now sane. The decision of the bench of judges appears to us to have been founded on section 87 of the Act of 1857, which we have already quoted. It will therein be seen that " where any person charged under any indictment or criminal libel with the commission of any crime shall be found insane, so that the person cannot be tried upon such indictment . . . the Court before whom such person shall be brought to be tried as aforesaid shall direct a finding to that effect to be recorded, and thereupon such Court shall order such person to be kept in strict custody until his Majesty's pleasure shall be known " ; but the section goes on to say, " or if upon the trial of any person so indicted such person charged with such indictment or criminal libel shall appear to the jury to be insane " the Court shall direct a finding to that effect to be recorded, etc. The reading of the section seems to indicate two alternative methods of procedure, the first not being a trial in respect that the accused is not called upon to plead because of his being found to be insane, the second, however, being a trial, the accused having pleaded and a jury having been impannelled to try him. Section 88 deals with the case of any prisoner where it shall be given in evidence upon the trial that such person was insane at the time of committing the crime or offence with which he is charged. It will be seen in the questions put to the jury by the Lord Justice-General that the procedure in this section was also included. Reviewing the whole procedure in this case one cannot help coming to the conclusion that where a man charged, as this man was, with so dastardly a crime, is not called upon to plead at the pleading diet because of his having been certified to be of unsound mind and unable to instruct his defence, and whose sanity was questioned in the same way precedent to his trial, he should either have been subjected to an inquiry as to his fitness to plead, or, having been allowed to plead, that the jury ought to have been called upon to say whether or not from the evidence he committed the act charged against him.

The fifth case which we have cited is exactly similar to the case just

discussed up to and including the point of procedure where the accused is allowed to plead. It differs, however, from it in the following particulars:—(1) there was no doubt that the accused committed the act charged; (2) that accused had already been incarcerated in an asylum for a few months some time previously, but had been discharged therefrom on an action of liberation; (3) evidence was adduced at the trial on behalf of accused by medical witnesses and others to rebut the testimony of the Crown doctors as to his insanity; and (4) accused himself gave evidence on his own behalf, thereby affording an opportunity to the jury to form an opinion for themselves on the question of his sanity or insanity from his behaviour, demeanour, and mode of witness-giving. In the previous case the accused was incarcerated in an asylum on account of an alleged crime which was not proved against him; in this case no attempt was made by the accused to deny the crime charged against him, but he declared himself to be sane and that he would rather suffer ten years in prison than suffer incarceration in an asylum. Both cases are alike in that the whole case—alleged insanity and alleged crime—was placed before a jury, but while in the previous case present insanity was proved the alleged crime was not proved; in this case the alleged crime was proved and the alleged insanity was not proved.

The sixth case, which may be called the Wigtownshire case, contains also certain points of interest respecting lunacy procedure associated with crime. The accused, soon after the commission of the act of shooting and killing his aunt, was sent to an asylum—Perth Lunacy Prison—by the authorities under the terms of the Act of 1857, section 89, or of the Act of 1862, section 15. After a residence of eight years in that place he recovered his sanity, was liberated, but was at once arrested on the charge of murder. At his trial the fact that he was found to be insane at the time of committing the act and was placed under care in Perth Lunacy Prison was sufficient evidence of non-liability for the consequences of his act, and the evidence of the medical witnesses satisfied the Court that he had now recovered his sanity. But although he was acquitted by the jury on the ground of his insanity at the time, he could not be there and then liberated by the Court, but could only be freed after petition and by order of a Secretary of State.

The last case cited (Case 7) is in some respects the most extraordinary case of the series. Here was a man who brutally murdered his wife, who was duly tried and duly defended, whose mental condition had been examined by medical persons who could not, however, declare him to be of unsound mind, who was found guilty and was sentenced to death, on whose behalf there was no recommendation to mercy by the jury nor petition for reprieve by the public, but whose execution did not take place owing to what seemed a very unusual intervention of the Secretary for Scotland. It is not publicly known at whose instance the attention of the Secretary for Scotland was called to the case, but the fact remains that by his instructions a commission of lunacy experts was sent 15 days after the trial and 6 days before the date of execution to the prison in which the condemned man was confined for the purpose of examining him. These experts are presumed to have reported to the

Secretary for Scotland, but what was contained in their report was not publicly known. It was publicly announced, however, several hours before the time appointed for the execution to take place that he was reprieved and his sentence respited to penal servitude for life. This procedure gave rise to considerable discussion at the time, and one of the questions then canvassed was the legal position of the Secretary for Scotland in so acting. We have not been able to discover by what powers under the Scottish Lunacy Acts the Secretary for Scotland acted. There is a form of procedure in section 89 of the Act of 1857 which provides that "in the case of a prisoner who exhibits insanity when in confinement as a prisoner under any sentence or under any charge of any crime or offence or under any civil process, the Sheriff shall inquire with the aid of two medical persons, as to the insanity of such prisoner, and if it shall be certified by such Sheriff and such medical persons that such prisoner is insane, it shall be lawful for one of his Majesty's Principal Secretaries of State, upon receipt of such certificate, to direct by warrant under his hand that such person shall be removed," etc. This procedure does not seem to have been followed in the present case, because the condemned man was not respited during his Majesty's pleasure, but respited to penal servitude for life; for if a certificate of insanity after inquiry had been sent to the Secretary for Scotland, the condemned man would have been removed from prison to an asylum, and would not have been condemned to penal servitude for life.[1]

The following case, which occurred in England, shows what is still the opinion of some judges as to the criterion of insanity:—

8. At the Oxford Assizes, Feb. 4, 1904, the case of R. *v.* Bond was tried before Mr Justice Ridley and a jury, the charge against the accused being that he had committed indecent assaults upon a number of little girls. Medical evidence as to the mental condition of accused was adduced by two experts in lunacy who stated that the accused, who was 63 years of age, was unable to exercise any will at all when certain attacks came upon him, that he had no moral judgment, and that he was the victim of incurable mental disease. Both experts were prepared to grant a certificate of the lunacy of accused, who was a man of accomplished education. Counsel for accused contended that the opinions of the judges in the famous case of Macnaghten were not to be taken as constituting a binding rule applicable in every case, and he quoted Mr Justice Stephens' opinion, as expressed in his work "General View of the Criminal Law"—viz. that "no act is a crime if the person who does it is at the time when it is done prevented, either by defective mental power or by any disease affecting his mind (*a*) from knowing the nature and quality of his act, (*b*) from knowing that either that act is illegal or that it is morally wrong, or (*c*) from controlling his own conduct, unless the absence of the power of control has been produced by his own default."

The judge ruled, however, that the real question was: whether the state of the prisoner's mind was such that he was unable to distinguish right from wrong, and he put it to the jury that the question they had to answer was, whether the prisoner was responsible for his actions at the time he committed the offences with which he was charged, whether he knew the offence was wrong at the time it was committed. He repudiated the idea that mere decay of the faculties is evidence of insanity, or that a person suffering from senile decay is not responsible for his actions.

The jury found the prisoner guilty, and he was sentenced to a term of imprisonment.

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[1] Author. The Plea of Lunacy in Scottish Criminal Courts, *Lancet*, vol. ii., 1909, p. 1427.

Insanity and Contract of Marriage.—The only other part of the subject to which some allusion ought to be made is that which relates to insanity and the law of contract. It will, perhaps, be sufficient to confine attention to insanity and the law of contract in marriage. This is well illustrated by a recent decision of Court.

In Jackson *v.* Jackson, decided by Mr Justice Bargrave Deane on May 26, 1908, the question was as to the validity of a marriage contract made by a person suffering from delusions. The wife sued for declarator of nullity of marriage on the ground that her husband, when he married her, had morbid delusions, notwithstanding she could not prove that he did not understand the nature of the contract. Mr Justice Deane said in his decision: "the question to be decided is, Was the respondent at the time the marriage was contracted suffering from illness which, although it did not prevent him understanding the nature of the contract, rendered him a prey to the influence of morbid delusions on the subject? I think it is clearly established that this gentleman's condition of mind—he is now admitted to be insane—has been of gradual growth; that it commenced before the time of his intimate acquaintance with this lady; that it existed at the time of the marriage; and has progressed up to the present moment." [1]

The Court decreed nullity of the marriage.

FORMS OF INSANITY

As in other departments of medicine and surgery subdivision exists, so also insanity has been divided into different forms or types from the clinical symptoms. It must, however, be borne in mind that these are but arbitrary and academic divisions of one central condition—viz. aberration of mind of different degrees and characters. It is enough for our purposes to state that of the many classifications which have been made, one of the best, perhaps, is that which was drawn up by experts —the International Congress of Alienists, in 1867—and which is as follows:—

Simple Insanity:—
- Mania.
- Melancholia.
- Recurrent Insanity.
- Moral ,,
- Delusional ,,
- Impulsive ,,

Epileptic Insanity.
General Paralysis.
Toxic Insanity.
Puerperal ,,
Idiocy and Imbecility.
Senile Dementia.
Sequential ,,
Dementia due to coarse Brain-lesion.

Dr Fitch of Halifax [2] has suggested a scheme for the definition, classification, and discrimination of the various forms of insanity, which is based upon easily recognisable symptoms, for the purpose of

[1] *B. M. J.*, vol. i., 1908, p. 1321.
[2] *Med.-Legal Journal of New York*, June 1898.

differentiation of responsibility and irresponsibility. It is worthy of careful consideration, but we cannot do more than refer to it.

For the purposes of the law, however, a much simpler classification has been adopted—viz.

Dementia Naturalis = Idiocy and Imbecility = Congenital or Developmental Insanity.

Dementia Adventitia = Acquired Insanity.

The term "non compos mentis," while it may be made to cover both of the above divisions, is more commonly used to designate less-developed forms of mental unsoundness than are included in the above.

As this is simply a treatise of the medico-legal aspects of insanity, the reader is referred for the clinical sides of it to treatises on Insanity.

SOMNAMBULISM AND HYPNOTISM, IN RELATION TO CRIME AND RESPONSIBILITY

A case of a very interesting character was tried at the Leeds Assizes, 1901, in which the question of responsibility arose under curious circumstances. A young man, of previous good character, was charged with an offence under the Criminal Law Amendment Act, in that he was found by a girl, who was residing in the same house, in her bed, clothed in trousers and shirt. The prisoner, when accused, declared that he must have gone there in his sleep, as he was the victim of somnambulism. His father testified that the accused, another son, and his wife, were the victims of the somnambulistic habit, and that he had on former occasions found the accused trying to climb out of the window during his sleep. The jury found the prisoner not guilty.[1]

Closely allied to the phenomena of somnambulism are those of hypnotism. Hypnotism is the modern designation of certain psychical conditions and was formerly known by the names of animal magnetism, electro-biology, Braidism, and Mesmerism, the last two from the surnames of men who practised and wrote concerning the art. Although the phenomenon has apparently been known since ancient times, it is only during the last thirty years or thereby that it has received considerable attention by scientific observers. Hypnotism is difficult to define. It may be said to be a sleep-like condition which is capable in apt subjects of being induced by artificial means or by suggestion, the condition being based upon physiological states of the brain and nervous system, not yet, however, well understood. The precise form which it will take in a person put under its influence cannot be predicated. In one individual it may take the form of a cataleptic state, while another may be able to execute complex movements at the will or suggestion of the operator. The principle of hypnotism seems to be this—the concentration of the mental energy of the subject on an object or an action, through a sense-organ or by ideation, the action of the other brain-centres or functions being meanwhile inhibited, the production of fatigue in the centre or function involved, and the induction of drowsiness, lethargy, or sleep which is called the hypnotic condition. During this state, the subject is under the influence of

[1] Ambulatory Automatism, *Lancet*, vol. i., 1889, p. 807.

the suggestions of the operator. It would appear, therefore, as if on the part of the subject no degree of volition remains, except that which is originated and determined by the will of the operator.

The question, whether an operator who puts a subject into the hypnotic condition is capable of unduly influencing the mind and actions of the subject, came into prominence in this country in the case of Kingsbury and Crofton *v.* Howard, which was tried before Mr Justice Barnes and a special jury in the Probate Division of the High Court of Justice, in July 1898. The plaintiffs—Dr Kingsbury and Mr Crofton—were executors appointed under the will of Mrs Howard of Blackpool, who left an estate worth about £90,000. Of this total amount she left about £30,000 to charities, £30,000 to Dr Kingsbury her medical attendant, and the remainder in legacies to relatives. The defendant—the only surviving son of the deceased—alleged that at the time the will was made the testatrix was of unsound mind, and that the first-named plaintiff had used undue influence over her by hypnotism. In the course of the trial, it was acknowledged by Dr Kingsbury that he had hypnotised, or had tried to hypnotise Mrs Howard, as a therapeutic agent in her treatment, but he denied that he had exercised any undue influence over her, or that her acts were consequent upon hypnotism or were of the nature of post-hypnotic suggestion. After a long trial, the jury returned a verdict for Dr Kingsbury, with costs, The question still remains to be answered, whether under hypnotic suggestion a person might not be actuated to improperly sign documents, or will away an estate. Questioned in cross-examination on this point, Dr Kingsbury in the above case stated that he did not believe in the possibility of persons being induced to execute deeds, wills, promissory notes, or to sign cheques in that way. In his book,[1] he expresses similar views. Other observers, however, do not express themselves so confidently, as, for example, Bentivegni,[2] and others. Obviously, the answer to this question will centre round the kind and amount of control which is attained by the operator over his subject by suggestion. It is quite clear that a certain degree of control is obtained by the operator, as shown by the acts of a subject which follow suggestions by the operator. But who shall say to what extent such control in individual cases may be attained, or what are the limits of suggestion ? It would be impossible, in the present state of our knowledge, to affirm how far suggestions may operate upon the mind of a subject. Bernheim[3] in his experiments shows that even suggestions to perpetrate crimes may be conveyed to the minds of subjects, and that all the essential acts of the suggested crimes may actually be carried through by the subject, the only difference being that mock weapons or articles have been used instead of real ones. It is said by those who do not believe that the execution of improper deeds or documents or wills can be prompted by suggestion, and still less that crimes may be suggested to persons of rectitude or law-abiding persons in the hypnotic state, that such persons are protected from so acting by their moral consciousness. This, at best, is but a mere

[1] "The Practice of Hypnotic Suggestion," 1891.
[2] *Die Hypnose und ihre civilrechtliche Bedentung*, 1890.
[3] *Hypnotisme*, 1891.

opinion, which must be qualified by the results of Bernheim and the views of such observers as Liégeois. Milne Bramwell [1] cites the authority of Liébeault and Liégeois for the statement that there are only 4 or 5 per cent. of hypnotised subjects to whom with absolute certainty commission of crime could be suggested. If this statement is capable of confirmation by further experience, a very serious aspect is given to the subject, as the possibility of successful criminal suggestion is thus indicated.

It must, therefore, be considered to be an open question as yet whether undue influence may not be exercised over, or criminal suggestions may not be conveyed to, hypnotised persons. If it be true that any person may by the exercise of his or her will successfully resist hypnotising influences or acts, then a certain safeguard exists against such possibilities as the above occurring in right-minded persons. There can be little doubt, however, that there are certain persons who are so constituted as to seem little able to resist such influences. Whether the health of persons repeatedly subjected to the hypnotic condition is affected prejudicially still remains undecided. One school of observers believes that prejudice is exercised, and another, composed of those, it must be said, who have practical and extensive experience in its employment, asserts equally strongly the opposite view. There the question must rest for the present.

But there is another important aspect of this subject. Since it is possible in the hypnotic condition to reduce a person into a state in which there is absolute loss of volitional power and incapability of resistance, and of utter loss of knowledge of what happens while the person is under its influence, further opportunities for the commission of sexual crimes upon females become possible. Gilles de la Tourette [2] points out that a female in the hypnotised state is at the mercy of an unscrupulous operator, and that, under its influence, rape has been committed. He quotes cases of this from Tardieu,[3] and from the writings of other observers.[4] In three of these cases, not only was rape committed, but pregnancy followed. We are not aware, however, of any recorded cases in this country of this crime being perpetrated under hypnotic influence.

Hypnotic influence has, moreover, been pleaded in defence of commission of crimes in the French Courts. This plea received considerable prominence in the trial of the Gouffé murder case (p. 183). The female accused—Bompard—pleaded as her defence that the part she played in the tragedy was the result or effect of post-hypnotic suggestion by the male accused, her paramour Eyraud. Although much evidence was given on both sides as to the validity of her plea, the jury did not accept the plea as proved and found her guilty.

In view, therefore, of the present state of knowledge of the range of action and of the effects, immediate and more remote, of hypnotism,

[1] *B. M. J.*, vol. ii., 1898, p. 672.

[2] *L'Hypnotisme : Au Point de Vue Médico-Légale*, 1887.

[3] *Étude médico-légale sur les attentats aux mœurs*, 7th edit., p. 90 ; *op. cit.* p. 92.

[4] *Annales d'hygiène et de médecine légale*, 1879, 3rd series, t. i. p. 39 ; *ibid.* t. vii., Jan. 1882.

the conclusions of the Committee of the British Medical Association, which was appointed in 1890, and which, after full investigation of the subject, reported in 1893, are not only justified, but ought, also, to constitute the attitude of the medical profession concerning this comparatively unknown condition. These conclusions are as follow :—

1. That hypnotism is frequently effective in relieving pain and procuring sleep ;
2. That dangers may arise from its use ;
3. That when used for therapeutic purposes, its employment should be confined to qualified medical men ;
4. That female patients should not be hypnotised except in the presence of a relative or a person of their own sex ; and,
5. That legal restrictions should be placed upon public exhibitions of hypnotism.

As yet no legal restrictions have been placed upon public exhibitions in this country, but they have been enacted in Prussia.

INEBRIETY

The abuse of alcohol by persons may bring them under certain circumstances within the category of insanity and irresponsibility. This remark is not so much intended to illustrate the fact that alcoholism is one of the more indirect causes of the insane condition, but to signify that insanity—perhaps of a temporary kind—may be induced by the direct effects of alcohol. The common law rule is that mere drunkenness cannot be pleaded as an excuse for crime, but, as has been seen, if a state of mental unsoundness has been produced by alcohol, that could be pleaded as an excuse, and if proved, would be held to be so. The question, therefore, resolves itself into whether or not an accused person who has committed a crime while under the influence of alcohol is or is not insane.

Lord Deas in 1881, in the trial of a prisoner who was charged with murdering a fellow-prisoner in a Glasgow police cell, remarked in his charge to the jury that " if a man was insane at the time he committed the offence, no matter whether the insanity lasted for ten minutes or for half-an-hour, merely under drink would not do, but if drink produced insanity for however short a time, and the man did certain things while insane that there was no reason to think he would do while sane, that was quite enough." In former cases,[1] Lord Deas made it perfectly clear that, although drunkenness and *delirium tremens*, not amounting to insanity, were no excuse for crime, they were factors in the reduction of the quality of a charge of murder to one of culpable homicide. In 1892, Lord Kingsburgh [2] stated in his charge to the jury : " You are entitled to take into consideration in the question whether the full guilt of murder has been incurred in this case, the important fact that the man was intoxicated at the time, and to a certain extent using violence, quite unconscious as to the extent of

[1] R. *v.* Dingwall, September 1867 ; 5 Irvine 479 ; R. *v.* Granger, September 1878 ; *Scot. Law Reporter*, vol. xvi., p. 253.

[2] Kane, 3 White, 386.

it. Although he is responsible for that, he may not necessarily be guilty of murder."

Lord Young, in 1889, however, declined to let the case of a married woman go to the jury and discharged the prisoner. She was charged with culpable homicide, having when in *delirium tremens* caused the death of her infant from neglect and starvation. She was discharged on the ground that *delirium tremens* was a disease.

These decisions of the Scots Courts show that while the condition of drunkenness *per se* is not a complete answer to a charge, it may be a mitigating factor. In such cases as the foregoing, experience demonstrates that the alcohol taken either acts abnormally on an individual whose brain and nervous system are easily rendered unstable, or upon persons who have been the victims of profound brain and nerve disturbance, as from sunstroke, or other causes. It is a purely legal question how far such a man would be responsible for an act voluntarily committed which induced the condition of mind which led up to the crime, and, therefore, we need not discuss it further. The practice in English law-courts is to consider the existence of *delirium tremens* at the time a crime was committed as a full answer to the charge, on the ground that it constitutes a state of insanity and irresponsibility.[1]

In English procedure, *delirium tremens* would appear to be a complete answer to a charge. This was accepted in 1845 in Reg. *v.* Watson (York Winter Assizes) and in Reg. *v.* Simpson (Appleby Summer Assizes). Baron Bramwell accepted this plea in 1865 in the case of Reg. *v.* Burns at the Liverpool Summer Assizes. This judge ruled that though the quality of the act might be known by the prisoner the jury might acquit if they believed him to be suffering from a delusion leading him to suppose that what he did, if it had been true, would have justified his act. In 1881 in Reg. *v.* Davis, tried at Newcastle on April 27, Mr Justice Stephens directed the jury to return a verdict of not guilty on the ground that *delirium tremens* was a distinct disease and a secondary consequence of drinking. In 1886 at the January Leicester Assizes in the case of Reg. *v.* Baines, Mr Justice Day charged the jury that if a prisoner was in such a state of intoxication that he did not know the nature of his act, he was insane in the eye of the law and that it was immaterial whether the mental derangement consequent upon such intoxication was permanent or temporary. In 1895 Mr Justice Hawkins ruled that *delirium tremens* absolved from responsibility. In 1899 a man was charged at Leeds with shooting at his daughter with intent to murder her. Dr Bevan Lewis, called for the defence, said that in his view the prisoner at the time of committing the act was suffering from *mania a potu*, a disease of the mind which could be greatly aggravated by a little drink. In answer to the judge, Dr Lewis said that in his view all men who are very drunk are mad. The jury found the prisoner guilty.[2]

It may, therefore, be taken that, when the effects of alcohol amount to insanity and irresponsibility, they absolve the doer of a crime from sentence. It has been contended by some, however, that drunkenness

[1] R. *v.* Burns (Liverpool Summer Assizes), 1865; R. *v.* Chaplin, Warwick Winter Assizes, 1878; R. *v.* Davis, Newcastle Assizes, Ap. 1881; R. *v.* Baines, Leicester Assizes, January 1868.

[2] *Vide B. M. J.*, vol. ii., 1896, p. 802.

of itself is synonymous with irresponsibility, but we are far from satisfied that this is anything like a true statement of the case; indeed, we go further and say that in the bulk of cases of drunkenness, responsibility for actions cannot be removed. We are free, however, to admit that there are certain cases in which drunkenness produces, or is evidenced by, maniacal frenzy, in which the individual is for the time being insane and irresponsible. Drunkenness, it must be remembered, is but a relative term; it does not lend itself easily to definition, and, therefore, the standards by which the existence of the state is gauged are very variable. To say even when a man is drunk is a most difficult problem. Further, the physiological effects of alcohol differ in different individuals. This is a matter of popular observation; consequently it is imperative when drunkenness is pleaded as an excuse for crime, that the whole facts must be laid bare before a court of law.

Attempts have been made to define and delimit the stages or degrees of drunkenness. Magnan, for example, divides it into five stages—viz. (1) Slight excitement and a feeling of well-being, in which speech and gestures are more animated than usual; (2) Crowding and confusion of ideas, the mood being gay, or sad, or full of tender emotions; (3) More marked confusion of ideas, accompanied by incoherence, perversion of taste and smell, illusions, thick speech, vacant countenance, and staggering gait; (4) Coma; (5) Death. Triboulet confines his stages to three in number—viz. (1) Freedom of expression of emotions and ideas despite circumstances and surroundings (*in vino veritas*), which may be termed the irritable and loquacious stage; (2) Disconcerted inco-ordination and confusion of ideas—the mental and physical pugnacious stage; and (3) State of dreaminess, lack of impression of mental ideas, affectionate or lachrymose manifestations, muscular inco-ordination.

These give a fairly accurate picture; but, after all, the personal equation must be reckoned with. There are, undoubtedly, men who are intoxicated first in their legs before they are intoxicated in their heads, and others who suffer first in their heads before their legs are affected.

That chronic alcoholism is not only a menace to the mental health of its victim, but is also productive of mental instability and defect, is proved by nothing so much as by the very enactments of the Legislature in the Inebriate Acts. In the Act of 1879 (42 & 43 Vict. cap. 19), it was affirmed that the habitual drunkard had power by his own act to secure his detention in a licensed institution for a period not exceeding one year, for the purposes of reformation and cure. The Act of 1888 (51 & 52 Vict. cap. 19) made the provisions of the former Act permanent. The Act of 1898 (61 & 62 Vict. cap. 60), while it contains no provision for the compulsory detention of non-criminal habitual drinkers, does contain provisions for the detention of criminal inebriates of both sexes, for reformative purposes. In the present state of the law, it would be impossible to enact the compulsory detention of non-criminal inebriates either in a prison or an asylum, so long as they do not commit any breach of the law, and so long as they are not certified to be of unsound mind. The provision, in the case of criminal inebriates convicted of an offence punishable with imprisonment or

penal servitude—that such an one may be ordered to be detained for a term not exceeding three years in a State inebriate reformatory, in addition to, or in substitution of, any other sentence—is a statutory punishment just as is any other statutory punishment for any other crime committed in any other circumstances. But before pronouncing such a sentence, the Court must be satisfied that the offence was committed under the influence of drink, or that drunkenness was a contributory cause, and that the offender himself admits that he is, or has been found by the jury to be, a habitual drunkard. The second class of habitual drunkards, called "repeaters," is composed of those who within twelve months preceding the date of conviction of a fourth offence have been summarily convicted of minor offences, and are to be punished by being detained in any certified inebriate reformatory for not more than three years. These sentences, it is evident, are parallel with those passed upon boys and girls who have got beyond the control of their parents, and who are ordered to be detained in reformatories for like periods. The law, therefore, while it does not transgress any principle affecting the responsibility of those committed, acts on the assumption that such persons are less able to resist the perpetration of offences by reason of their habits, and, therefore, are not mentally sound, although the mental unsoundness does not go the length of actual insanity and irresponsibility. This is indicated by the fact that an offence which, in the case of an occasional offender, would be met by a fine or a few days' imprisonment, becomes, by the mere greater frequency of the same act, one which needs detention for three years in a reformatory.

In the Children Act, 1908 (8 Edw. VII. ch. 67), section 26, the following enactment is made :—

"Power as to Habitual Drunkards

"Where it appears to the Court by or before which any person is convicted of an offence of cruelty, or of any of the offences mentioned in the First Schedule to this Act [offences under ss. 27, 55, and 56 of the Offences Against the Persons Act, 1861, under ss. 5, 42, 52, and 62 of that Act, or under the Criminal Law Amendment Act, 1885, or under the Dangerous Performances Acts, 1879 and 1897, or any other offence involving bodily injury to a child or young person] that that person is a parent of the child or young person in respect of whom the offence was committed, or is living with the parent of the child or young person, and is a habitual drunkard within the meaning of the Inebriates Acts, 1879 to 1900, the Court, in lieu of sentencing that person to imprisonment, may, if it thinks fit, make an order for his detention in a retreat under the said Acts, the licensee of which is willing to receive him, for any period named in the order, not exceeding two years, and the order shall have the like effect, and copies thereof shall be sent to the local authority and the Secretary of State in like manner, as if it were an application duly made by that person and duly attested by a justice under the said Acts ; and the Court may order an officer of the court or constable to remove that person to the retreat, and on his reception

the said Acts shall have effect as if he had been admitted in pursuance of an application so made and attested as aforesaid :

" Provided that—

(*a*) an order for the detention of a person in a retreat shall not be made under this section unless that person, having had such notice as the Court deems sufficient of the intention to allege habitual drunkenness, consents to the order being made ; and

(*b*) if the wife or husband of such person, being present at the hearing of the charge, objects to the order being made, the Court shall, before making such order, take into consideration any representation made to it by the wife or husband ; and

(*c*) before making the order the Court shall, to such extent as it may deem reasonably sufficient, be satisfied that provision will be made for defraying the expenses of such person during detention in a retreat ; and

(*d*) nothing in this section shall affect any power of the Court to order the person convicted to be detained in a certified inebriate reformatory."

Experience during the ten years which have elapsed since the passing of the last Inebriates Act, 1898, has not been satisfactory, inasmuch that so long as the confinement in a retreat of a non-criminal habitual drunkard must be the voluntary act of the inebriate, so long will that Act be likely to remain practically a dead letter. As a matter of fact the inebriate is about the last person to surrender what freedom he has. Consequently, public opinion has been developing steadily and strongly in the direction of urging that some power should be conferred by the Legislature on persons who are responsible or chargeable for the inebriate for his compulsory confinement in a retreat for curative purposes. In 1908, Departmental Committees were appointed in England and Scotland respectively to consider the operation of the Law relating to Inebriates and detention in reformatories and retreats. The English Committee reported in 1908, and the Scottish Committee in 1909, in each case after hearing evidence. The main features of each Report and of the Recommendations may be seen in the following :—

No. of Recommendation	English Report	No. of Recommendation	Scottish Report
I.	That the Inebriates Acts, so far as may be necessary to carry out Recommendations, be repealed, and that an Act be passed consolidating existing Acts so far as not repealed, and extending the law relating to inebriates.	I.	The same.
II.	That the term " Inebriate " be substituted for that of " habitual drunkard," and be defined as follows :— " An inebriate is a person who habitually takes or uses any intoxicating thing or things, and while under the influence of such thing or things, or in consequence of the effects thereof is—	II.	Same as to change of designation. Definition : " An inebriate is a person who habitually takes or uses any intoxicant or narcotic, and while under the influence of such, or in consequence of the effects thereof is—

No. of Recommendation	English Report	No. of Recommendation	Scottish Report
II.—*continued*	(*a*) dangerous to himself or others, or (*b*) A cause of harm or serious annoyance to his family or others ; or (*c*) Incapable of managing himself or his affairs, or of ordinary proper conduct."	II.—*continued*	(*a*) At times dangerous to himself or any other person ; or (*b*) At times incapable of managing himself or his affairs ; or (*c*) At times a cause of harm or serious annoyance to his family or to any other person ; or (*d*) Unfit to have the care of any child of which he is the parent."
III.	Retreats to be licensed by Home Secretary, and to be subject to inspection directed by said Secretary.	III.	Same. Licenses to be granted by Secretary for Scotland.
IV.	That it be made unlawful for any person for payment to board, etc., in an unlicensed house more than one inebriate at the same time.	IV.	Same.
V.	Stamp duty under Habitual Drunkards Act, 1879, on licenses of retreats be abolished.	V.	Same.
VI.	That licensee of a retreat be empowered to grant leave of absence to any patient therein for any reason licensee may consider satisfactory.	VI.	Same ; but with addition "for a period not exceeding 3 weeks, and for a longer period subject to regulations made by Secretary for Scotland."
VII.	Practically identical.	VII.	That a licensee or any person authorised in writing by him, and any police constable without further warrant than original committal or request for reception, be empowered to retake any inmate who has escaped from a retreat or who during leave of absence breaks any condition of such leave ; said escape and circumstances of recapture to be reported to the Inspector under the Act and to such other person as may be appointed by Secretary for Scotland.
VIII.	Power of transference of inebriate from one retreat to another be given to Home Secretary.	VIII.	Same ; but to Secretary for Scotland.
IX.	Power of discharge of inmate from a retreat to be given to Home Secretary. If prior to expiration of period of committal, not unless 14 days' notice of hearing of application has been given to all persons interested.	IX.	Practically the same.
X.	"That inebriates should be allowed to enter, before a Justice of the Peace, into a legal obligation to abstain from intoxicants for a specified period not less than one year" ; the form of application to be set forth in the suggested Act to include a certificate to be signed by the Justice to the effect that the	X.	(1) That power be given to a relative, friend or guardian, or other person having an interest, and to the Procurator-fiscal, to petition the Sheriff for an order of guardianship or for the committal to a retreat of an alleged inebriate. (2) The procedure in the petition should be carried through by any

No. of Recommendation	English Report	No. of Recommendation	Scottish Report
X.—*continued*	Justice has explained to applicant the nature of the document and the consequences of any breach of the obligation contained therein.	X.—*continued*	of the above-named persons, or by the Fiscal, who, on a *primâ facie* case being made out to him, should be required to bring the case before the Court. (3) When the petition is presented by any person other than the Fiscal, it should be supported by a written declaration signed by the petitioner, and one other person to the effect that the alleged inebriate is a person to whom the Act applies. (4) The Sheriff should dispose of the petition summarily *in camerâ* unless he otherwise determine, and, if he is satisfied by the evidence led before him, which need not necessarily include a medical certificate, that the alleged inebriate is an inebriate within the meaning of the Act, he should have power, alternatively— (*a*) To make an order placing the inebriate under guardianship for a period of one year; or (*b*) To commit the inebriate for a period not exceeding six months and thereafter for a further period of guardianship for a year. (5) When the order is in terms of (*a*) and the conditions of guardianship are broken by the inebriate, the Sheriff shall have power on report of guardian, or, failing him, of original petitioner, summarily to commit the inebriate to a retreat for a period not exceeding six months, with a further period under guardianship for one year. (6) In the event of breach of conditions of guardianship subsequent to detention in a retreat, the Sheriff should have power on a like report to commit inebriate to a retreat for a period not exceeding three years. (7) Secretary for Scotland shall have power to prescribe from time to time conditions of guardianship and to approve of modification of same in individual cases. (8) Power should be given to Sheriff when placing a person under guardianship to apply to his case the provisions of section 72 of the Licensing (Scotland) Act, 1903, relating to the purchase and obtain-

No. of Recommendation	English Report	No. of Recommendation	Scottish Report
		X.—*continued*	ing of exciseable liquors, and the selling or supplying the same, without the conditions as to previous convictions, contained in that section.
XI.	That inebriates should be permitted to apply voluntarily to a Justice for an order of guardianship.	XI.	Recommends that an order for detention in a retreat should cover the conveyance to, reception, and detention in a retreat of the inebriate named therein; and that the provisions of the existing Inebriates Acts (as amended) regarding detention of persons who enter retreats should apply to inebriates committed by Sheriff.
XII.	The guardian so appointed should have power: (1) To prescribe place of residence. (2) To deprive inebriate of intoxicants and to prevent him procuring them. (3) To require inebriate to submit to control of nurses or attendants. (4) To warn sellers of drink and drugs, and others, against supplying inebriate with the same.	XII.	Empowers Sheriff to require, when necessary, the inebriate or person on whom he is legally dependent, to pay expenses of application, or of guardianship, or of maintenance in a retreat to such an extent as Sheriff shall consider reasonable and proper where means are available for this purpose.
XIII.	(1) That power be given to a relative, friend, or guardian voluntarily appointed to petition a Judicial Authority for a compulsory order of guardianship or for committal to a retreat. (2) When such petition is presented, it should be accompanied by a medical certificate, unless the inebriate has refused to submit himself to medical examination, and by a statutory declaration signed by petitioner and at least one other person, to the effect that the alleged inebriate is a person to whom the Act applies. (3) On receipt of petition and documents aforesaid, the Judicial Authority should visit the alleged inebriate, or summon him to appear before him to show cause why he should not be subjected to guardianship or committed to a retreat. Proceedings should be conducted, if desired by the alleged inebriate, in private, both parties being entitled to be represented by solicitors or counsel. (4) Having satisfied himself that the alleged inebriate is an inebriate within the meaning of the Act, the Judicial Authority should point out	XIII.	Protection to be afforded to persons who act in pursuance of proposed Act against civil and criminal proceedings, if such persons have acted in good faith and with reasonable care on the lines of the Vexatious Actions (Scotland) Act, 1898, and the Vexatious Indictments Act, 1859. Any action raised by a detained inebriate to be commenced within six months, or, by special leave of the Court, within twelve months, next after release of inebriate bringing the action.

No. of Recommendation	English Report	No. of Recommendation	Scottish Report
XIII.—*continued*	to him the advantages of the voluntary provisions already suggested. If the inebriate is unwilling to take advantage of these provisions, or if he has previously taken advantage of them but has failed to observe the conditions thereof, the Judicial Authority should be impowered to make an order for either compulsory guardianship or committal to a retreat. (5) When the Judicial Authority has satisfied himself that the case is one in which a compulsory order should be made, he should exercise his discretion as to the nature of that order. Guardianship is a less severe measure than detention, and should always be resorted to when practicable and likely to meet the needs of the case. (6) If the Judicial Authority is not satisfied, he should adjourn the consideration of the petition or dismiss the petition. If he is of opinion that the petition is frivolous and vexatious, and ought not to have been presented, he should be empowered to order the petitioner to pay the costs of the proceedings.		
XIV.	Defines the powers of compulsory guardians.	XIV.	(1) That section 23 of the Inebriates Act, 1898, be amended so as to apply also to cases tried summarily. It should be the duty of the Procurator-fiscal in all cases where an offence is committed under influence of drink or of which drunkenness was a contributing cause, and where there is *primâ facie* evidence that offender is an inebriate, to charge him with being an inebriate, as well as with the offence ; and that in all cases of offences tried under indictment or summarily, where offender pleads guilty or is convicted of the offence, the Court should have power without a jury to deal summarily with the question whether offender is or is not an inebriate, and, if satisfied that he is, in addition to or in substitution for, any other sentence, to order his detention in a reformatory. (2) That section 24 of the same Act should be amended by providing that where any person is found guilty in a Police Court or
XV.	Defines the words "Judicial Authority" to mean and include a Judge of the High Court of Justice, County Court Judge, Recorder, Stipendiary Magistrate, any two Justices, or any Justice of the Peace specially appointed by Quarter Sessions. The remaining Recommendations include, *inter alia* : (1) Protection to persons acting under suggested Act. (2) Powers to magistrates to deal summarily with inebriate offenders. (3) Committal of inebriates for trial. (4) Abolition of need for three previous convictions. (5) Consent of inebriate to be dealt with summarily to be abolished. (6) Grants from Treasury to After-Care Associations. (7) Provision by the State for inebriates committed by the		

No. of Recommendation	English Report
XV.—*continued*	courts; recognition by the State of existing reformatories; provisions by State and Local Authorities combined for poor or destitute inebriates in retreats and for State Reformatories for recalcitrant cases. (8) Committal of inebriates to reformatories and their release on probation. (9) Provisions for inebriates convicted under Inebriates Act, 1898.
. . . . .	
XXXIX.	That any person who, by delirium tremens, has made himself a charge upon the rates, should *primâ facie* be deemed an inebriate, and liable to be proceeded against as such at the instance of the guardians to whom he has made himself chargeable.

No. of Recommendation	Scottish Report
XIV.—*continued*	Justice of the Peace Court of any of the scheduled offences, if there is evidence or information submitted by the public prosecutor that leads the Magistrate to believe that such person is an inebriate it should be in the power of the Magistrate to remit such person to the Sheriff to be dealt with as an inebriate, and where such person has been convicted of any of these offences three times within the preceding twelve months, the Magistrate should be bound to remit him to the Sheriff to be dealt with according to law. (3) That in cases under sections 23 and 24 of the same Act, where there have been three previous convictions as aforesaid, or where the person charged has been under detention in a reformatory or under guardianship within the twelve months preceding the date of commission of the offence with which he is charged, the *onus* of proving that he is not an inebriate shall be placed on him. (4) Gives a list of extended schedule of offences to which above shall apply. (5) When a person has been committed under section 23 of the same Act (amended as above) the Court, in addition to or in substitution for any other sentence in respect of the offence then charged, should have power— (*a*) To place offender under guardianship; or (*b*) To commit offender to a reformatory. (6) Where the conviction follows under section 24 of the Act (amended as above) the Court, in like case, should have power— (*a*) To place offender under guardianship; or (*b*) To sentence offender to imprisonment for not more than six months; or (*c*) To commit offender to a reformatory.
. . . . .	
XXVI.	That in urgent cases of acute alcoholism, the Sheriff should have power on an application by the nearest available relative, or by

No. of Recommendation	Scottish Report
XXVI.—*continued*	any person having an interest, accompanied by an affidavit of a medical man, to pronounce an order of urgency for the care, control, and treatment of the person in respect of whom the application is made for a period not exceeding 14 days. Such an order should be available as evidence in any subsequent application in terms of the Inebriates Act.

The Recommendations of the Reports which have not been specifically included in the foregoing tabulated account deal with the proposed provisions for the accommodation and maintenance of all inebriates who are convicted and committed by the courts, said accommodation and costs of maintenance to be provided by the State, and also for the classification of inebriates in reformatories.

It need only be pointed out further that the principle of the compulsory committal of inebriates has by three previous Committees been recognised and recommended—viz. (1) Select Committee on Habitual Drunkards, 1872; (2) Departmental Committee on Treatment of Inebriates, 1873; and (3) the Departmental Committee on Habitual Offenders, Inebriates, etc., 1895.

It remains to be seen if, and when, the foregoing recommendations of the Departmental Committees will receive Parliamentary consideration and sanction and become law.

In the law of Austria—Universal Civil Code, Par. 21—it is enacted that in cases of mental infirmity whereby the victims are unable to manage their affairs properly, a curator, after due procedure before the Court, may be appointed by the Court to manage their estate. But the law is also extended to habitual drunkards, morphinomaniacs, and others, who, although admittedly not insane, but simply pyschologically degenerate, are detained at first either in a "Psychiatrische Klinik," or a hospital, and are thence sent to an asylum. The curatory is removed when the person has recovered control, and it may be renewed as often as he lapses. Schlangenhausen affirms that in Austrian asylums the proportion of habitual drunkards to insane varies from 10 to 40 per cent.

SECTION II

TOXICOLOGY

CHAPTER XVII

LAWS RELATING TO POISONS

TOXICOLOGY means simply the science of poisons. In respect that poisoning is one of the methods by which a murderer seeks to destroy his victim, it is essential that students and practitioners alike should be familiar with the outstanding symptoms and signs of poisoning, not only for the purpose of detecting their symptoms on persons still alive, but also their effects in the examination of the bodies of persons, the causes of whose deaths have been anomalous and obscure, lest poisoning may have been the cause.

What is a poison ? To answer this question may seem at first an easy matter, but when the definitions offered are submitted to criticism, it will be found that none will cover the field of their operation, except the definition is made ponderous and unhandy. If we say with Taylor, for example, that a poison is " a substance which when absorbed into the blood is capable of seriously affecting health or of destroying life," then we necessarily exclude such corrosive poisons as the mineral acids and the alkalies which do not kill by being absorbed into the blood, but either by rapid destruction of those parts of the ingestive apparatus with which they come in contact, or by producing such secondary pathological changes in these parts that the mechanical act of ingestion is seriously hindered, or the digestive apparatus is much impaired. Probably the definition by Letheby[1] is one of the best—viz. " Anything which otherwise than by the agency of heat or electricity is capable of destroying life, either by chemical action on the tissues of the living body, or by physiological action from absorption into the living system." Even to this, however, may be offered with some degree of cogency the objection that it does not include those substances, which developed as products of pathological changes in the body itself, as in uræmia, acetonæmia, cholæmia, and other conditions, none the less certainly cause poisoning. On the other hand, the definition would include all of the poisons which may be exhibited for homicidal purposes, and that is the connection in which the definition is demanded. The law, however, does not demand that a poison should be defined further than a substance which if applied to the

[1] Woodman and Tidy, *op. cit.* p. 31.

body, or administered internally, has been applied or administered with the *intention* to kill or do harm. The law on the subject is contained in 24 & 25 Vict. cap. 100.

Section 11 runs thus: "Whosoever shall administer or cause to be administered to or taken by, any person, any poison or other destructive thing with intent to murder, shall be guilty of felony."

Therefore, even although the poison administered, etc., be not followed by bodily injury, either as the effect of prompt treatment or otherwise, if the *intent* to commit murder is proved, the person administering it is held by the law to be guilty of felony.

Section 23 enacts that "Whosoever shall unlawfully and maliciously administer to, or cause to be administered to, or taken by any other person, any poison or other destructive or noxious thing, so as thereby to endanger the life of such person, or so as thereby to inflict upon such person any grievous bodily harm, shall be guilty of felony"; and section 22, to cover the administration of substances calculated to enable another crime to be committed, ordains that "whosoever shall unlawfully apply or administer to, or cause to be taken by, or attempt to apply or administer to, or attempt to cause to be administered to or taken by any person, any chloroform, laudanum, or other stupefying or overpowering drug, matter, or thing, with intent, in any of such cases, thereby to enable himself or any other person to commit, or with intent, etc., to assist any other person in committing any indictable offence, shall be guilty of felony."

It will, therefore, be apparent from section 23 that if anyone administers any poison, or other destructive or noxious thing, to the danger of life or the infliction of grievous bodily harm, he shall be guilty of felony. To meet the possible plea that the substance administered was not intended to endanger life or to inflict grievous bodily harm, and that the substance so administered did neither the one nor the other, section 24, by enacting that if the substance be administered with *intent only to injure, aggrieve, or annoy*, the person administering, etc., shall be guilty of a misdemeanour, makes the act a crime, and closes the last loophole of escape against the culprit. Hence in any case in which it has been proved that a poisonous or noxious substance has been administered, but without the effect of killing, endangering the life, or inflicting grievous bodily harm, and where the intent to do one or other of these cannot be proved to the satisfaction of the jury, they may return a verdict in terms of the last-named section, and convict the administrator of a misdemeanour. The foregoing sections of the Act embrace, it will be observed, a variety of names for the substance administered—viz. *poison, destructive thing, stupefying or overpowering drug*, and *noxious thing*. Moreover, the term "deadly poison" is generally used in indictments in such cases. Since this would not include substances which either in themselves, or in certain quantities would not cause death, but under other circumstances are calculated to do so, it has been ruled by Mr Justice Erle[1] that this term "deadly poison" should be treated as mere "legal surplusage." The question, too, as to what constitutes a "noxious thing," has been raised in courts of law. There have been at least

[1] *Law Times*, Ap. 12, 1845.

two rulings on the subject; first, Lord Chief-Justice Cockburn and Mr Justice Hawkins at the Bodmin Assizes, 1877, gave the following ruling in the case of a man who was charged with administering cantharides with criminal intent: that there must not only be an administration of a noxious drug with a guilty intent, but that it must have been administered in sufficient quantity as to be noxious. As in this case the quantity administered was too small to effect grievous bodily harm, the man was acquitted. The other ruling was given by Lord Coleridge in R. *v.* Cramp.[1] The prisoner was charged with having administered half-an-ounce of Oil of Juniper, with intent to procure abortion. He was convicted, but appealed on the legal ground that the substance used must be noxious in itself, and not only when given in excess. Lord Coleridge ruled that "if a person administers, with intent to produce miscarriage, something which as administered is 'noxious,' he administers a 'noxious thing.'" It may, consequently, be taken that the law is so comprehensive that the most skilful poisoner shall not escape on technical pleas. For the law respecting the application of corrosives to the surface of the body, we refer the reader to p. 207 *et seq.*

LAWS REGULATING THE SALE OF POISONS

The Acts of Parliament by which the sale of poisons in England and Scotland is regulated, are as follows:—31 & 32 Vict. c. 121 (1868), and the Amending Acts, 32 & 33 Vict. c. 117 (1869), 38 & 39 Vict. c 63 (1875); and in Ireland, 33 & 34 Vict c. 26 (1870), and the Amending Act, 38 & 39 Vict. c 63 (1875). According to law, a medical practitioner who has passed an examination in pharmacy in order to obtain his degree or diploma, and who, after receiving such degree or diploma, is registered as a practitioner, is entitled equally with a duly qualified chemist under the Pharmacy Acts to keep an open surgery for retailing, dispensing, or compounding poisons, provided that in such sale he conforms to the requirements of the Sale of Poisons Acts. He is himself entitled to sell poisons, or he may depute the sale to a qualified assistant in his absence, but he is not entitled to depute the sale to an unqualified assistant. Where it is proved that his unqualified assistant so offends by selling poisons or preparations which contain poisons, he is liable, according to a notice of the General Medical Council, to be found guilty of conduct "infamous in a professional respect." All medicines containing poisons which he dispenses must be labelled with his name and address, and the contained poison, together with the name of the person to whom it is dispensed, shall be entered in a book to be kept by him for the purpose. It should be definitely and clearly understood that the law does not differentiate between the sale of a poison as a constituent of a medicinal mixture and the sale of a poison by itself.

The law relative to dispensing of medicines which are poisonous is contained in the Pharmacy Acts, 1868 (31 & 32 Vict. cap. 117, and cap. 121). Section xvii. of the former Act makes it illegal to sell any poison unless labelled with the name and address of the seller, and illegal to sell any poison in the first part of Schedule A of the Act to any person unknown to the seller unless introduced by some person known to the seller, every sale to be entered in a book kept for the purpose.

This section is modified by section iii. of the Amending Act (31 & 32 Vict. cap. 121) as follows:—"Nothing contained in section xvii. of the said recited Act shall apply to any medicines supplied by a legally qualified medical practitioner to his patient or dispensed by any person registered under the said Act, provided such medicine be distinctly labelled with the name and

[1] *Times*, March 1, 1880.

address of the seller, and the ingredients thereof be entered with the name of the person to whom it is sold or delivered, in a book to be kept by the seller for that purpose."

The most recent Act bearing upon the sale of poisons is the Poisons and Pharmacy Act, 1908 (8 Edw. VII. 7. ch. 55).

Its chief enactments are as follows :—

Section 1—(1) repeals Schedule A of the Pharmacy Act, 1868 (31 & 32 Vict. cap. 121), and the schedule to this Act is substituted therefor; the schedule to this Act may be amended by adding thereto or removing therefrom any article or by transferring any article from one part of the schedule to another in manner provided by s. 2 of the Pharmacy Act, 1868.

Section 2 enacts that so much of the Act of 1868 as makes it an offence for any person to sell or keep open shop for the sale of poisons, unless duly qualified under the Pharmacy Acts, shall not apply in the case of poisonous substances to be used exclusively in agriculture or horticulture for the destruction of insects, etc., or in sheep dips or weed killers which are poisonous by reason of their containing arsenic, tobacco or the alkaloids of tobacco, if the person so selling or keeping open shop is duly licensed for the purpose by a local authority and conforms to regulations, but nothing in this section shall exempt such person from the requirements of any other provision of the Pharmacy Act, 1868, or of the Arsenic Act, 1851, relating to poisons: provided that His Majesty may by Order in Council amend this provision by adding thereto or removing therefrom any poisonous substance. Before granting any licence under this section, the local authority shall take into consideration whether in the neighbourhood where the applicant for the licence carries on or intends to carry on business the reasonable requirements of the public with respect to the purchase of such poisonous substances as aforesaid are satisfied. His Majesty may, by Order in Council, make regulations for the purposes of carrying this section into effect. The local authority for the purposes of this section, in any borough in England of over 10,000 inhabitants, shall be the council of the borough, and in any Royal, parliamentary, or police burgh in Scotland, the town council, and as respects any other place, the county council.

Section 3 amends ss. 15 and 16 of the Pharmacy Act, 1868, enacting that any pharmaceutical chemist or chemist and druggist carrying on business, unless where the business is *bonâ fide* conducted by himself or by a duly qualified person, and unless the name and certificate of qualification of the person conducting the business is conspicuously exhibited in the premises, shall be guilty of an offence under s. 15 of the Act of 1868 ; and the provisions of s. 16 of that Act, which enable the executor, administrator or trustee of a deceased chemist to continue his business so long as such business is *bonâ fide* conducted by a duly qualified assistant, shall be interpreted in terms of the foregoing subsection. A body corporate, and in Scotland a firm or partnership, may carry on the business of a pharmaceutical chemist or chemist and druggist, (*a*) if the business, so far as it relates to the keeping, retailing, and dispensing of poisons, is under the control and management of a superintendent who is duly qualified under the Pharmacy Acts, whose name has been forwarded to the registrar appointed under the Act of 1852, and who does not act at the same time in a similar capacity for any other body corporate or firm or partnership, and if in every premises so conducted the certificate of qualification of such superintendent is conspicuously exhibited. Section 4 gives further powers to the Council of the Pharmaceutical Society in making bye-laws.

Section 5—(1) " It shall not be lawful to sell any substance to which this section applies by retail, unless the box, bottle, vessel, wrapper, or cover in which the substance is contained is distinctly labelled with the name of the substance and the word ' Poisonous,' and with the name and address of the seller of the substance, and unless such other regulations as may be prescribed under this section by Order in Council are complied with ; and, if any person sells any such substance otherwise than in accordance with the provisions of this section or of any Order in Council made thereunder, he shall, on conviction under the Summary Jurisdiction Acts, be liable for each offence to a fine not exceeding five pounds. (2) The substances to which this section applies are sulphuric acid, nitric acid, hydrochloric acid, soluble salts of

oxalic acid, and such other substances as may for the time being be prescribed by Order in Council under this section."

Section 6—(1) The provisions of section 2 and section 5 of this Act shall apply to Ireland, with certain modifications, and section 7 applies to Ireland as sub-section 2 of section 3 applies to England or Scotland respectively.

Section 8 enacts that the Act shall come into operation on April 1, 1909.

The Schedule of the Act is as follows :—

PART I

Arsenic and its medicinal preparations.

Aconite, aconitine, and their preparations.

Alkaloids—all poisonous vegetable alkaloids not specifically named in this schedule, and their salts, and all poisonous derivatives of vegetable alkaloids.

Atropine, and its salts, and their preparations.

Belladonna, and all preparations or admixtures (except belladonna plaisters) containing 0·1 or more per cent. of belladonna alkaloids.

Cantharides, and its poisonous derivatives.

Coca, any preparation or admixture of, containing 1 or more per cent. of coca alkaloids.

Corrosive sublimate.

Cyanide of potassium, and all poisonous cyanides and their preparations.

Emetic tartar, and all preparations or admixtures containing 1 or more per cent. of emetic tartar.

Ergot of rye, and preparations of ergots.

Nux vomica, and all preparations or admixtures containing 0·2 or more per cent. of strychnine.

Opium, and all preparations or admixtures containing 1 or more per cent. of morphine.

Picrotoxin.

Prussic acid, and all preparations or admixtures containing 0·1 or more per cent. of prussic acid.

Savin, and its oil, and all preparations or admixtures containing savin or its oil.

PART II

Almonds, essential oil of (unless deprived of prussic acid).

Antimonial wine.

Cantharides, tincture and all vesicating liquid preparations or admixtures of.

Carbolic acid, and liquid preparations of carbolic acid, and its homologues containing more than 3 per cent. of those substances, except preparations for use as sheep wash or for any other purpose in connection with agriculture or horticulture, contained in a closed vessel distinctly labelled with the word "Poisonous," the name and address of the seller, and a notice of the special purposes for which the preparations are intended.

Chloral hydrate.

Chloroform, and all preparations or admixtures containing more than 20 per cent. of chloroform.

Coca, any preparation or admixture of, containing more than 0·1 per cent. but less than 1 per cent. of coca alkaloids.

Digitalis.

Mercuric iodide.

Mercuric sulphocyanide.

Oxalic acid.

Poppies, all preparations of, excepting red poppy petals and syrup of red poppies (papaver rhæas).

Precipitate, red, and all oxides of mercury.

Precipitate, white.

Strophanthus.

Sulphonal.

All preparations or admixtures which are not included in Part I. of this

schedule, and contain a poison within the meaning of the Pharmacy Acts, except preparations or admixtures the exclusion of which from this schedule is indicated by the words therein relating to carbolic acid, chloroform, and coca, and except such substances as come within the provisions of section 5 of this Act.

Should any poison, belonging to one or other of the foregoing sections, be sold, the seller must label the package with a label bearing the name of the poison or article, the name and address of the seller, and the word "poison." No poison included in Part I. may be sold to anyone unknown to the seller, unless he be introduced by someone known to the seller, and until, before delivery, the seller enters in a book kept for the purpose, the date of sale, name and address of buyer, the name and amount of the poison sold, the purpose for which the poison is to be used, and until the entry is signed by the buyer and by the introducer. In the case of the sale of arsenic, even further restrictions are imposed. If the purchaser be not known to the seller he must be introduced to the latter by a person who knows both of them, and who acts as witness of the sale. Besides the above details to be entered as the record of the sale, both the seller and the purchaser must sign the record. By the Sale of Arsenic Act—14 & 15 Vict. c. 13 (1851)—no arsenic can be legally sold to a person under the age of 21; nor may it be sold in quantities of less than 10 lbs., unless it be mixed with soot or indigo in the proportion of one ounce of the former, or half-an-ounce of the latter, to each pound of arsenic. When quantities of 10 lbs. or upward are sold for any purpose for which it would be unfitted by the above admixture, it may be sold without it. By the Act 26 & 27 Vict. c. 113, it is the law that "every person who shall knowingly and wilfully sow, cast, set, lay, put, or place, or cause to be sown, cast, set, laid, put, or placed into, in, or upon any ground or other exposed place or situation, any grain, seed, or meal which has been steeped or dipped in poison, or with which poison or any ingredient or preparation has been so mixed as thereby to render such grain, seed, or meal poisonous and calculated to destroy life, shall, upon a summary conviction, be liable to a penalty of any sum not exceeding £10." In a case tried in 1891, before the magistrates at Chelmsford, where a woman had put down some pieces of bread poisoned with phosphorus paste, and which was fully proved in evidence, she was acquitted, because the Act says nothing about bread. In view of the foregoing necessary stringent regulations, it is somewhat surprising to find that patent medicines which contain some of the above poisons may be sold without any such restrictions whatever. This anomalous state of matters has not yet been remedied, although the attention of the law officers of the Crown has been called to the fact by coroners and by the medical profession. It is, however, as illegal for an unqualified person to sell patent medicines which contain poisons as any other medicine containing a poison, or a poison itself.

In what Ways do Poisons act?—It may be said that their action is either (1) Local, or (2) Remote. They either kill or menace life by destroying the tissues with which they come in contact, or they produce these effects by being absorbed into the circulation, and thus act on organs, more or less remote from the point of their absorption, as the brain and spinal cord, or heart. Although the mineral acids, the caustic alkalies, and the corrosive salts destroy more or less extensively the parts they touch, death is not due in all these classes to the same prime cause; in the first, and, it may be, in the second, death is probably due to shock which the nervous system sustains, but in the third, while undoubtedly the local corrosive action is a factor in the production of the fatal result, the major factor is the absorption of the poison into the circulation. The irritant poisons, again, as arsenic, phosphorus, or cantharides, produce not only violent local irritation and inflammatory mischief, which of themselves may cause death by shock, but they do more mischief when they are ab-

sorbed into the body. With respect to the remote action of poisons, it is well known that toxic agents do not produce their poisonous results until they have been absorbed into the system, but that, when absorbed, certain of them act by election or preference upon certain organs more than upon others; and it is by the undue interference with the normal function of such organs that death is produced, or life is menaced. Thus, opium, morphia, alcohol, and others affect chiefly the brain; digitalis, baryta, strontia, oxalic acid (in certain doses), the heart; prussic acid, tobacco, etc., the lungs; and strychnia, the spinal cord. But certain others do not act upon any special organ, but upon the blood-stream itself; such as Arseniuretted Hydrogen, Chlorate of Potash, Pyrogallic Acid, Carbon Monoxide, and others. Those poisons which do act remotely are said to act physiologically in two ways—viz. (1) By being absorbed into the blood and being carried to the organs which they more immediately affect; and (2) by their local effect being transmitted from the local nerves of the parts first attacked to the nerve-centres, and from thence reflected to the organs which the particular poison affects. If we take the case of a poisoned arrow stuck in the body, or the sting of a venomous snake, or the application of poisonous matter to an abraded absorbent surface, it is obvious that the poison must be absorbed into the general circulation before it can possibly produce its general poisonous effects, for, if the absorption be prevented by any measures promptly adopted, the poisonous results will be averted. Majendie's experiments conclusively show this. He connected the cut ends of vessels of the limbs of an animal with the body by interpolating pieces of glass tubing; and even then the poison acted. Dr Blake [1] has demonstrated that if hydrocyanic acid be introduced into the stomach of an animal by a fistulous opening, after ligature of the portal vessels, no poisonous results will ensue; but that, immediately after removal of the ligatures, the poison begins to act. The second suggested method was the only way by which Christison believed the quick fatal results of the above acid could be accounted for. Blake's experiments, however, demonstrate clearly that even with respect to that poison, absorption was necessary, and was the means by which it acted. Moreover, Emmert has shown that where poison is inserted into limbs connected only to the body by the nerves, no poisonous effect is produced. We may, therefore, conclude that all poisons which act remotely, do so only by virtue of absorption, and that, although there is a sense in which corrosives by their action kill by shock to the nerve-centres, it is better for our purposes to consider the burden of their action as primarily local, and, secondarily central.

On the question of the rapidity of absorption of poisons, the researches of Masoin deserve consideration. He chose tartar emetic as the experimental poison because it takes some time to produce effects. The constantly minimal fatal dose for a rabbit was 1·25 to 1·50 centigramme per kilo of body weight of animal—this dose producing no symptoms for nearly twelve hours. By bleeding the animals, beginning 30 seconds after the injection of the poison and injecting normal saline solution, and at last transfusing blood from a normal rabbit (the control animals not being bled but being injected as the others) he found that

[1] *Edin. Med. and Surg. Journal*, vol. liii., p. 55.

the animals, when injected with the minimum fatal dose, suffered from the same symptoms and died in the same time whether bled after injection of the poison or not; that animals injected with a much larger dose than was necessary to kill lived longer if bled 30 seconds after injection than if left alone; that as much poison as is necessary to kill seems to be absorbed from the blood within 30 seconds, but that larger doses are to some extent retained in the blood for longer periods; but that even when the injected amount is four times as strong as is necessary to kill, the poison is absolutely removed from the blood in 12 minutes.[1]

RELATION OF POISONOUS DOSES AND THEIR EFFECTS

Attempts have been made from time to time to discover whether there exists any mathematical correspondence between the dosage of a poison and its effects.

Cash,[2] writing on the relationship of action to dose especially with reference to repeated administration of indaconitine, draws attention to Juckoff's observations on Koppe's case with digitoxin.[3] Koppe first took experimentally 0·5 milligram of digitoxin, without effect. Twenty-four hours later he took 1 mgm., with trifling effect resulting. After four more days, he took 2 mgms., with the result that he nearly died from the effects. This indicated that a 2 mgm. dose of digitoxin was not only twice, but many more times active than a 1 mgm. dose. Juckoff concluded that the addition of 0·1 mgm. to the (active) 1 mgm. dose would practically double the effect of that dose, of 0·2 mgm. would treble the effect, and of 0·3 mgm. would quadruple the effect; and so on. Cash, after reviewing various experiments by others with other drugs, arrives at the conclusion that "it is improbable that any universal law of uniform applicability associating dosage with its certain effect could be formulated which would prove adaptable to all classes of remedies, or even to such remedies as presumably belong to the same class." Harnack recognised two main classes into which potent drugs might be divided—viz. (*a*) those in which the lethal dose lies far above the active dose, as exhibited in physiological effect; and (*b*) those in which the lethal dose lies near the active dose. Of the former class, atropine may be taken as a type, and of the latter, strychnine.

How may the Action of Poisons be counteracted?—The effects of poisons may be counteracted by antidotes, which may be divided into three classes, because of their methods of counteraction—viz. (*a*) physical or mechanical, (*b*) chemical, and (*c*) physiological.

Mechanical or physical antidotes are but few in number. Some of them have, indeed, a chemical action to a limited extent. For example, white of egg or flour and water may be said to be mechanical antidotes in poisoning by corrosive sublimate, but at the same time, by the formation of albuminate of mercury which is practically insoluble in the stomach for the time being, they act partially as chemical antidotes.

[1] *Arch. Internat. de Pharm. et de Thérap. fascic.* v. vi., 1903.
[2] *B. M. J.*, vol. i., 1908, p. 1213.
[3] *Versuche zur Auffindung eines Dosirungsgesitzes.* Leipzig, 1896.

Probably, in the same way, animal charcoal may be reckoned as a mechanical antidote in alkaloidal poisoning, as by strychnia, but it is difficult to estimate how far the antidotal effect is not chemical because of the occluded oxygen. Mechanical antidotes may be said to exercise a beneficial effect in other cases only as they serve to dilute the poison and thus stay its effects; draughts of water or of demulcent fluids certainly act in this manner both in corrosive and irritant poisoning.

Chemical Antidotes.—These neutralise poisons by forming new compounds which either are insoluble, or less active; thus alkalies in acid, and dilute acids in alkali poisoning may be taken as the simplest type; sulphate of magnesia in poisoning by carbolic acid of the second type, and sulphates of the alkalies in poisoning by lead or barium, of the first type. Freshly prepared sesquioxide of iron, made by treating tincture of perchloride of iron with excess of ammonia, filtering the precipitate, and after admixture with water, administering it to the patient, is also a chemical antidote in respect that it forms the comparatively insoluble arseniate of iron; and, in a like manner, is tannin or its preparations in poisoning by tartar emetic.

Physiological Antidotes.—The mode of action of these must be differentiated. Chloroform may be said to exercise an antagonistic effect in strychnia poisoning, but all it really does is to overcome the tetanic contraction of the chest muscles which tends to kill the patient by asphyxiating him, and to give time and opportunity for the elimination of the poison from the stomach by surgical measures and from the body by the excretory channels. Atropine is held by many to be a physiological antidote to opium and morphia, and some maintain that the action conversely is equally well marked. To some degree, the theine of tea and caffeine in coffee may be held to be antidotal in action to the same poisons. Physiological antidotes are not always, however, reliable in their action.

Within the last two or three years injections of warm normal saline have been employed as almost a last extremity in cases of poisoning by morphia and other poisons with most beneficial results. It is not unlikely that this restorative action may depend upon two results—viz. (*a*) the dilution of the poison in the blood, and (*b*) the improved condition of the circulation due to the increased volume of fluid therein produced. Whatever may be the action, however, such injections ought, when possible, to be tried when other remedial measures are seeming to fail. The injections are best made into parts of the body where there is loose connective tissue, such as the axilla or flank.

Circumstances which may modify the Action of Poisons—1. *Quantity.*—The larger the quantity and the severer the symptoms, the more rapid the fatal result, is the first conclusion at which we would naturally arrive. But there may be salvation in respect of some poisons, from the very excess in quantity inducing rapid and complete emesis. It is this question of quantity which separates the medicinal action of a poisonous drug from its distinctively toxic action, and, as has been pointed out, which has prompted the law to differentiate between a poison and a noxious thing. It is also true of certain poisons that as is the quantity taken so is the action variable—for example, oxalic acid, in graduated quantities from larger to

smaller, may kill from (*a*) shock ; (*b*) action on the heart ; (*c*) action on the spinal nervous system ; (*d*) or action on the brain.

2. *Condition of Administration.*—A poison acts most rapidly when exhibited in a gaseous or vaporous form, next when injected subcutaneously, next when ingested in a state of solution, and least quickly, when in an insoluble form, and, therefore, difficult of solution in the stomach, or other part of the body ; for example, a piece of opium in the rectum will take longer to act than if it had been swallowed. It is important to remember, however, that the question of solubility must be considered more with relation to the part to which it is applied than to the vehicle in which it is administered.

3. *Chemical Combination.*—It is well known that certain substances when in certain combinations are very poisonous, but that in others are comparatively innocuous ; and further, that while the component parts of a compound are poisonous singly, the compound itself is comparatively inert ; thus sulphuric acid and baryta, while separate, are poisonous, but in combination form a salt, which, because of its insolubility, does but little harm except for its mechanical presence in the stomach.

4. *Mechanical Combination.*—When a powdery poisonous substance is administered with fluids of much lighter specific gravity the substance is liable to sediment in the vessel, and thus the quantity actually swallowed is less than where the vehicle of administration has been a fluid of specific gravity more nearly approaching that of the powder. It is by adopting this latter principle that the poisoner who uses arsenic administers it in a fluid which by its colour will mask the presence of the poison, and one which is heavy and viscid, such as porter, or cocoa, or coffee. Stewart has shown [1] that 100 grains of arsenious acid, mixed in a tea-cup with two teaspoonfuls of Epps' cocoa, boiling water and milk, could not be detected either by appearance, taste, or smell, but that on standing, the milk curdled, and the arsenic sedimented ; and that with arrowroot and gruel the same results were observed. When a poison is given in an assimilable form with food, its action will appear more quickly than if it be administered shortly after a good meal. In a recent case, it was shown that where a man swallowed by mistake a tablespoonful of equal parts of aconite, belladonna, and chloroform liniments, the symptoms did not come on acutely until about three-quarters of an hour after, during which time he walked some distance, travelled by train, and walked at the end of his railway journey fully half-a-mile.

5. *The Part of the Body to which the Poison is applied.*—A poison acts most rapidly (1) when exhibited in a gaseous or vaporous form to the lungs ; (2) when applied as a solution to serous surfaces ; (3) when placed in contact with mucous surfaces ; and (4) when applied to the unbroken skin. As examples of these may be taken chloroform, ammonia vapour, or carbon monoxide, the virulency of snake-venom when introduced into the circulation by the bite in the skin, and its innocuousness when swallowed, provided the mucous tract of mouth, gullet, and stomach is intact, and the inunction of mercury as oleate, by the skin.

6. *Habit.*—It is a matter of everyday observation that continuous

[1] "Trials for Murder by Poisoning," p. 395.

indulgence in alcohol and tobacco, for example, confers a comparative immunity from danger from poisonous doses. In like manner, the opium habit may be contracted to such an extent that immense doses may be taken with impunity, as, for example, in the well-known case of De Quincey. Further, from continued use, strychnia and arsenic are borne in doses which would be liable to act poisonously if taken to begin with. This is well established in the case of persons in Styria. Dr Knapp of Obergeiring[1] saw a woodcutter of that neighbourhood swallow, after crushing with his teeth, a piece of arsenious acid weighing 0·33 gramme, without any ill effects, notwithstanding that examination of his urine by Marsh's process gave evidence of the presence of arsenic; and Stewart[2] narrates the fact of his own knowledge that a student in the College of Science, Dublin, used to eat little pieces of the same substance of about 3 or 4 grains, without apparent harm.

7. *Condition of Bodily Health.*—A small dose relatively will kill a weakly person, from which a stronger person would likely recover. In certain diseases, some drugs can be exhibited with impunity in doses which, in other circumstances, would be likely to prove harmful; as, for example, opium in mania, tetanus, or delirium tremens, and in cases of acute pain. In other diseases, on the other hand, certain drugs cannot be exhibited even in small doses without attendant harmful effects; as mercury in cirrhosis of the kidney, arsenic in chronic dysentery, opium to patients predisposed to apoplexy; and in certain physiological conditions, as ergot, or large doses of quinine, in pregnancy.

8. *Sleep.*—That poisons seem to act more slowly during sleep is accounted for by the fact that absorption is then less active than during the waking condition; otherwise, sleep has no special bearing on the activity of poisons.

9. *Idiosyncrasy.*—This is borne out in the case of persons who suffer severely from such doses of mercury or opium as would, in the average person, produce but little physiological result. In like manner, idiosyncrasy asserts itself with respect to certain articles of diet, as cheese, shell-fish, and others.

EVIDENCES OF POISONING IN THE LIVING BODY

The evidences of poisoning will depend upon whether the act of poisoning is a single one, or a series of continuous periodic acts; or, as the attacks are sometimes denominated, whether the poisoning be acute or chronic.

(*a*) In acute poisoning the symptoms appear suddenly, while the individual is in good health. The person is seized with a group of symptoms of a definite character out of consonance with his previous state of well-being. This feature of the attack stands out prominently in all recorded cases of poisoning. At the same time, certain groups of symptoms of disease which simulate poisoning, may have a sudden onset, as cholera, gastro-enteritis, etc.

(*b*) In chronic poisoning, the onset of the symptoms is more gradual and insidious, because of the small quantity of poison which has been

[1] Binz, *Pharmacology*, vol. ii., p. 84 (Syd. Soc. Ed.).
[2] *Op. cit.*, p. 380.

administered at each time; for the intention of the poisoner may not be to kill his victim suddenly, but gradually by persistent administration of small doses of poison, in the hope of averting suspicion. In such cases, the possibility of detection lies in the want of causal relationship between the condition of the sufferer and the symptoms from which he suffers, in the fitful coming and going of the symptoms, in their appearance usually after food or liquids have been taken, and in their complete disappearance on the patient's removal from his usual surroundings.

(*c*) In acute poisoning especially, and in chronic poisoning generally, the symptoms appear soon after some kind of food or medicine, or drink has been taken. It must be recollected, however, that it is precisely under such circumstances that acute gastritis of an idiopathic character, perforation of the stomach, or other gastro-intestinal conditions may arise. In the case of Kate Dover tried in 1882, the symptoms of poisoning came on after dinner; in the case of Madeleine Smith, 1857, the symptoms were alleged to have come on after the victim had partaken of a cup of cocoa; in that of William Dove, in 1856, after the victim had been given some medicine; and in the case of Dr Pritchard, after various articles of food had been partaken of by the victims.

(*d*) Where more than one person has eaten of a similar dish, or of some article of food, and where they are similarly affected, there is strong presumptive evidence of poisoning. In Inverness, on Good Friday, 1882, several persons who ate hot cross buns made by one baker, were seized with symptoms betokening irritant poisoning. The Crown analyst, however, could discover no metallic irritant, but he found "an irritant alkaloid, of undetermined nature," which was supposed to be a constituent of the spice which had been mixed in the buns.[1] In the early part of the same year, in the village of Woodhouse, near Sheffield, 21 persons were attacked with the following symptoms—viz. vomiting, diarrhœa, dimness of vision, and creeping feelings in the extremities, which continued for several hours. It was discovered that all those who had partaken of brawn, and only those, were attacked. No mineral poison was found on analysis, and it was believed that the illnesses were caused by some poisonous animal irritant due to decomposition of the brawn.[2]

(*e*) The strongest proof of poisoning, however, is established by the discovery of poison in the food taken, or in the vomited matters, especially where it can be shown that such could not have happened from accidental extraneous contamination.

If a poison be found in the urine of a patient suffering from unexpected and anomalous symptoms, there can be no doubt whatever that the poison has been introduced into the body, has passed into the circulation, and has then been excreted.

GENERAL LINES OF TREATMENT

These may be summed up in a few sentences, and the mode and extent of their application must be left to the judgment of the practitioner in respect of the needs of individual cases.

[1] *B. M. J.*, 1882, vol. ii., p. 284. [2] *Ibid.*, 1882, vol. i., p. 396.

First. Remove the poison from the stomach;

Second. Neutralise in the stomach what cannot be removed, or in the body by physiological antidotes what has been absorbed;

Third. Aid the elimination of the poison from the body by the natural channels; and

Fourth. Treat urgent and dangerous symptoms during and after the seizure.

The best means to remove irritant, mildly corrosive, and narcotic poisons from the stomach is the siphon-tube, which is easily introduced, and, when intelligently used, can do no injury. The best kind of tube is made of flexible Para rubber, tube and funnel being combined in one piece. It should measure in total length about five feet and be marked at a point 20 inches from the stomach-end, which should be of thicker rubber than the rest of the tube, for easier introduction, and should be perforated by more than one opening. For adults a tube of half-an-inch diameter is a good size. For young children, a tube may be extemporised out of a soft rubber catheter, rubber tubing, a piece of glass tubing, and a small funnel. After the tube has been warmed and anointed with a lubricant, it is passed into the stomach by depressing the tongue with the finger, sliding the tube along the finger well back into the pharynx, and thus passing it downwards. When the mark on the tube is reached, the tube has entered the stomach. Warm water, at a temperature at which the hand can be freely introduced into it without discomfort, is then poured in by the funnel to the amount of about two pints, which water may contain a suitable dissolved antidote if such be available, the funnel all the time being held some distance above the patient's head. While the last portion of water is being poured in, and while the tube and a portion of the funnel is full of the water, the tube at its junction with the funnel is tightly pinched between the finger and thumb, and the tube is then lowered below the level of the stomach. Atmospheric pressure acting upon the column of water in stomach and tube will cause it to run out of both, and thus empty the contents of both. The operation may be repeated as often as is required. It may be necessary in some cases of determined suicide, or in other contingencies, to use a gag for the mouth. In all cases of strychnia poisoning, it is imperative that before attempting to introduce the siphon-tube into the stomach, the patient should be put under chloroform, otherwise the attempt will probably induce spasm, and frustrate the effort. Where a siphon-tube is not available, and since promptitude of action is all-important, the most easily procurable emetics, as mustard and water, or salt and water, should be freely used. Should the patient refuse or be unable to swallow, and if apomorphia be at hand, a hypodermic injection of $\frac{1}{20}$th to $\frac{1}{10}$th of a grain may be administered. It is a good plan, where the poison swallowed is known, to introduce a suitable chemical antidote dissolved in the water, such as permanganate of potash in opium or morphia poisoning in the proportion of 10 to 15 grains to the pint, and in poisoning by other substances, similarly suitable antidotes. The stomach siphon-tube ought not to be used in cases of poisoning by strong corrosives. In such cases, it is better, if possible, to counteract their effects by causing the patient to drink copiously of fluids charged with suitable

antidotes. In poisoning by certain substances, as arsenic, cantharides, turpentine, and others, which by irritant action upon the kidneys develop inflammatory processes therein and thus prevent natural elimination of the poison, it is necessary to assist the excretion of urea by getting the skin to act. Perspiration may be induced by hot baths, warm packs, or by hypodermic injection of pilocarpine.

After recovery from the immediate effects of corrosive poisoning, it is necessary to prevent, if possible, cicatricial contraction of the gullet. This is effected by bougies carefully regulated as to size, and carefully used. In certain cases of poisoning by liquid ammonia or other corrosive which gives off fumes, laryngeal complications may be set up ; it may become necessary, therefore, in order to prevent death by asphyxia, to perform tracheotomy. These, with rectal feeding, and the allaying of pain, constitute the main needs in cases of poisoning.

The Duty of a Medical Practitioner in Cases of Suspected Poisoning.—Suppose a medical man be called to a case which, from the symptoms exhibited, he suspects to be due to slow poisoning, what points should he attend to, besides his duty in trying to ward off death ? They may be comprehended in the following—viz.

(*a*) Note the time of occurrence of the symptoms, and their character ;

(*b*) Note their relation in point of time to the last partaking of food, drink, or medicine ; and the order in which they appear.

(*c*) Observe whether the symptoms do or do not intermit, or increase steadily in severity.

(*d*) Inquire into the previous condition of health of the person attacked.

(*e*) If there has been vomiting, see the vomited matter, and, if possible, secure it for purposes of examination on some reasonable pretext, or note whether the vomited matters have been hastily disposed of.

(*f*) Secure a portion of food, drink, or medicine suspected, and samples of urine, for after-examination.

(*g*) If food or a particular dish is suspected, inquire whether similar food, or dish, has been previously eaten with impunity, and note, after inquiry, whether or not any other person than the one attacked has eaten of it with impunity, or has been attacked simultaneously.

(*h*) Take mental note of explanations offered or remarks made, regarding the onset of symptoms.

(*i*) Where the symptoms are not conform to the bodily condition, and where, in spite of appropriate treatment, they continue, narrowly watch the whole surroundings of the patient, and the conduct of those tending him.

EVIDENCE OF POISONING ON THE DEAD BODY

1. *Evidence from Post-Mortem Appearances.*—The post-mortem appearances found will be considered in detail when the poisons are considered in groups or classes. It is sufficient to say that such pre-

cautions should be taken as are laid down on page 27. In conducting a post-mortem examination where poisoning is suspected—and especially where there is a possibility of a volatile odorous poison being found—it is very advisable that no odorous disinfectant should be used in the post-mortem room prior to the examination, lest the sense of smell be blunted. We are acquainted with the details of a case in which two medical men made an examination of the body of a woman which was found under suspicious circumstances, and where they then failed to discover that death was due to carbolic acid,—owing to the fact, it was stated, that such a disinfectant had been used in the room before the examination was made.

2. *Evidence from Chemical Analysis.*—This is, *par excellence*, the most important proof of poisoning—when a poison is found in the contents of the stomach and intestines, in the substance of the internal organs, in the urine, or in one or other, or more than one of these. It may happen, however, in certain cases, that by reason of decomposition of the tissues of the body, and the lapse of time between the death and the examination, the poison may not be found on analysis. This is possible, for example, in the case of hydrocyanic acid. This is also true of other poisons of vegetable origin.

In a criminal trial in Germany in 1883, four experts, Ranke, Buchner, Gorup-Besanez, and Wislicenus, who had made an experimental study on this point, gave evidence. The experiment made was as follows:—Seventeen dogs were each made to swallow a pill, containing 5 centigrams, or about $\frac{3}{4}$ of a grain, of strychnine. The average period between the administration of the poison and the occurrence of death was 35 minutes, but in individual cases it varied greatly. The first tetanic attack supervened in from 5 to 83 minutes, and the average interval between the attacks was 18 minutes. Each attack lasted a minute on the average, and death almost always occurred during a spasm. Rigor mortis set in from 21 to 97 minutes after death, the average interval being 50 minutes. It was rapidly diminishing 16 hours after death. The bodies were interred. After intervals of 100, 130, 220, and 330 days respectively, the bodies were exhumed, and the alkaloid searched for by a modified Stas' method. The experimenters did not discover strychnine, even when a decigram ($1\frac{1}{2}$ grains) of the poison had been administered. They came to the opinion that the physiological test was the most delicate test.[1]

Difficulties, too, may occur in cases where, with respect to the particular poison employed, there are no distinguishing chemical tests for its identity, as in aconitine. There are some medical jurists, however—the late Professor Christison, for example—who have held, or who hold, that if the symptoms, post-mortem appearances, and moral evidence are very strong, it is not necessary that the poison itself should be found, in order that a charge may lie, and a conviction be obtained. That, however, is a question which can only be decided in each individual case, and regarding which it is not advisable that a general rule should be stated.

Evidence by Experiments on Animals.—Such experiments either constitute the principal proof of the existence of a poison, or merely

[1] *B. M. J.*, vol. i., 1883, p. 72.

corroborative proof. Marshall Hall's test for strychnia by immersing a frog in the solution suspected to contain the poison, is one which would only be used as corroborative evidence, since the poison may be isolated from the bodily tissues by Stas', Dragendorff's, or Selmi's process. In the Lamson case, tried in 1881, where the poison used was aconitine, Dr Stevenson had to fall back upon purely experimental evidence of this kind upon himself and upon mice, to distinguish the character of the alkaloid which he isolated from the body.

The late Mr Montague Williams who conducted the defence, and who tried to establish that death was due merely to ptomaine poisoning, quoted Lord Coleridge to the effect that tests upon animals were most unreliable. Such an opinion even from such an eminent expert in law cannot be deemed as binding upon experts in medicine, and must, therefore, be taken for what it is worth. It is necessary to admit, however, that experiments upon certain animals with certain poisonous substances would be highly inconclusive, since certain animals are insusceptible to the influence of certain poisons which are inimical to man; for example, rabbits can live on the leaves of belladonna, hyoscyamus, and stramonium, and it has been stated by more than one observer that pigeons may take relatively large quantities of morphia without the poisonous effect being exhibited. It has long been known that it is difficult to poison the hedgehog with opium, cyanides, arsenic, or corrosive sublimate, and Lewin [1] has shown that this animal can be said to be immune in the ordinary sense of the word from cantharides. It shows a remarkable tolerance to this drug when introduced into the stomach, but the animal does not possess absolute immunity against it, since the mucous membrane of the conjunctiva and rectum exhibit irritant effect when the drug is locally applied. At the same time, a cat or a dog will exhibit the same line of symptoms after swallowing prussic acid as a man; and so, also, with respect to other poisons. Therefore, when experiments upon animals are appropriately and properly conducted, they afford valuable evidence.

Moral Evidence.—A medical practitioner has usually little to do with this aspect of evidence, although he must not shut his eyes to what is going on around his patient, and he may be able to testify as to the truthfulness or correctness of statements made to him either by the person poisoned, or by some individual who is afterwards charged with the crime; for in this connection, it is undoubtedly his duty to play the rôle of detective as part of his duty of physician, in the sick room. It has been the lot of some practitioners to witness cases in which a patient's health was being undermined by the more or less regular administration of small doses of poisons, and such is not unlikely at any time. What course, then, should a practitioner follow when he suspects such proceedings? He cannot speak of it openly, because that would at once defeat his object—viz. the discovery of the actual fact, or it might expose him if he did so prematurely, or, if having spoken out his suspicions were ill-established, to an action for slander. On the other hand, if he allow matters to proceed without action of any kind, he may expose himself later to the censure of a judge in open court, or of the public. In the Pritchard poisoning case,

[1] *Deut. med. Woch.*, June 16, 1898.

Dr Paterson, one of the witnesses for the Crown, who stated in the witness-box that he formed the opinion the first time he was called to see Mrs Pritchard that she was being poisoned by antimony, was severely taken to task by the Lord Justice-Clerk who presided at the trial in the following words :—" He [Dr Paterson] said, in answer to the questions put to him, that his meaning was—what he intended to state in the box was—that he was under the decided impression, when he saw Mrs Pritchard on these occasions, that somebody was practising upon her with poison. Now, he thought it consistent with his professional duty, and I must also add, with his duty as a citizen of this country, to keep that opinion to himself. In that I cannot say that he did right. I should be very sorry to lead you to think so. I care not for professional etiquette, or professional rule. There is a rule of life and a consideration that is far higher than these—and that is the duty of every citizen of this country—that every right-minded man owes to his neighbour, to prevent the destruction of human life in this world, and in that duty I cannot say but Dr Paterson failed." But it has been urged by some, that the proper course to pursue is that the medical practitioner should deliberately say in the presence of the suspected party what he believed was going on, and that if the condition of the patient did not improve he would be bound to call the criminal authorities to his aid. This is a step, however, which could only be taken when poison had been actually found in the excretions of the patient. But in our view it is not the right step, because it may first of all lead to the dismissal of the medical attendant from the further treatment of the case, and the patient would thus be deprived of his knowledge ; further, from the legal point of view, his conduct might be considered as compounding with crime. The best course, probably, to adopt, where poison is found as described, is for the medical attendant to call in, on his own responsibility, a colleague with whom he may consult, and, thereafter, determine to have the patient attended by skilled nurses, who alone should have the entire management of the patient, with regard, even, to the preparation of food, and its administration. Should these measures fail, then he ought to take the patient into his confidence, and by skilfully laid plans try to detect the source of the poison and the poisoner.

CLASSIFICATION OF POISONS

By reason of the fact that poisons are so numerous, and their actions individually, so different, it is necessary to reduce them to a system or classification. Various classifications, some of them more or less elaborate, have been made, and upon different bases. One classification has been established upon the sources of poisons, without respect to their action ; another, upon their action, without respect to their sources ; a third, by reason of their action upon the different organs of the body ; and so on.

For example, they have been divided into (*a*), mineral, (*b*) vegetable, (*c*) animal, and (*d*) mechanical agents. In another classification, they are grouped into three great divisions—viz. I. Irritants, embracing

Corrosives; II. Neurotics or Narcotics; III. Narcotico-Irritants. Again, they have been classified as to their action into two main divisions—viz. I. Chemical. II. Vital.

I. Chemical.

1. Corrosives. { Acids, Alkalies, Caustic Salts.
2. Vulnerants: Glass; Needles.

II. Vital.

1. Irritant Metalloid = Phosphorus, Iodine.
   ,, Metallic = Arsenic, Antimony, Mercury, etc.
   ,, Vegetable = Gamboge, Colchicum, Squill.
   ,, Animal = Cantharides, Ptomaines.
2. Narcotic—Somniferous = Opium.
   ,, —Deliriant = Hyoscyamus, Belladonna.
   ,, —Inebriant = Alcohol, Chloroform, Ether, Cannabis Indica.
3. Sedative—Cardiac = Digitalis.
   ,, —Cerebral = Hydrocyanic Acid.
   ,, —Neural = Aconite, Conium.
4. Excito-motory = Strychnia, Ergot.
5. Toxæmic or Septic = Snake poison, Ptomaines.
6. Irrespirable Gases = Carbonic Acid, Carbon Monoxide, Coal-gas, Chlorine, etc.

Perhaps the simplest classification is that which is first given. But we do not propose to follow closely any of the above classifications, since all of them are too arbitrary, and some are not sufficiently practical.

I. The Mineral class lends itself to two subdivisions—viz.

1. The Corrosive Poisons.
2. The Irritant ,,

(*a*) General Action of Corrosives.—There is more or less destruction of parts with which the corrosive substance comes in contact; there is no remote systemic action, excepting, perhaps, shock; the symptoms come on immediately after swallowing, and consist of burning, agonising pain in mouth, throat, gullet, and stomach, continuous retching and vomiting of shreddy bloody matter; intense thirst; and, probably, some implication of air-passages. There will be signs of corrosion of lips, or mouth; usually, the mind is clear; death may be due to shock, to extensive destruction of parts, to suffocation from implication of larynx, to perforation of the stomach, or, later, to starvation from cicatricial contraction of gullet, or stomach, or both.

Post-Mortem Appearances.—These may be generally expressed as signs of corrosion and destruction of parts, varying in extent from localised patches to extensive destruction, particularly in the stomach.

(*b*) General Action of Irritants.—The symptoms come on at a variable interval after the poison has been swallowed, usually from a half to one hour thereafter. They are indicative of gastro-intestinal irritation, and consist of severe pains in stomach and abdomen, associated with, or followed by, violent, continuous and painful vomiting and

diarrhœa. The vomited matter, at first consisting of the contents of the stomach, becomes bilious, and, later, is composed of "coffee-grounds" material. Along the track of the gullet there is a feeling of intense heat and, usually, of constriction, which provokes considerable thirst, to satisfy which by drinking only further provokes vomiting. The diarrhœa, consisting at first of ordinary loose stools, and afterwards of stools mixed with blood accompanied by tenesmus, is severe and urgent. After some time, the patient begins to show signs of collapse or shock; the pulse becomes thready and irregular, and the skin clammy and cold; cramps may appear in the muscles of the limbs; and, although during all this time the mind of the patient is clear, before death unconsciousness, preceded or succeeded by convulsions, usually heralds the fatal issue. The period of death is variable, depending upon the amount of the poison swallowed, and the condition of the patient at the time. Death may be due to shock, shock combined with the effects of absorption of the poison into the system, or to protracted suffering from consequent inflammation of the gastro-intestinal tract.

Post-Mortem Appearances.—These consist of evidences of irritation, inflammation, and ulceration in stomach and intestines, and especially in the rectal portion of the bowel.

Corrosives — I. The Mineral Acids. — The symptoms come on immediately; there is violent burning pain, which extends from mouth to stomach; gaseous frothy eructations; brownish or blackish vomit, mixed with coffee-grounds sediment, and sometimes, even with blackened or yellowish portions of mucous membrane. The vomit has a strongly acid reaction, stains clothes or carpet upon which it falls, and causes effervescence with a carbonate; there is intense thirst, and the efforts to swallow in appeasing it are attended with great difficulty and pain; there may be considerable dyspnœa, from swelling of epiglottis and mouth of larynx. The mouth and lips will be found excoriated, the mucous membrane of tongue and mouth, soft and pasty, and looking as if covered with a coating of paint, of differing colour depending upon acid swallowed; hence articulation is apt to be indistinct. If, however, the acid has been taken out of a spoon, or from a necked bottle, the lips may escape: the teeth may be loosened if the gums be much destroyed. The vomiting and retching being more or less constant, the patient becomes weaker, and although the mental faculties may remain clear till near the end, convulsions, suffocation, exhaustion, or shock from perforation of stomach, puts an end to the sufferings of the patient. Recovery may follow prompt antidotal measures, but death may eventually result, notwithstanding, from stricture of gullet or stomach.

Post-Mortem Changes.—Lips may be stained, yellow, whitish, or brownish; the mucous membrane of mouth is corroded, the tissues being softened and discoloured; the gullet is similarly affected, although, here and there, may be found blackish areas and patches from altered, effused blood; the stomach is collapsed and contains a blackish, charred-looking material, or is covered by a yellow coating, and the mucous membrane thrown into corrugated folds; it may, or may not be perforated; if perforated, some of the acid will have

escaped into the abdominal cavity, and will have acted upon the contents over a variable-sized area.[1]

In dealing with such cases, it is necessary to bear in mind the post-mortem appearances of gastric ulcer, and of post-mortem digestion of stomach.

General Treatment.—The stomach-pump, or stomach-tube, should never be used, as they are dangerous. Alkalies—as lime, chalk, calcined magnesia, carbonates of the alkaline earths—mixed with water, and, later, diluent, demulcent drinks — as barley-water, milk, thin gruel—should be given freely.



Fig. 118 shows the marks of corrosion round the mouth from the action of corrosive poison. The figure exhibits the appearances in the victim of the Oldham Case. The corrosive marks in this case were at each angle of the mouth, and involved the mucous membrane of upper lip and adjoining skin. The patch on the left side measured 1¼ inches in length and ⅓ of an inch in width; that on the right side being one inch in length and ⅓ of an inch in width. On the chin to the right of the median line and ¼ of an inch below the junction of skin and mucous membrane of lower lip was a dry corroded patch of skin circular in shape and ⅓ of an inch in diameter. Sulphuric acid is believed to have been the corrosive used.[3] (Photograph kindly lent by Dr Harris.)

1. **Sulphuric Acid.** — It is commonly used in certain trades, in the form of strong, and often, impure, vitriol. In dilute form, it is used in medicine, either diluted by itself, or in the form of aromatic sulphuric acid. A child who swallowed some of the acid died in about 24 hours after.[2]

It may have to be examined in one of four conditions—viz.

(*a*) Concentrated acid;
(*b*) Dilute acid;
(*c*) Mixed with Vomited Matter or Contents of stomach;
(*d*) As Stains upon clothing.

A. Concentrated Acid.

Tests.—

1. It chars organic matter, such as sugar.

2. When mixed with water, it evolves considerable heat.

3. When boiled with a reducing agent, as chips of wood, or copper foil, fumes of SO_2 are given off, which are detected by, (*a*) odour; and (*b*), by first making blue, and then bleaching, starch-paper dipped in iodic acid, or potassium iodide.

B. Dilute Acid.

1. When a drop or two of methyl-orange is added to some of the liquid, the yellow or orange colour is changed to pink or red.

2. If a solution of barium chloride be added after acidifying with

[1] Norman Moore's Case. *Lancet*, vol. i., 1879, p. 373.
[2] *B. M. J.*, vol. i., 1881, p. 174.
[3] *Med. Chron.* (Harris), May 1887.

dilute HCl, a dense white precipitate is formed, which is practically insoluble in boiling nitric or hydrochloric acids.

C. Mixed with Contents of Stomach, or in Vomit.

When filtered, the above tests may be employed.

D. Stains upon Cloth.

1. This acid changes black cloth to a dirty brown, which becomes reddened at the edges; the dilute acid gives a red stain, which in time becomes brown.

2. The stains remain long damp, the acid being hygroscopic.

3. Cut out stain; macerate in water; filter; apply Barium test.

4. Cut out similar-sized piece of unstained cloth, and treat similarly —for parallel test.

Post-Mortem Appearances.—Intense destruction of stomach, the mucous membrane of which is blackened more or less extensively. From post-mortem diffusion, the corrosive action may be observed in the peritoneal cavity, and in consequence, the large intestine may share these appearances. The œsophagus may also, in parts, be blackened and eroded, and sloughs may be found in the larynx.[1] In one case in which a man took half-a-pint of the acid with suicidal intent, and from the effects of which death took place in 2 hours, the stomach was wholly destroyed, and the whole alimentary tract from mouth to rectum was changed. Owing to post-mortem diffusion, the acid had saturated the pericardium, surface of the heart, and neighbouring portions of lung and diaphragm, while all the abdominal viscera were hardened on their surface, and the abdominal muscles were saturated by it.[2]

Quantitative Analysis.—The total amount of acid present in stomach may be estimated by cutting up the stomach and contents, and macerating in water, which must be repeated as often as the fluid remains acid; then the combined macerations should be filtered, concentrated by boiling, and titrated, either *in toto* or in aliquot portion, by decinormal ($\frac{N}{10}$) soda, potash, or ammonia, using methyl-orange as an indicator; or by precipitating the acid with $\frac{N}{10}$ barium chloride in excess, and calculating the amount of acid in the dried and weighed precipitate of barium sulphate.

Fatal Dose.—Half-a-drachm has killed a child about one year old, in 24 dours. Christison states the smallest fatal dose in an adult to be ʒi. On the other hand, recovery has followed the taking of ʒiv.

Fatal Period.—Shortest, one hour; average, eight to sixteen hours. Death, however, may be instantaneous from shock, and life may be prolonged for weeks or months.

2.. **Hydrochloric Acid.**—Spirit of Salt.—It is used in various trades. It may be found as follows :—

(*a*) Concentrated Acid.[3]
(*b*) Dilute Acid.
(*c*) Mixed with Contents of Stomach, or with Vomit.
(*d*) Stains upon cloth.

1. Concentrated Acid.—*Characters* : it is either colourless, or of a

[1] *B. M. J.*, vol. i., 1883, p. 235.
[2] *The Lancet*, vol. i., 1879, p. 373.
[3] *B. M. J.*, vol. ii., 1902, p. 617.

pale lemon-yellow colour, due to perchloride of iron; fumes in the air, and gives off dense fumes of ammonium chloride, in presence of ammonia.

Tests.—

(*a*) It tinges organic matter a light yellow colour.

(*b*) It does not act upon copper or mercury.

(*c*) When peroxide of manganese is added, and the mixture is warmed, chlorine gas, recognised by its greenish-yellow colour, and its pungent, suffocating odour, is given off, which bleaches litmus paper, and turns starch-iodised paper blue.

2. Dilute Acid.—

When a solution of $AgNO_3$ is added, a precipitate, curdy in character, and white at first, but, later, becoming greyish in colour on exposure to light, is thrown down. The precipitate is soluble in NH_3, and is not soluble in HNO_3, as is the oxalate of silver.

3. Mixed with Contents of Stomach, or with Vomit.—

1. Test with methyl-orange for acidity.
2. Apply Silver test.

4. Stains upon Cloth.—From this acid, stains at first are of a bright red colour, changing in about ten to twelve days to a reddish-brown.

Treat as before, and distinguish by negative responses to tests for other acids, and by positive silver test.

Cases.—A young man, aged 23, was admitted into Middlesex Hospital for œsophageal stricture. Four years previously he had swallowed about 4 ounces of "spirits of salts." He recovered from the effects, having been promptly treated in a hospital, where he had to remain, however, for nine weeks. He was extremely emaciated on admission, was semi-conscious and hardly able to hold his head up. He complained of intense epigastric pain, vomited occasionally, and had intense thirst. His temperature was 95° F.

Gastrostomy was performed, but he died ten days afterwards. Post-mortem examination revealed stricture of the gullet, 2½ inches above cardiac end of the stomach, of a hard, fibrous, and annular character, although admitting a No. 15 catheter. There was also a dense, hard, fibrous stricture at the pylorus, scarcely admitting a fine probe. The stomach was much hypertrophied and pouched at its cardiac end, but the gullet was only slightly pouched.

A woman, aged 50, swallowed 3 ounces of this acid with suicidal intent. Six hours later she was discovered by her groaning. When taken to hospital, she was much collapsed, and complained of great epigastric pain. There were no signs of corrosion of mouth or tongue. She died about 8 hours after taking the poison. Post-mortem examination showed no signs of corrosion of mouth or tongue; the epiglottis was much charred; the larynx was intensely red, œdematous, and somewhat charred; the gullet was much charred, the mucous membrane being entirely gone; the external surface of the stomach was nearly black, there being hæmorrhage from it into the peritoneal cavity. There was no perforation of the stomach. Internally, its whole surface was charred almost black, this being more marked at the pyloric than at the cardiac end. The duodenum at its commencement was slightly charred.[1]

Post-Mortem Appearances.—The parts of mucous membranes which have come in contact with this acid are dirty-white or ash-grey in colour, which is, however, most marked in the gastric membrane. Although perforation of the stomach is not so frequently found as from sulphuric acid, it has, nevertheless, been met with in several

[1] *B. M. J.*, vol. ii., 1902, p. 617.

cases. In such cases, the acid will be found to have attacked the abdominal viscera, more or less; but whether perforation takes place or not, by reason of post-mortem diffusion through the gastric walls, some measure of erosive action on the abdominal organs is likely to be found. In addition to the colour of the mucous membrane above-named, patches of erosion, of varying depth, some of them blackish, or reddish in colour, are also likely to be seen on the gastric mucous surface.

Quantitative Analysis.—Macerate stomach and contents in distilled water repeatedly, until last washing is free from acid. Concentrate contents by evaporation. Then, either titrate against a $\frac{N}{10}$ alkali solution, using methyl-orange as indicator, or precipitate as silver chloride, by using excess of silver nitrate, and calculate acid from precipitate.

Fatal Period.—From 4 to 30 hours.

Fatal Dose.—Half-an-ounce. Recovery has followed where 2 ounces have been taken.

3. **Nitric Acid, or Aqua Fortis.**—The strong commercial acid varies in colour from a pale yellow to a deep orange, depending upon amount of impurity, the height of the colour being due to presence of peroxide of nitrogen. It produces yellow stains on organic matter, due to formation of picric acid, which are darkened by addition of an alkali. A woman, applying some strong acid to relieve toothache, inadvertently swallowed a quantity, and died from the effects.[1] A man, a brassfounder, swallowed by mistake for beer a quantity of the acid, from the effects of which he died.[2] The strong acid has occasionally been thrown instead of vitriol to destroy or disfigure the features of the face. (*Vide p.* 208.)

1. Concentrated Acid.

Tests.—

(*a*) It evolves irritating fumes on exposure to the air.

(*b*) It stains organic matters yellow, for the reason given.

(*c*) When added to copper foil, dense reddish fumes, irritating in character, are given off, which redden but do not bleach litmus paper.

(*d*) If strong HCl and a fragment of gold leaf be added, and heat applied, the latter is dissolved.

2. Dilute Acid.

(*a*) Negative response to barium and silver tests.

(*b*) Concentrate by heat; add carefully potassium carbonate until solution be neutral; dip bibulous paper in solution, and dry; thereafter ignite, when paper will burn like touchpaper, due to presence of potassium nitrate.

(*c*) With strong H_2SO_4 and a crystal of green sulphate of iron, a dark ring is formed round the crystal.

3. Mixed with Contents of Stomach, or with Vomit.

Macerate stomach and contents with distilled water repeatedly, until washings are acid-free: filter; titrate solution, after concentration, against $\frac{N}{10}$ solution of KHO, using methyl-orange as indicator.

[1] *B. M. J.*, vol. i., 1882, p. 235. [2] *Ibid.* vol. i., 1883, p. 976.

4. Stains upon Clothing.

Macerate cloth in water, and add to solution some KHO—to form Picrate of Potash.

On November, 15, 1907, a woman drank by mistake for lemon squash a small quantity of nitric acid, and on discovery of her mistake by an impulsive movement of her arm spilled the rest of the acid over her face. She was given linseed oil, which was at hand, then white of egg and large draughts of water. She kept vomiting small quantities all the time, and complained of great pain, to ease which morphine hypodermically was given. The acute symptoms passed off in about 3 hours. Next morning she complained of great epigastric pain, and had constant retching and vomiting of brown-coloured matter. Her tongue and fauces were greatly swollen and of a dirty-grey colour. She had much difficulty in swallowing, which gradually increased for some days and then subsided. Ten days after the accident she was seized with a violent attack of vomiting and brought up a complete cast of her œsophagus. Three days later she brought up a similar cast of her stomach She gradually thereafter broke down, suffered from paraplegia followed by a state of dementia, and died on May 27, 1908. Post-mortem examination showed that the gullet was strongly adherent to the surrounding structures, especially to the vertebral column, from which it could not be stripped without tearing. The mucous membrane existed only in patches, and there were numerous strictures. The stomach was reduced in size, being capable of holding only 3 ounces of water, and was adherent to neighbouring structures. Its posterior wall was devoid of mucous membrane, but the anterior wall still showed some mucosa. There was stenosis of the pyloric, but none of the cardiac, end of the stomach.[1]

Fatal Period.—Death commonly occurs within 24 hours; it has however, happened in 1½ hours. On the other hand, life has been prolonged for months after the acute symptoms have passed off.

Fatal Dose.—Of the strong acid, the smallest fatal dose recorded is ʒij. The fumes of the strong acid have proved fatal, from accidental breakage in a room, laboratory, or other confined place [2] of large vessels containing the concentrated acid.

II. Corrosive Alkalies.

1. Caustic Potash.
2. Caustic Soda.
3. Caustic Ammonia.

The caustic alkalies are used for a variety of purposes in the arts and in processes of manufacture, and the last-named also for domestic washing purposes. Generally speaking, in poisoning, while acting corrosively, they play the part of the bases of soaps, the fatty acids of which are provided by the fat of the tissues.

1. **Caustic Potash.**—Cases of poisoning by this are comparatively rare. We have seen but one case, in which a man swallowed a quantity of strong solution of this substance in mistake for ginger-beer, and although he recovered from the acute symptoms, he suffered from some degree of œsophageal stricture during the few years he lived afterwards. While poisoning by caustic potash is rare, poisonous effects are more common from the use of concentrated solutions of the carbonate, or pearl ash. The symptoms, generally, are of the corrosive type, but are not so severe as after the use of the mineral acids. Swelling of the tissues with which the alkali comes in contact is likely to be marked

[1] *B. M. J.*, vol. ii., 1908, p. 1679.

[2] *New York Med. Record*, 1886; *Lancet*, vol. i., 1863, p. 311; *ibid.* vol. ii., 1890, pp. 695 and 949.

and severe, and the surface of mouth, tongue, and lips becomes highly reddened and ulcerated or eroded. The vomited matter has an unctuous feel, due to the formation of a soap, and its reaction is markedly alkaline.

The post-mortem appearances are indicative generally of corrosion, but not so markedly as after the mineral acids.

Koeppelin [1] found a stricture of the gullet on post-mortem examination of the body of a man, aged 34, who 6 months before had swallowed some caustic potash by mistake.

Chemical Analysis.—The contents of the stomach feel soapy, and give a markedly alkaline reaction. In dealing with the vomited matters, or the contents of the stomach, for quantitative estimation of the alkali, it is best to macerate the organ and its contents in distilled water until the last washing is alkali-free; then to filter the macerated fluids; concentrate by evaporation; and titrate an aliquot portion with normal sulphuric acid, using methyl-orange as an indicator; and then to obtain amount of alkali present by calculation: one c.c. of standard H_2SO_4—·056 gramme of KHO, and ·069 gramme of K_2CO_3. The nature of the alkali may be tested by the flame test, or by testing with platinic chloride in an acid solution, when, if potash be present, a crystalline canary-yellow precipitate of the double chloride of platinum and potassium will be formed.

Fatal Period.—Death has occurred after a few hours. Not many fatal cases have been recorded.

Fatal Dose.—Very uncertain.

Treatment.—Dilute acids, and diluent, demulcent drinks.

2. **Caustic Soda:** NaHO.—Commonly met with as washing soda, a mixture of the hydrated oxide and the carbonate.

The remarks made respecting Potash hold good also concerning this alkali.

Accidental poisoning would seem to be relatively more common by caustic soda than by caustic potash. A man under treatment in a Liverpool hospital was given by mistake a dose of strong caustic soda. He was suffering at the time from septic inflammation of the arm. Evidence was given that the chief cause of death was the septic mischief, but that the poison had hastened his death. The post-mortem examination showed severe internal burning by a corrosive irritant.[2] In May 1905, a woman in Glasgow drank a small quantity of this substance in mistake for herb beer. After treatment she recovered.

3. **Caustic Ammonia.**—We have seen two cases of attempted suicide by drinking ammonia sold for domestic washing purposes. In both cases, which recovered, the symptoms of dyspnœa and dysphagia were very urgent, and the former were accompanied by some degree of cyanosis. In one of the cases—that of a young woman—the mouth and throat were corroded in patches, the tongue and pharynx were swollen, and after these symptoms had subsided under treatment, stricture of the lower third of the œsophagus took place, which, however, was overcome by the use of graduated bougies. In neither of the cases was the amount of fluid swallowed ascertained. We ascertained from analysis of a portion of the fluid left in the bottle from which the quantity had been swallowed, that the strength of the ammonia was

[1] *Lyon Méd.*, Sept. 17, 1899. [2] *B. M. J.*, vol. ii., 1904, p. 1547.

9·8 per cent. The liquor ammoniæ, fort., contains from 36 to 37 per cent. pure ammonia. In cases of which the primary effects are successfully overcome, death may happen some months later from stricture of the gullet. In one case, death followed three months later from this cause.[1] The urgent symptoms in poisoning by ammonia are due to the involvement of the air-passages. In June 1904, a child of sixteen months was given by a young sister some liquid ammonia in mistake. Despite all efforts, the child died. Cases have been put on record where, by reason of the bursting of vessels containing ammonia, workmen have been enveloped in the fumes from which they have died. In Glasgow, in Sept. 1898, an ammonia cylinder burst in a cold storage works, whereby the manager and two workmen lost their lives. The two men, on being rescued, were found to be suffering from great swelling of fauces, uvula, tongue, and lips, with congestion of conjunctivæ. The epithelium of mouth and palate was destroyed by the caustic action of the ammonia. Both suffered before death, which took place on the third day, from capillary bronchitis. The post-mortem appearances seen were as follows :—a raw, inflamed condition of fauces, uvula, tonsils, and tongue ; the bronchi were covered with a fibrinous membrane which was easily stripped, leaving a raw surface beneath ; the larynx, trachea, and finer bronchioles, were likewise covered with this false membrane. The lung substance, on microscopic examination, showed the presence of a very evident broncho-pneumonia, marked hyperæmia and thickening of the walls of bronchioles, and the presence in the alveoli of a fine reticulum of fibrin, containing leucocytes and catarrhal cells. The blood generally was dark in colour, and was imperfectly coagulated. Death was due to asphyxia.[2]

In 1900, another fatal case of poisoning by the fumes of ammonia occurred in an ironwork in Glasgow—in a man who was engaged cleaning a still in connection with an ammonia boiler. He was unconscious when found, and shortly thereafter died.

Serious symptoms of poisoning have also followed the swallowing of the carbonate. In one case recorded by Taylor, where ʒv of *sal volatile* were taken, the patient was comatose within ten minutes after, but he eventually recovered.

In 1903, a chemist was convicted of manslaughter for having by mistake given a man a bottle containing caustic ammonia instead of *sal volatile*. The man in partaking of a dose fell to the floor in great agony and died the same night.[3]

Oliver states that in the decade 1883–1892 ammonia poisoning was the cause of 64 deaths by accident and of 34 by suicide in England and Wales, standing then seventh among the poisons productive of accidental, and ninth among those causative of suicidal, deaths. He reports the case of a boy of 7 years who was admitted to the Newcastle Royal Infirmary on Sept. 16, 1895 suffering from the effects of liquid ammonia used for domestic purposes which he had drunk.[4]

Fatal Period.—Shortest period known is 4 minutes.

Fatal Dose.—ʒi and upwards of strong ammonia.

[1] *Med. Times and Gazette*, Nov. 1853, p. 554.
[2] Workman and Monro, *Glas. Med. Jour.*, vol. ii., Nov. 1898.
[3] *B. M. J.*, vol. i., 1903, p. 584.
[4] *B. M. J.*, vol. ii., 1895.

Chemical Analysis.—The qualitative examination for this substance may be performed by Nessler's test, which gives in very dilute solutions a markedly dark orange-red precipitate. To make a quantitative estimation, the stomach and its contents may be distilled into a receiver containing a definite quantity of Standard Sulphuric Acid, and by titration backwards, the amount present may be arrived at very easily.

Aczal of Budapest, in the *Ungarische Medizinische Presse*, 1904, states that in the ten years 1887–1897 out of 1032 suicides, no fewer than 415 were due to poisoning by caustic alkalies.

III. Corrosive Organic Acids.—

1. **Oxalic Acid.**—This acid is used in the arts by shoemakers, bookbinders, brass polishers, straw-hat makers, and the oxalate of potash, by washerwomen, for taking rust stains out of linen. It is sometimes taken with suicidal intention, has occasionally been mistaken for Epsom salts, and fatal results have ensued in both classes of cases.

Symptoms.—If a large dose of the acid be taken, the following symptoms are commonly found—viz. a burning, acrid taste on swallowing; vomiting which is severe and continuous; burning sensation in gullet and stomach; occasionally, a sense of suffocation, with lividity of countenance, and hurried respiration; anxiety of countenance; the skin cold and clammy. In one case, the vomiting continued until the fifth day, when death took place suddenly;[1] and in another, recorded by Christison, the vomiting did not supervene until seven hours after swallowing, the acid in this case having been much diluted. The vomited material may, at first, consist only of the contents of the stomach and of large quantities of mucus, but, sooner or later, it becomes of a greenish-black, or nearly black, colour, resembling thick coffee-grounds consisting of mucus and altered blood. In addition to the foregoing symptoms, there are great pain and tenderness of the abdomen, so much so, occasionally, that the patient lies doubled up. If the case be short in duration, the bowels are not affected, but if it be prolonged, purging and tenesmus may be present. The pulse becomes feeble, small, and irregular, and, not infrequently, the patient complains of a sensation of numbness in the limbs. Convulsions often precede death. It may be stated, in brief, that the symptoms depend upon two factors: (1), the amount of the acid taken, and (2), the concentration or dilution of the acid fluid swallowed. When in concentrated solution, the acid acts as a corrosive.

The following case recorded by Braithwaite presents several points of interest. A young woman, aged 24, bought at short intervals three penny packets of oxalic acid, each containing a quarter of an ounce. She mixed the contents of the packets and dissolved them in a small amount of water, and drank the solution about 6.45 P.M. At 7 P.M. she went into the house of a neighbour saying she was dying. She died at 7.10 P.M. Post-mortem examination of the body showed white corrosions at the left corner of the mouth, on the tongue, and on inside of cheeks. On opening the abdominal cavity, it was found that part of the contents of the stomach had escaped into the peritoneal cavity from two circular perforations about $1\frac{1}{2}$ inches apart. The stomach

[1] *Lancet*, vol. ii., 1860, p. 509.

wall around the perforations was found to be extremely thin and quite denuded of mucous membrane over a radius of several inches, and the rest of the stomach showed that the mucous membrane was intensely congested and inflamed, and in places, partly detached. The gullet and jejunum showed similar changes, but of less intensity. Analysis of contents of stomach, which amounted to about five ounces, and which were of a dark brownish colour, showed the presence of oxalic acid.[1]

Post-Mortem Appearances.—If the dose be large and the acid concentrated in the vehicle swallowed, all the parts which have come in contact with the acid are softened and white—corroded, in short—or stained with blackish or reddish streaks. The stomach contains a dark-brown, glairy fluid, which has an acid reaction. The mucous membrane of this organ is corroded to a greater or lesser extent, and underneath it, the blood-vessels may be distinctly seen because of their dark-coloured contents. The membrane may not be much corroded if death be rapid. Perforation is rare, but it has been found. Moore describes the condition of the stomach of a woman, aged 24, who had taken several ounces of the acid, and had died *four* hours after. The epiglottis, fauces, and pharynx were pink and grey in tint, the lower part of gullet, grey, the mucous membrane detached in parts, and everywhere wrinkled. The stomach was distended with dark blood, but there was no abrasion. The mucous membrane generally was of a brownish colour, with darker lines along the course of the vessels.[2]

Fatal Dose.—A boy of sixteen died in eight hours after a dose of 60 grains.[3] Recovery, however, has followed the swallowing of half-an-ounce, and 1½ ounces,[4] respectively, after prompt and active treatment.

Fatal Period.—The shortest period is that recorded by Dr Ogilvy of Coventry—viz. three minutes. Death took place in a second case in ten minutes, after one ounce had been taken; in a third, at the end of thirty minutes, from the same dose; while a person has survived for five days.

Treatment.—Consists in the use of chalk, whiting, or lime, with milk, or other demulcent drinks, and in small concentrated quantities.

Chemical Analysis.—If the vomited matter or contents of the stomach be examined, and if they be found highly acid, filter; if not very acid, boil with distilled water before filtering, and concentrate by evaporation. To the filtered liquid, add acetic acid and acetate of lead till precipitation ceases; collect precipitate and wash. The precipitate will consist of oxalate of lead. Then diffuse the precipitate in distilled water, and pass through it a current of H_2S, which throws down lead sulphide; filter to remove precipitate; heat, to expel excess of H_2S, and concentrate solution by evaporation on a watch-glass, when the crystals will form out; these can be dissolved and tested by liquid tests. Dialysis may be used here to advantage. The contents of the stomach, or vomited matter, are put in the dialyser placed in distilled water, and the acid will pass through the membrane. The dialysate may then be concentrated, and the crystals evaporated out.

[1] *B. M. J.*, vol. i., 1905, p. 183.
[2] *Ibid.* vol. i., 1882, p. 740.
[3] *Lancet*, vol. ii., 1855, Dec. 1.
[4] *B. M. J.*, vol. i., 1881, p. 640.

2. **Oxalate** or **Binoxalate of Potash**—salts of sorrel, or salts of lemon—is an acid salt, used for removing iron stains from clothing, and, therefore, may be accidentally or suicidally taken. It may practically be deemed to be as poisonous as the acid itself. In one case where about half-an-ounce was taken by mistake for Rochelle salts, the patient was seized with acute symptoms of poisoning within three minutes after—viz. severe burning pain in gullet and stomach, vomiting of a brownish tough mucus, and partial unconsciousness; and later, with purging, and severe pains in loins and back. He recovered.[1] The same dose, however, proved fatal in another case. In October 1908, a young woman in Glasgow took by mistake for Epsom salts a

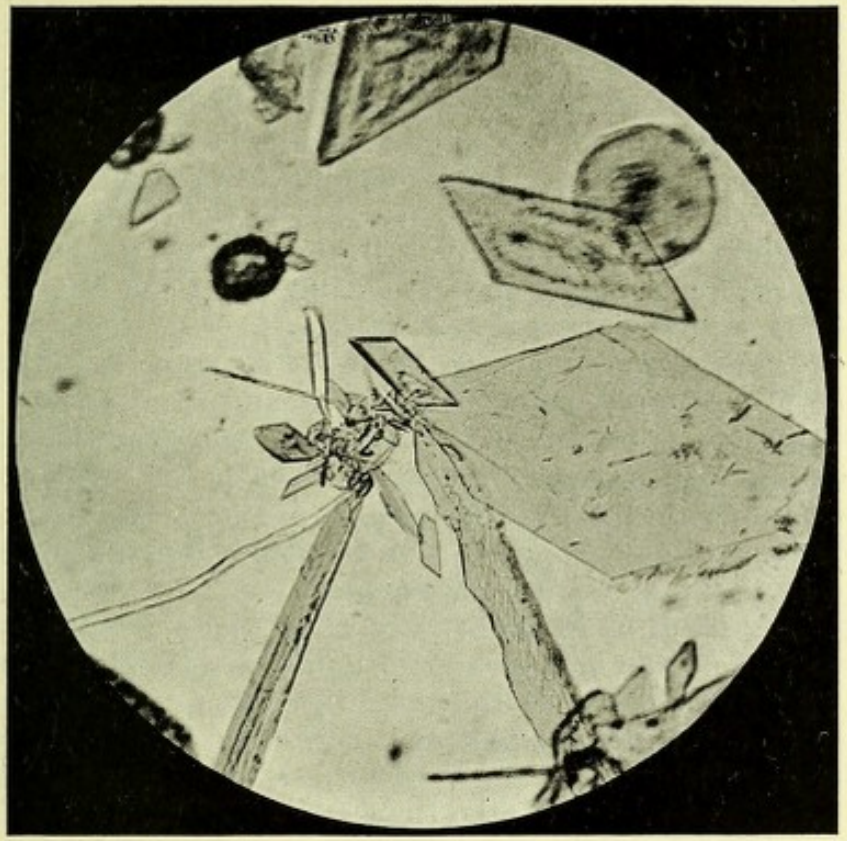

FIG. 119.—Photo-micrograph of crystals of Potassium Binoxalate. ×500 diameters. (Author.)

quantity of salts of sorrel. She died before assistance could be obtained. One case recovered, under prompt attention, after one ounce had been taken.[2] Where part of the contents of the packet are available for chemical examination, the following tests will distinguish the acid or salt:

(*a*) It consists of crystals of 4-sided prisms, which are soluble in water and alcohol;

(*b*) When heated on platinum foil, the crystals melt and dissipate in vapour without combustion, leaving no residue behind, if pure, and without leaving any black stain. This distinguishes oxalic acid or oxalates from the salts of all other carbon acids;

(*c*) When heated in a close tube, they melt and dissipate in vapour,

[1] Park, *Glas. Med. Journal*, vol. xxxii., p. 179.
[2] *Med. Times and Gazette*, vol. xxvii., p. 480.

which condenses in a cool part of the tube as a white crystalline sublimate. This distinguishes oxalic acid from the sulphates of zinc and magnesia, which are not so affected by heat;

(*d*) Solution of the crystals gives with $AgNO_3$ an abundant white precipitate of the oxalate of silver, which differs from the chloride, first, by being soluble in nitric acid, and second, after the precipitate has been dried and heated by its being dissipated in white vapour with detonation;

(*e*) Calcium acetate or sulphate solution gives a slowly-formed crystalline, white, precipitate of oxalate of lime, which is readily soluble in nitric acid, less easily in dilute HCl, and is not soluble in tartaric, acetic, or any vegetable acid.

3. **Acetic Acid.**—In the glacial form, acetic acid acts as a corrosive; but as dilute acid, simply as an irritant. A few cases of poisoning from the glacial form have been recorded.

Symptoms.—The parts with which the acid comes in contact are softened, and rendered of a whitish or pale yellowish colour. Laryngeal complications, because of the volatility of the acid, are commonly found in such cases. The action, locally, is therefore that of a corrosive, and such effects are apparent in the mouth. In one case a girl of 17 swallowed one ounce of the acid in which she mixed about 30 grains of red oxide of mercury. (*Vide post.*)

Post-Mortem Appearances are those of a corrosive; the mucous membrane of gullet and stomach will be found more or less attacked, and there may be appearances of corrosive action, certainly of inflammatory action, in the upper air-passages.

Fatal Period is variable, but rapid.

Fatal Dose.—℥i of the glacial acid killed a child; but an adult has recovered after taking six fluid ounces.

4. **Carbolic Acid, or Phenol** (C_6H_5OH).—This substance is obtained by the action of nitrous acid on aniline, by the dry distillation of salicylic acid, and by the dry distillation of coal. Its use is familiar to the lay public as a popular disinfectant, and of late years, by reason of its facility of purchase and its common use, has given rise, suicidally and accidentally, to more deaths than any other poisonous substance. Up to the year 1900 this acid was promiscuously sold by drysalters, oilmen, and other tradesmen, without any restriction, but owing to the large number of deaths from its use, suicidally and accidentally, action was initiated by the Privy Council whereby it became a scheduled poison. The Act of Parliament enacts that carbolic acid, cresylic acid, and all preparations of these substances, or their homologues which contain more than 10 per cent. of these acids and which are used as disinfectants, must, hereafter, be sold as poisons, and with the same restrictive care as those poisons scheduled in former Pharmacy and Sale of Poisons Acts. (*Vide* pp. 557, 559.)

When pure, the acid consists of long, colourless, prismatic, needle-like crystals, which melt at 42° C., and boil at 183° C. It possesses a burning sweetish taste. It is slightly soluble in water (1 in 11), but is freely soluble in glycerine, ether, alcohol, benzene, etc. Although called an acid by reason of the form of its composition, unlike other acids it does not redden litmus paper. In concentrated form, it coagulates albumen. If the pure crystals are exposed for some time to the air,

they become of a pinkish-red colour, due, it is believed, to their partial conversion into rosolic acid. For sanitary purposes, however, it is usually sold in a much cruder form, as a dark-coloured liquid more or less resembling porter or stout, which, like the purer forms, possesses a characteristic pungent, penetrating odour, but which consists of a mixture of carbolic acid, cresylic acid, and other derivatives, as ortho-, meta-, and para-cresol. These preparations are sold as Jeyes' Disinfecting Fluid, Creolin, Izal, and as other compounds. Carbolic acid acts as a mild corrosive upon the skin and mucous membranes, when in the crystalline form or in strong solutions. It gives a white, bleached, and puckered appearance to the skin at the point of application, the epidermis is destroyed, and a yellowish-brown, or brown appearance or staining results. It sometimes produces necrosis and gangrene of parts when locally applied, especially of fingers or toes.[1] Harrington has recorded 152 cases, 18 of these occurring within his own experience.[2] Kortium records several cases of a finger or toe becoming gangrenous.[3] Upon mucous membranes it produces a white coating, or ashy-grey or yellowish appearance.

Symptoms.—An intense burning pain in mouth, throat, and stomach ; vomiting, which may be neither severe nor continuous, of frothy mucus ; coldness and clamminess of skin ; contraction of pupils ; lividity of lips ; stertorous, hurried, or laboured breathing ; small, thready pulse ; subnormal temperature ; early onset of insensibility. In many cases, the odour of the acid may be detected in the breath, though not in every case.[4] There may be signs of corrosion of the lips, corners of the mouth, or lower lip, the marks showing a pale-brown or yellowish colour. These, however, may be absent in suicidal cases, where the poison is swallowed from a long-necked bottle, or where the vessel is put well back into the pharynx. We have seen this in one case. The symptoms depend in some measure upon the concentration of the poison swallowed ; if a strong solution (60 to 90 per cent.) is taken, death may follow quickly, with or without vomiting, and with rapidly intervening coma, and stertorous breathing ; if a dilute solution, however (1 to 3 per cent.) be taken, the symptoms supervene only after absorption, are not usually so rapid in onset, and consist of prostration, unconsciousness, etc. It is to be borne in mind that owing to the local anæsthetic action of this acid, symptoms of irritation, as pain and vomiting, are not nearly so prominent as in poisoning by oxalic acid or the mineral acids.

From the foregoing, it will be apparent that carbolic acid has both a local and a systemic action, and that the symptoms will depend upon two main factors—viz. (*a*), the concentrated or diluted state of the poison taken, and (*b*), the amount absorbed into the circulation.[5]

Post-Mortem Appearances.—Those parts of the skin surrounding the mouth, and the mucous membrane of lips and buccal cavity, with which the poison has come in contact, are stained of a pale brown or yellowish colour. But this effect entirely depends upon the strength of the poison ; for example, a one per cent. solution produces no effect

[1] *Lancet*, vol. i., 1889, p. 138. [2] *Amer. Jour. Med. Sciences.*
[3] *Internat. klin. Rundschau*, 1889. [4] *B. M. J.*, vol. ii., 1896, p. 507.
[5] *Vide* Lewin, *Deut. med. Woch.*, Ap. 21, 1898.

whatever, a two per cent. a slight staining, only observable on careful examination, a four to five per cent. solution, a whitish discoloration which is likely to disappear within six hours, whereas a strong solution of the acid or the pure acid itself, causes a white slough which lasts for a long time. Where impure carbolic solutions are swallowed, the colour of the stain will be more or less affected. The mucous membrane of gullet and stomach are also more or less similarly attacked, the latter, chiefly, doubtless owing to the longer period of contact; indeed, the action of carbolic acid upon the stomach membrane may be said to be characteristic, as it is corrugated, thrown into projecting folds or wrinkles, which have a more or less brownish colour, and which look as if they had been tanned. On opening the abdominal cavity, the odour of phenol can be usually detected easily, owing to the fact that after death some of the acid passes through the walls of stomach. For this reason, the peritoneal covering of stomach and of upper intestines is found injected. The odour of the acid is, however, most marked on opening the stomach, and its contents may be found to consist of blood-stained mucus. The lungs and brain are usually found congested, owing to the proximate cause of death.

But death may result from carbolic acid by absorption through the medium of the unbroken skin. At an inquest held in London into the circumstances attending the death of several sailors resulting from the bursting of some casks of crude carbolic acid, Dr Dupré stated as his opinion that the immediate cause of death was absorption of the acid through the skin. This is questionable, as the cause may have been the inhalation in a confined area of the fumes of the acid.[1] It appears that the men who died had been sent into the hold to secure the rolling casks, that they were severely burned, although not to a degree to cause the deaths, which occurred very suddenly, shortly after the incident.[2] Moreover, in the days of the early Listerian treatment of wounds by carbolic acid, many cases of poisoning were recorded, due to absorption of the poison in the wounds and by the skin from the surgical dressings, the main symptoms being signs of shock and carboluria.[3]

Fatal Dose.—One drachm has killed in twelve hours.[4] Prof. Lewin, who was consulted in a case, stated as his opinion, however, that a man could not be fatally poisoned by one gramme of carbolic acid. This was a case in which a man died after exhibiting certain indefinite symptoms. On analysis, 0·6595 gramme of carbolic acid was found in the contents of stomach. On exhumation of the body eleven days after, the kidneys, brain, and liver were further examined, and an additional amount of the acid was found, sufficient to increase the total quantity found in the body to one gramme. Lewin admitted, however, that death from carbolic acid might occur by the direct action of the poison on the nervous system, but he did not believe that the quantity found in this case would be sufficient. Lewin, in his *Toxicologie*, gives the fatal dose as 8-60 grammes. Recovery, however, has followed the swallowing of large doses; in one case,[5] from one ounce of 90 per cent.

[1] *Vide B. M. J.* (Unthank), 1887.
[2] *Med. Press*, vol. i., 1901, p. 694.
[3] *B. M. J.*, vol. i., 1903, p. 1145.
[4] *Deut. med. Woch.*, Ap. 21, 1898.
[5] *The Lancet*, 1891 (Greenway).

phenol, in another, of a girl of 17, where six ounces of crude carbolic acid were taken,[1] and in a third, of a child of two, from half-an-ounce of crude acid containing 30 per cent. carbolic acid.[2]

Foulerton records a very interesting case of a watchman who, mistaking crude carbolic acid for tea, swallowed about three ounces of it. The acid contained 90 per cent. of pure carbolic acid. He died within an hour. It appears that on discovering his mistake he informed a fellow-workman, who assisted him to hospital, which was about a quarter of a mile from the works. On his arrival there—about twenty-five minutes after the acid had been swallowed—he became unconscious, and died twenty minutes later.[3]

At the Calcutta Criminal Sessions, April 1884, a medical practitioner was tried and found guilty of having caused the death of a child by administering an enema of carbolic acid—containing 200 drops of Calvert's No. 2 acid — for worms. Collapse followed immediately after the injection, and the child died in a few hours. The practitioner was fined 500 rupees for his rash and negligent act.

Recovery has also followed, after prompt treatment, the swallowing of about a pint of *Jeyes' fluid*. A man attempted to commit suicide in this way, and on his recovery expressed regret that he had not succeeded.[4] *Izal*, which is an oily substance obtained from certain coke ovens, and which forms a creamy emulsion with water, has a faint odour of phenol. By the manufacturers it is claimed to be non-poisonous. Klein's experiments on rabbits, in which this substance was administered hypodermically and by the mouth, do not appear to us to be conclusive of its non-poisonous properties. Hobday [5] asserts that toxic symptoms follow the use of Izal if used injudiciously. Having used it as a dressing to the skin of dogs and cats, he found that the following toxic symptoms were produced—viz. subnormal temperature, continual irritation, involuntary muscular twitchings, followed by complete inability on the part of the animal to rise, coma, and death. In like manner, *Creolin* [6] and *Lysol* may produce toxic effects. Cases of fatal poisoning by the latter have been recorded.[7] A boy of 14, suffering from dysentery, took an injection of rather less than 1½ ounces of lysol in about a pint of water, at 1 P.M.; he was found in bed quite unconscious half-an-hour later, suffering from all the characteristic symptoms of poisoning by carbolic acid. He died at 5.45 P.M.

Kluge [8] has collected together 13 cases of lysol poisoning, four of which were due to its external application, and nine to its internal use. He narrates the facts of a case in which a nurse gave, by mistake, to an adult female patient who was suffering from enteric fever, some 12 grammes of lysol, of which 10 grammes were swallowed. In five minutes afterwards, the patient was cyanosed and in a state of stupor; the pulse could not be felt. After the stomach was freely washed out and camphor injected, she improved, and in three and a half hours after the administration of the lysol, she became conscious, and com-

[1] Hind, *The Lancet*, 1884. [2] Oliver, *B. M. J.*, 1884, vol. i., p. 356.
[3] *The Lancet*, vol. i., 1889, p. 115. [4] *B. M. J.*, vol. i., 1901, p. 1618.
[5] *Journ. Comp. Path. and Thérap.*, Sept. 1900.
[6] *Vide* Pinner, *Deut. med. Woch.*, 1895; *The Lancet*, vol. i., 1896, p. 1732.
[7] *B. M. J.*, vol. ii., 1900, p. 1497. [8] *Münch. med. Woch.*, July 12, 1898.

plained of burning in the mouth. She eventually recovered. Kluge is of opinion that the toxicity of carbolic acid is eight times greater than that of lysol. Stille-Ihlienworth [1] records toxic effects to have been produced in several persons by inhalation of creolin vapour. Burgl [2] collected 18 cases, 13 being due to internal administration, of whom 5 died, and 5 to external application, and gives 2 additional cases of lysol poisoning. Lysol is a compound made of equal parts of cresol and linseed oil potassium soap. Cresol is methyl-phenol. The first case by Burgl was that of an infant of five days old who was given a coffee-spoonful of lysol in mistake for syrup of rhubarb, of which it died in 14½ hours after. The second case was that of a girl, 8⅓ years of age, who had been given ʒi of lysol in mistake for infusion of ipecacuanha, and who died in a few minutes thereafter.

Carbolic compounds are known under different trade names. Of one of these, *Carbolacene*, a fatal suicidal case occurred in a lunatic asylum near Glasgow. A nurse took from the poison cupboard a small quantity of this disinfectant which she mixed with water in a carafe, intending to use it in her bath. Her attention being directed to a restless patient who was getting out of bed, she laid the vessel down to attend to the patient. Another patient on the other side of the ward meantime seized the carafe, and drank its contents. Although medical assistance was at hand at once, and the person's stomach was washed out, she died soon afterwards.

Fatal Period.—Usually death follows from carbolic acid within three hours after the poison has been taken. It has, however, followed in three minutes, and it has been retarded until sixty hours after.

Treatment.—In view of the anæsthetic action of the poison, ordinary emetics may fail to act; at the same time, in the absence of more certain appliances for emptying the stomach, they must be tried. But the best treatment is to wash out the stomach with the aid of the siphon-tube, using great care in its introduction, until the washings cease to smell of the acid. It is also a good plan to dissolve magnesium sulphate in the ingoing warm water, so that the benefit of whatever antidotal effect this salt may have should be secured; for it has been observed that in cases of carbolic acid poisoning, sulphates disappear from the urine. In view, also, of the condition of shock, the patient should be surrounded with warming-pans or bottles to restore the bodily heat. After preliminary recovery, rectal feeding should be adopted for some days.

Chemical Analysis.—The odour of the acid in the stomach contents points to its presence; but in order to detect it by chemical tests, it ought to be separated from the stomach contents, either by shaking them up with ether and siphoning off the supernatant fluid which contains the carbolic acid, or by slightly acidulating the contents with dilute sulphuric acid, and distilling. In the distillate, the acid will be found. The following tests may then be employed :—

1. *Landolt's Test.*—To a portion of the ether solution, or distillate, add a few drops of bromine water. A whitish, or yellow-whitish precipitate of tri-bromo-phenol ($C_6H_2Br_3OH$) will be formed. Collect the precipitate, wash it, and gently heat it in a test-tube with sodium-

[1] *Memorabilien*, July 1889. [2] *Münch. med. Woch.*, Sept. 24, 1901.

amalgam and water; thereafter pour the mixture into a large watch-glass and acidulate, when the characteristic odour of phenol will be given off.

2. To a second portion, add dilute ammonia and a few drops of 1 to 20 solution of freshly-made bleaching-powder; heat; a bluish or greenish coloration (depending upon degree of dilution) will be formed, which, on being acidulated, will be changed to red or yellow.

3. To a third portion, add a few drops of Ferric chloride (the perchloride of the B. P. will do), when a violet colour will be produced.

Quantitative Examination.—Landolt's reaction may be utilised as a means of estimating quantitatively the amount of acid present. If the whole of the acid be precipitated by bromine water, the precipitate, after being washed and dried, may be weighed. The amount of phenol is estimated by the fact that 100 parts of the tri-bromo-phenol are equivalent to 28·38 parts of phenol.

IV. Caustic Salts.—There are certain salts of different elements which possess caustic properties—viz. of Antimony, Copper, Silver, and Zinc, and compounds of Chromic acid.

The Chloride or Butter of Antimony ($SbCl_3$), used for certain trade purposes, has been taken both accidentally and for suicidal purposes. It is a light brown, dark brown, or dark red coloured liquid, and possesses marked caustic properties; indeed, the symptoms produced are more markedly those of a corrosive than of an irritant. In the few cases which have been recorded, the prominent symptoms were persistent vomiting, severe burning pain in the mouth, throat, gullet, and stomach, and general signs of collapse.

Post-Mortem Appearances.—Evidence of corrosion of parts with which the poison has come in contact, with denudation of mucous membrane.

Fatal Dose.—Not very well known. Taylor records a case in which an army surgeon suicidally took from two to three fluid ounces, and died. A boy of ten years, however, has recovered from about half-an-ounce. For other cases, consult *Prov. Med. Journ.*, December 23, 1846; *The Lancet*, February 26, 1848, p. 230; *Ibid.*, May 19, 1883.

1. **Sulphate of Copper** ($CuSO_4$) in the solid form, or in very concentrated solution, exercises a limited corrosive effect, but its action is mainly that of an irritant. (*Vide post.*)

2, **Zinc Chloride** ($ZnCl_2$), as a solid, or in concentrated solution, also acts corrosively. It is the chief ingredient in the disinfecting solution known as "Sir J. Burnett's Fluid," which contains about 350 grains to the ounce of water. In several of the cases recorded in which this substance caused death, corrosion of the stomach has been found.[1] The symptoms are chiefly those of a corrosive poison.

This salt is sometimes used to "load" textile fabrics. In December 1898, a number of men employed to clean the streets of Birmingham after a snowstorm, and who were provided with overcoats, were admitted into the hospitals suffering from large patches of sloughing skin of the wrists and knees. Upon inquiry, it was found that these effects were caused by the presence of considerable quantities of zinc chloride in the overcoats, and that the localised results were due to the

[1] *Med. Times*, July 13, 1850, p. 47; *The Lancet*, vol. ii., 1857, p. 271.

dripping of the wet garments at the places named. It was shown at a meeting of Bradford cloth manufacturers that an 18-ounce worsted coating might be found to contain two to three ounces of zinc chloride.

3. **Silver Nitrate** ($AgNO_3$) likewise is corrosive, both in the solid and liquid form. One case is recorded, with a fatal result, in which a piece of solid stick nitrate became lodged in the throat while the tonsil was being cauterised.

4. **Chromic Acid** and the **Chromates of Potash** and **Soda** are also corrosive in action in the solid and concentrated liquid forms. Diluted, they act as irritant poisons, having, it would appear, special action upon the nervous system. In chrome workers, the caustic action is particularly seen in destruction of the nasal septum, and the formation of deep ulcers upon the hands, called " chrome-holes " by the workmen. For cases, consult the following references :—White, *University Med. Mag.*, 1889 ; *B. M. J.*, 1889 (Fowler) ; *B. M. J.*, 1888 (Stewart) ; *The Lancet*, 1892 ; (Turnbull) *B. M. J.*, vol. i., 1881, p. 481 (where a child of two died from eating a piece of bichromate of potash, size of a pea). Hermann [1] affirms from observations made on 257 persons, workers in chrome works, that chromic acid and the chromates exercise both direct and indirect action ; the former characterised by the nose and skin lesions referred to, and the latter by causing lesions in stomach, respiratory tract, and kidneys. Of 77 workers employed for not longer than one month, 34 remained healthy, 32 has nasal abscess, and only one, perforation : of 39 who had worked longer than three and less than six months, 2 were healthy, 14 had abscess, and 23, perforation ; and of 31 who had worked for more than a year, none were healthy, 7 had abscess, and 24, perforation. It would, therefore, appear that six months' employment in a chrome work is likely to lead to nasal septum perforation in the bulk of those employed. Smith [2] records the symptoms of lead poisoning in several female mill-workers, from working with an orange-coloured cloth containing bichromate of lead.

[1] *Münch. med. Woch.*, Ap. 2, 1901. [2] *B. M. J.*, vol. i., 1882, p. 8.

CHAPTER XVIII

IRRITANT POISONS

Arsenic.—This poison is found existing in nature as a metal, and as sulphides of the metal, realgar and orpiment, and can be purchased in these crude forms in native Indian bazaars; in flues, as arsenious acid, from the calcining of ores containing arsenic, the arsenic being deposited in a cool part of the flue. In Cornwall, for example, where *mundic*—an ore containing arsenic, tin, copper, and sulphur—is roasted, the arsenic is the product aimed at. With the metallic form the medical jurist has little to do, although it is stated that a fly-powder, which is sold in shops, contains the poison in the metallic form as well as in that of arsenious acid.

Arsenious acid, or white arsenic, is the substance most commonly employed in homicidal poisoning. As met with in commerce, it is either in the form of cakes, broken lumps, or a white, gritty powder. The lumps, at first, look almost transparent and crystalline, but later, they become opaque like enamel, and the fracture-surface takes a porcellanous appearance. According to Act of Parliament, arsenious acid cannot be sold in smaller quantity than 10 lbs., without being mixed with either soot, charcoal, or indigo in the proportion of one ounce of the two first named and half-an-ounce of the last to the pound of arsenic, and therefore, when it is sold by a pharmaceutical chemist it looks like a dark grey, or bluish powder. It may, however, when unadulterated, give rise to accidental poisoning, by being mistaken for granulated sugar, or other like substance. A case was reported from the Bristol Royal Infirmary [1] in which powdered arsenic was mixed in a meat-pudding, which, after having been partaken of by several members of a family, caused them all to be seriously ill. One of them, a child of five years, died, the rest recovering after longer or shorter illnesses. Post-mortem examination of the body of the child showed in the stomach a brightly injected patch about the size of a shilling on the posterior wall, several punctiform hæmorrhages here and there in the mucous membrane, and reddened patches in duodenum, lower part of descending colon, and upper part of rectum. Chemical examination of the remains of the meat-pudding showed that it contained a large quantity of arsenic.

Physical Properties—(*a*) *Solubility.*—Arsenious acid is very insoluble in water. Cold water will only dissolve one-half to one grain per ounce, and the solution thus obtained gives a faint acid reaction with litmus paper. When arsenious acid is mixed with boiling water and is boiled for some time, about 55 grains per ounce will be held in solution so long as the water is hot, but after the water has become cold only about 12 grains per ounce remain dissolved, the remaining 43

[1] *The Lancet*, vol. i., 1879, p. 699.

grains being deposited in the vessel. By reason of this insolubility, when the fine powder is placed in water or other liquid, some of it forms a whitish film on the surface of the fluid, and the heavier particles fall to the bottom of the vessel. (*b*) *Effect of Heating.*—If some of the powder is placed on a platinum spatula and heat is applied to the under surface thereof, the powder will completely disappear in white fumes without the spatula becoming blackened, and without leaving any residue behind. If a cold piece of glass be held a little distance above the spatula, the white fumes will sublime on the glass, and, on examination by a hand-lens, the sublimate will be found to consist of crystals of the octohedral type.

Uses in the Arts.—It is somewhat extensively used in the arts; in dyeing, artificial flower-making, and taxidermy, in paper-making, for ornamental cards, and for wall-paper hangings. (*Vide* Fig. 121.) Murrell has demonstrated that out of seventeen different kinds of paper wrappings of cigarettes and tobaccos, arsenic was present in the labels of six —that is, one-third.[1] It ought to be borne in mind that arsenic is not confined to wall-papers which are green in colour, and that although it is not so commonly used for this purpose as it used to be, there is no law in Great Britain, as there is in Germany, to prevent its use. It is used in medicine, also, for a variety of purposes. It is sold as a constituent of vermin-killers and of fly-papers, and it has been used as an adulterant of violet powders. In medicine, and in fly-papers, the arsenic usually exists in the form of sodium or potassium arsenite, since arsenious acid is soluble definitively in alkaline solutions. Arsenic in the form of a soluble sodium arsenite is a common constituent of "weed-killers," and cases of poisoning by weed-killer have been recorded. The following may be taken as typical. Aldred[2] records the cases of two gamekeepers. They had been up all night of June 22 watching young pheasants. Being thirsty, one of them, at 6.15 A.M., tasted some liquid in a beer bottle which he had been plainly told was poisonous. He took, however, "one mouthful and spat it out again," then handed the bottle to his neighbour, who took two gulps. Soon after, they were found lying on the ground, vomiting and complaining of burning pains in the stomach. Both were quite conscious. Their skins were cold and clammy, and their pulses small and feeble. Arsenical poisoning was diagnosed, which was confirmed by a telegram from the makers of the weed-killer. The younger of the two men by 6 P.M. was much worse. He was drowsy, slightly cyanosed, and collapsed. He died about midnight. Post-mortem examination of his body showed slight blistering of the lips. The stomach contained about ¾ pint of dark, greenish-black fluid. He had been given lime-water and a solution of sesquioxide of iron as antidotes. The mucous membrane, which was covered with mucus, presented patches of "crimson-plush" injection at the lower end of the gullet, at cardiac end of stomach, and, to a less degree, in duodenum. The elder man, whose age was 63 years, and who took the one mouthful, passed a restless night owing to pain in his left leg. Next day he had marked external strabismus of the left eye with diplopia. His pulse, numbering 130, was feeble and irregular.

[1] *B. M. J.*, vol. ii., 1896, p. 96.
[2] *Ibid.* vol. ii., 1907, p. 626.

By June 26, although the squint was still marked, he was improved generally. Over the middle of the peroneal area of left leg was a bright red patch the size of the palm of the hand. The toes of left foot were blue and cold, especially the little toe. " Foot-drop " of left foot was now present, and there was an area of anæsthesia corresponding to the area of nerve supply of anterior tibial nerve. By July 7, the left little toe showed decided evidence of gangrene, and it did become affected with dry gangrene. By August 4 the squint had disappeared ; there was marked wasting of muscles of legs and thighs ; left foot-drop was still complete, but right foot-drop was not so complete ; and knee-jerks were absent. The weed-killer was a mixture of caustic soda and arsenic. A case was tried before Mr Justice Grantham in 1906 in which a domestic servant was charged with having administered, over a period of four weeks, doses of sodium arsenite in the form of weed-killer, to the family in whose service she was employed. The medical officers of Maidstone and Holloway Gaols thought the girl was insane, the former being of opinion that she was the subject of moral insanity. The judge decided, however, that she was quite sane, and she was accordingly tried. Fatal toxic effects may also be produced by arsenic in the gaseous form of Arseniuretted Hydrogen.

Cacodylic Acid and **Cacodylates** are also poisonous. Cacodylic acid, or dimethyl-arsenic acid, $As(CH_3)_2O(OH)$, consists of oblique rhombic crystals, which dissolve very readily in water and alcohol, and melt at 200° C. The acid unites with various metals as sodium, lithium, calcium, magnesium, iron, mercury, and with other substances, as quinine, guaiacol, etc. According to several observers, it is comparatively non-poisonous, but this statement has been traversed by Murrell,[1] who affirms that the symptoms resulting from the administration of " cacodylate of sodium are far more severe than those which follow the exhibition of arsenic in its ordinary forms." According to the former, cacodylates, although comparatively rich in arsenic, are relatively inactive. It was, therefore, believed that such compounds could be exhibited with great benefit to patients in larger doses than the more usual arseniferous preparations. Professor Fraser of Edinburgh,[2] starting from the proposition that if such arsenical compounds are incapable of producing toxic effects when exhibited in such relatively larger amounts, assumed that they must therefore be pharmacologically inert and therapeutically inefficient. He tested this assumption, however, by clinical observations and by chemical tests. In a series of cases, he showed that arsenic administered as cacodylates is less therapeutically active than when administered as liquor arsenicalis. He found that the arsenic in the former preparations is united to the bases as arsenic acid, and that cacodylates failed to give the usual reaction with silver nitrate ; further, that when Marsh's process was employed for the detection of arsenic in the urine of persons to whom liquor arsenicalis had been administered, the arsenic could be detected, but when cacodylates had been given, that the process failed to detect the arsenic. He concluded, therefore, that the arsenic in cacodylic acid and cacodylates is so firmly bound chemically to

[1] *B. M. J.*, vol. ii., 1900, p. 1823 ; vol. i., 1901, p. 120.
[2] *Ibid.* vol. i., 1902, p. 713.

the base that even after absorption into and elimination from the body this stable chemical union is not dissociated, and the arsenic passes through the body as an inert substance without exercising much or any pharmacological activity.

Methyl-di-sodic Arsenate, or **Arrhénal** ($CH_3AsO_3Na_2H_5O_2$), is a substance which was introduced by A. Gautier in 1902 as a substitute for cacodylates. It is freely soluble in water, sparingly soluble in alcohol, and insoluble in ether. Le Roy des Barres has recorded a case of acute poisoning by this substance in a patient aged 40, who was prescribed the drug and, at the same time, Hunyadi Janos water. By a mistake, he was given the entire contents of the bottle containing the arrhénal. Five minutes afterwards vomiting began, and a few minutes later, diarrhœa. This continued more or less for the next three days, but after the fourth day no further trouble was experienced.[1]

Chronic poisoning may result from persons occupying rooms the walls of which are covered with paper containing arseniferous pigments. The mode by which the poison enters the body was for a long time the subject of much dubiety: many believed that it was thrown by attrition of the paper surface into the room atmosphere as a fine powder; others, that it was volatilised by heat in the upper levels of the room. It has now, however, been definitely determined that its source is a gaseous compound of arsenic—viz. *diethylarsine*. While Gmelin was the first to draw attention to this form of arsenical poisoning, it was left to Bujwid,[2] Morpurgo,[3] Gosio,[4] Abel and Buttenberg,[5] Biginelli,[6] Abba,[7] Selmi,[8] Gigliotti,[9] Maasen,[10] Scholtz,[11] Marpmann,[12] Rosenheim [13] and others to indicate the true cause. From the researches of these investigators, there cannot be the least doubt that the factors in the production of diethylarsine are microscopic moulds or fungi which grow in the flour-paste with which wall-papers are hung, of which there are at least ten which have the power not only to live and grow freely in arseniferous media, but to decompose arsenious acid or its salts into the gaseous form named. Of these ten *Penicillium brevicaule* is probably the most powerful. Indeed it has been demonstrated that this mould, on being cultivated in a medium which contains a soluble or insoluble salt of arsenic, will decompose into the gaseous form, and thus enable so small quantities as 0·01 milligramme and even 0·001 milligramme of arsenic to be detected.

Morgan made a fresh investigation of the biological action of moulds on arsenical compounds, particularly with *P. brevicaule* culture made by pouring over sterilised bread-crumbs a peptone beef broth emulsion

[1] *Arch. Gén. de Méd.*, June 30, 1903.
[2] *L'Union Phar.*, vol. xlvi., p. 293.
[3] *Oesterr. Chem. Zeit.*, i. 167.
[4] *L'Orosi*, 1900, vol. xxiii., pp. 361-377.
[5] *Zeit. Hyg.*, vol. xxxii., pp. 449-490.
[6] *Atti. Real. Accad. Lincei*, 1900, vol. ix. ii., pp. 201-214 and pp. 242-249.
[7] *Centralb. Bakt*, par. ii. 4, 806.
[8] *Berichte der deutochen chemischen, Ges.* 7, 1642.
[9] *Ibid.* 14, 2295.
[10] *Arb. Kais, Gesellsch*, A. 1902, 18, 475-489.
[11] *Berl. klin. Woch.*, xxxvi. 913-915.
[12] *Pharm. Centr. Halle*, vol. lii., 666-672.
[13] *Proc. Chem. Soc.*, vol. xviii., 1902, No. 253, p. 138.

of the mould and its spores. He found that at the end of 24-28 hours the presence of so small an amount of arsenic as 0·000001 gramme revealed itself in the mould mixture by its garlicky odour. He, however, is inclined to look upon this test of Gosio as rather a biological curiosity than as a reliable test for arsenic.[1]

In the Annual Report of Inspector of Factories for 1900, an investigation was reported by the Factory Department of the Home Office regarding the presence of arsenic in wall-papers, the results being generally to the effect that British-made papers might now be deemed to be practically arsenic-free, if infinitesimal amounts are left out of count, and that bronze-coloured papers are the most likely to contain the larger amounts. In 1904, the Department of Agriculture of the United States[2] published a report which contains the results of an inquiry regarding (1) cases of poisoning by arsenical wall-papers and fabrics, (2) the arsenical ingredients of those sold in America, and (3) the laws governing their sale. Among other valuable information, it was reported that the State Legislature of Massachusetts enacted in 1900 that in wall-papers sold in that State the amount of contained arsenic must not exceed 0·10 grain per square yard. Of 537 samples of wall-papers analysed, four samples were found to exceed that limit, two of these having been imported from Britain. Five samples contained between 0·077 and 0·10 grain per square yard, and ninety per cent. of the total number of samples examined, less than 0·046 grain per square yard. For further information on this subject, the reader is directed to " Poisoning by Arseniuretted Hydrogen," 1908, by the author.

Arsenic may also be found as an accidental adulterant of many substances. Its alliance with copper in nature, and the manufacture on the commercial scale of sulphuric acid from arsenical pyrites, and the further manufacture of hydrochloric acid from such arseniferous sulphuric acid and common salt, all indicate lines of adulteration. Indeed it may be said with strict relation to fact, that arsenic-free commercial sulphuric acid, hydrochloric acid, copper, or zinc does not exist in the market; hence the great necessity for establishing the purity of these reagents when they are to be used for the detection of arsenic. Such arseniferous acids, therefore, when used in the manufacture of other substances—as in the manufacture of glucose, from which beer was manufactured for the Manchester market, and which gave rise to such widespread arsenical poisoning—may be far-reaching in their effects. This, however, was not unknown before the Manchester outbreak. Ritter of Rouen[3] pointed out that glucose, by reason of its being manufactured with such impure acid, may convey arsenic into beer, confectionery, syrups, and other food-stuffs. It is also found in glycerine. A firm of chemists in Bradford was fined for selling glycerine which contained arsenic to the amount of $\frac{1}{13}$ grain per lb., the Royal Arsenical Commission having recommended local authorities to take action where arsenic is found to exist in glycerine over $\frac{1}{100}$ grain per lb.[4] For the further recommendations of the Royal Arsenical Commission, the reader is advised to consult its Reports.

[1] *Lancet*, July 4, 1903. [2] Bulletin, No. 86, Washington, 1904.
[3] Reimann's *Färber Zeitung*, No. 3, 1878.
[4] *B. M. J.*, vol. ii., 1905, p. 158.

Hehner reported to the Isle of Wight Council in 1903 that in a sample of sweets sold in their district he had found arsenic to the amount of $\frac{1}{15}$ grain per lb., which seemed to be due to the oxide of iron with which the exterior of the sweets was coated.[1] Death, too, may happen from arsenical poisoning in unlooked-for ways. At an inquest held at Camborne, it was shown that a girl of eight died from the effects of arsenical inhalation, due to her having fallen into an arsenic flue while walking along a pathway with some other children.

Symptoms.—These may be divided into—

I. Acute or Sudden ; and
II. Chronic or Prolonged.

I. *Acute or Sudden Form of Poisoning.*—The intensity of the symptoms is regulated, to some extent, by the physical form in which the arsenic is exhibited—in solution, or in suspension—and by the quantity taken. Their onset is also regulated by these and other factors. Usually, however, the symptoms appear within one hour after the poison has been taken, although in some cases, where even large doses have been given, they may be tardy in appearance ; for example, in one case ʒi of the powdered arsenious acid taken into an empty stomach did not produce symptoms of the fact until the expiry of two hours after [2] ; in a second case, where the quantity was similar in amount, not until seven hours had elapsed ; while in a third case, ten hours intervened before symptoms appeared.[3] When the poison is introduced into the rectum or vagina, days may elapse before the symptoms come on. On the other hand, when the poison is in the form of AsH_3, the symptoms may supervene within fifteen minutes or even earlier. The symptoms exhibited when the poison is swallowed are as follow :—faintness and depression, accompanied by a feeling of sickness ; burning pain in stomach and epigastrium, which is increased by pressure ; these are followed by nausea, retching, and vomiting, which is very severe, continuous, and persistent. It ought to be noted, however, that absence of pain in stomach has been observed in isolated cases. The vomited matters vary in appearance during the course of a case. At first, they consist simply of the stomach contents, then they become blackish or greenish in colour, from admixture with bile, or from the soot or indigo present in the poison administered, and, latterly, consist of mucus mixed with blood in greater or lesser quantity. Insistent and painful diarrhœa follows, accompanied by great tenesmus, the later stools, especially, being thin, and streaked or tinged with blood; indeed, they may be nearly completely composed of blood. The patient may complain of a sense of suffocation. There is usually an intense thirst, the gratification of which, however, only increases the vomiting. Painful cramps may be present in the muscles of the lower limbs, not unlike those met with in cases of cholera. The pulse becomes small, feeble, irregular, and almost imperceptible, the face, anxious and pinched, owing to the painful respiration brought about by the painful condition of stomach and diaphragm ; the skin becomes cold and clammy, or, at

[1] *Times*, Aug. 25, 1903.
[2] *Ann. d'Hyg.*, vol. i., 1837, p. 344.
[3] *Med.-Chir. Rev.*, Jan. 1854, p. 294.

first, this condition may be alternated with flushes of heat all over the body. Death is usually preceded by great general restlessness, by some form of paralysis, or by convulsions, or coma.

II. *Chronic or Prolonged Poisoning.*—In whatever way the poison is exhibited in the form of small repetitive doses, the general symptoms are remarkably constant in their character. These have reference to (1) the general nutrition of the body; (2) facial appearance; (3) gastro-intestinal irritation; (4) skin-eruptions; and (5) implication of nervous system. One of the earliest signs, probably, is the gradual loss of flesh, which indicates malnutrition; and accompanying this, there will probably be falling out of the hair, ragged growth of the finger-nails, and pigmentation of the skin. The facial features are somewhat striking: The eyes are suffused and watery, the conjunctivæ being reddened and congested, and there is increased nasal secretion—in short, symptoms of coryza. The tongue presents either a reddened, raw condition, or it is covered with a thick, white coating. Eczematous eruptions may be present on the body, which are usually accompanied by increased pigmentation of the skin, or the skin may assume an earthy, or jaundiced appearance. The patient will complain of symptoms of gastro-intestinal catarrh—a feeling of sickness after food, with or without succeeding vomiting, of loss of appetite, or even loathing for food, catarrhal diarrhœa or diarrhœa alternated with constipation. The nervous symptoms, although not characteristic or pathognomic, are striking. The patient complains of numbness of skin of hands and feet, hence he is unable to handle articles easily, firmly, or freely, and he walks with unsteady and uncertain gait, if able to walk at all. There may also be mental hebetude, or delusions. These symptoms of peripheral neuritis may be accompanied by some measure of paresis or paralysis of the limbs.

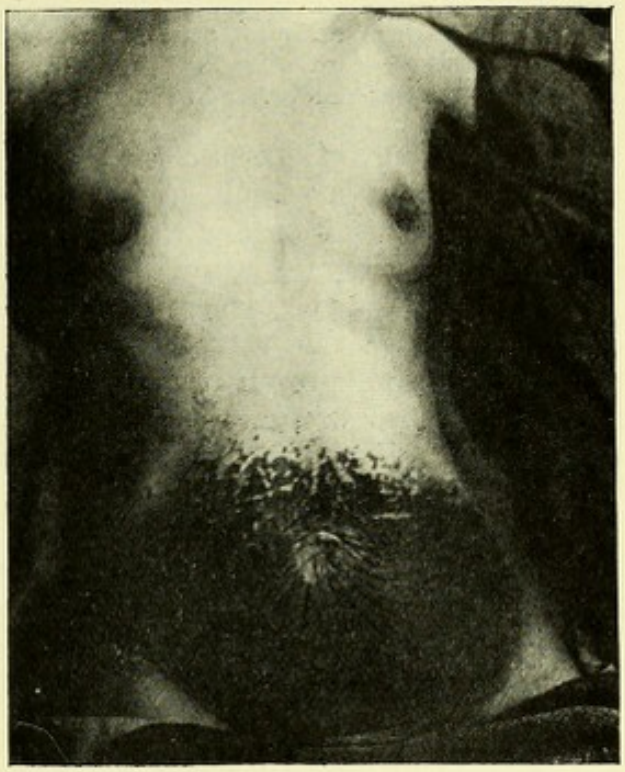

FIG. 120.—Arsenical Pigmentation of Abdomen. The patient, of whose body this is a photograph, was a confirmed beer-drinker, and was one of the victims of arsenical beer. The pigmentation, which, over the breasts, around the axillæ, and over the back, was almost greenish-yellow in colour, and too pale to show in the photograph, was darker over the abdomen, where it was yellowish-brown in colour, and showed papery exfoliation of superficial pigmented skin-layers. There was no pigmentation of face or inside of mouth. This case was recorded[1] by Professor Hall, to whom we are indebted for the use of illustration.

Remarkable outbreaks of chronic poisoning have been recorded from time to time.

[1] *B. M. J.*, vol. i., 1901, p. 1405.

In 1828, a mysterious outbreak occurred in Paris, involving about 40,000 persons, which was believed by some, from the symptoms exhibited, to have its origin in arsenical poisoning. In 1885, at Havre, fifteen persons were seized with symptoms which at first resembled enteric fever, and then influenza, until symptoms of paralysis appeared. Brouardel and Pouchet investigated the cause of the outbreak, and discovered arsenic in the osseous tissues of those who had died, although there was no trace of it in the viscera.[1] In 1889, an outbreak involving 405 persons occurred at Hyères, which was found to have originated in the mistake of a wine merchant who poured arsenical solution into his wine casks. Brouardel[2] also records a similar seizure at St Denis, due to the presence of this poison in bread, from which 268 persons suffered. The presence of arsenic in bread may be accounted for by the use of hydrochloric acid and sodium carbonate to generate carbonic acid in the aeration of the dough, since commercial hydrochloric acid commonly contains arsenic in smaller or larger percentage amounts.

Elimination of Arsenic from the Body.—It is clear that arsenic is not a cumulative poison, but that the process of elimination from the body by different organs begins at once, so long as the physiological action of these organs is not crippled by consequent pathological changes. The kidneys are the principal emunctory organs, although the stomach seems to share this duty, since even in poisoning by AsH_3 vomiting is an early and prominent symptom. From the knowledge of these facts, diagnosis of the presence of arsenic in the body of a person who presents the foregoing line of symptoms may be made by the detection of arsenic either in the urine, or in the vomited matter.

Post-Mortem Appearances.—The severity of these appearances depends very largely upon the quantity taken, and the period which elapses between the time of taking and the occurrence of death. The stomach is, primarily, the seat of post-mortem appearances, even although the poison has been introduced into the body by other ways than ingestion. When the poison has been swallowed the mucous membrane is found to be highly inflamed in many small patches, which correspond to deposits of the poison, round which the inflammatory changes centre; occasionally, however, the mucous membrane may be detached in patches from the underlying muscular coat. The surface of the membrane is generally covered with tenacious mucus, streaked or deeply tinged with blood. In the centre of the inflamed patches may be found small gritty deposits of the arsenious acid. The mucous membrane has, upon occasion, been found ulcerated, and, in rarer cases, gangrenous. The contents of the stomach vary in colour from a dull-brown to a brownish-red, like "coffee-grounds" in appearance, due to altered blood. The cardiac end of the stomach is usually more inflamed than the pyloric, doubtless due, in some measure, to the vomiting. The mucous membrane keeps a tenacious hold of the gritty particles of the acid once they have entered the stomach. In the case of L'Angelier for causing whose death Madeleine Smith was tried, notwithstanding there had been persistent vomiting for eight hours, 88 grains of arsenious acid were found in the stomach after death. In other cases which have been recorded, and after varying lengthy periods of vomiting, quantities amounting to 60 and 30 grains of the acid have been found in this organ after death. Perforation of the stomach is rare, but has been observed in a few cases. The small intestine shares in the inflammatory

[1] *Ann. d'Hyg. Pub.*, S. 3, vol. xxii., p. 137. [2] *Loc. cit.*

disturbance, and while in some cases the effect is general, in most it is mainly confined to the duodenum. In the large intestine, the rectal portion is generally most affected ; this is probably to be accounted for by the great tenesmus which prevails along with the diarrhœa. The above appearances persist for variably long periods after death, doubtless due to the antiseptic nature of the poison ; [1] they have been found present, for example, twelve months after death in one case, and nineteen months in another. While the foregoing may be taken to be descriptive of the appearances in the average fatal case where the poison has been ingested, their incidence is but little changed no matter by what other channel the arsenic enters the body. They are found, for example, in cases of respiratory poisoning by AsH_3, and even where the arsenic has been introduced *per vaginam*. Kockel showed the genital tract, liver, and kidneys of a woman of 27, who died from arsenical poisoning, the poison having been introduced into the vagina.[2] In addition, however, to the inflammatory appearances described, fatty degenerative changes of involuntary muscle-fibre and of tissues of kidney and liver are found, with disintegration of the red-blood corpuscles, and a jaundiced condition of the skin.

Reference has already been made (p. 144) to the preservative influence of arsenic upon the tissues of those poisoned by this substance. This has been frequently observed and noted. But the facts recorded by Whitford [3] of the appearances of the bodies of the victims of Flannagan and Higgins, who were tried at Liverpool in 1884, are of special interest. By reason of arsenical poisoning having been established in one of the three victims, the bodies of two other persons—Mary Higgins and John Flannagan, aged 10 and 24 years respectively—were exhumed and examined. Although the body of Mary Higgins had been interred for about $13\frac{1}{2}$ months, and that of John Flannagan for $37\frac{1}{2}$ months, both were found to be in a remarkable state of preservation. In the case of Flannagan, indeed, the face and body generally could be easily identified.

The abdominal viscera of Mary Higgins were found on analysis to contain 1 grain, and those of John Flannagan, $3\frac{1}{4}$ grains of arsenious acid. Another noteworthy appearance found in the stomach and intestines of the bodies of those poisoned by arsenic after interment, and which was found in the above cases, is a golden-yellow pigment or coating of the mucous surface of those parts. This was believed by some observers to be composed of arsenic sulphide. But Campbell Brown and Davies of Liverpool subjected the pigment found in the foregoing cases to chemical analysis,[4] and they found that it did not contain any appreciable amount of arsenic, but that it mainly consisted of bile-pigment. Littlejohn and Drinkwater have recorded two cases of poisoning with arsenious acid in which the yellow sulphide was found in the alimentary canal.[5] (For other cases of arsenical poisoning, consult *The Lancet*, vol. i., 1854, p. 224 (Atlee Family) ; and *ibid.* vol. i., 1862, p. 325.)

[1] (1) *Dublin Journ. Med. Science*, 1888 (Pearson) in *re* R. *v.* Cross ; (2) *Annales d'Hyg.*, 1889, Brouardel and Pouchet.

[2] *Monats. f. Geb. u. Gyn.*, May 1899.

[3] *B. M. J.*, vol. i., 1884, p. 504.

[4] *Ibid.* p. 506.

[5] *Edin. Med. Jour.*, Jan. 1906, p. 26.

Fatal Dose.—The smallest recorded fatal dose is two grains. Recovery has occurred, however, after larger doses.

Fatal Period.—While death has occurred in individual cases at the end of twenty minutes, and ten hours respectively, the average fatal period may be considered to be from twelve to forty-eight hours. L'Angelier died within fifteen hours. Death, however, may not supervene so early even after very large doses of the poison; in one case, for example, where 220 grains were swallowed, death did not ensue until the seventh day; in a second, until the sixteenth day; and in a third, where the poison was absorbed through the skin, until the twentieth day.

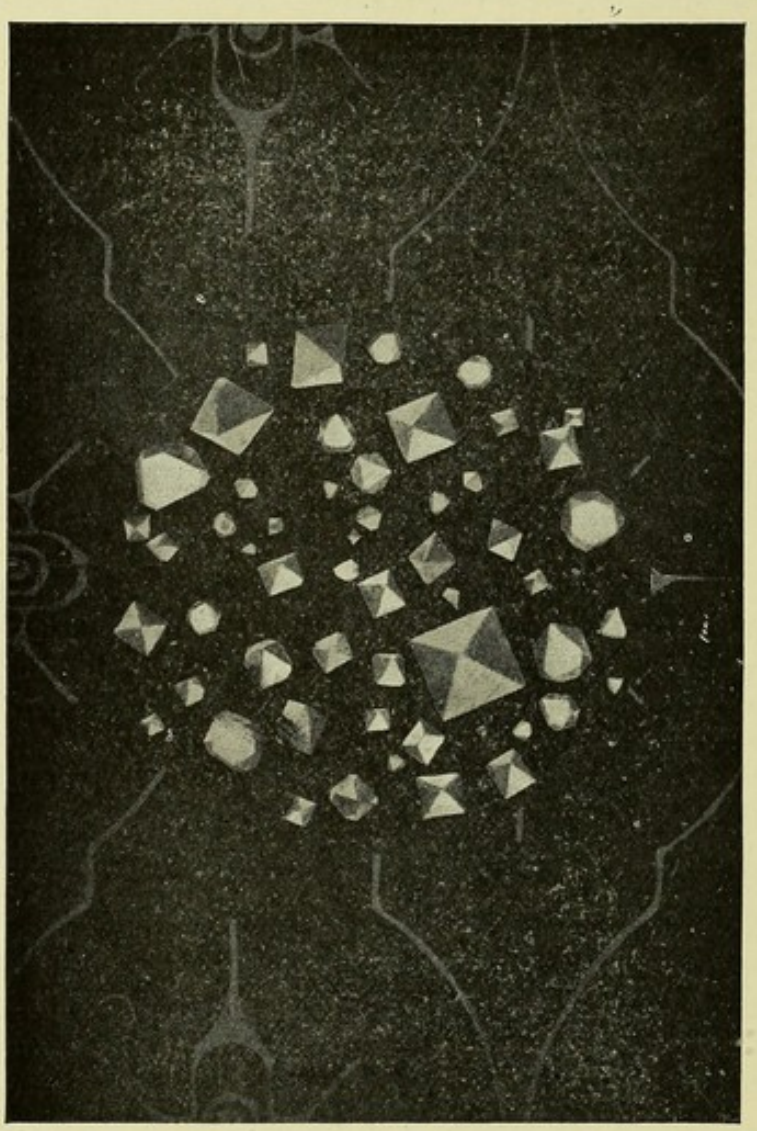

Fig 121.—This Photograph represents a piece of Dark Green, Flock Wall-Paper measuring 23·5 centimetres in length and ·15 centimetres in breadth. From a disc of the paper measuring 11·5 centimetres in diameter, the amount of Arsenic present was estimated. The crystals enclosed in the disc were obtained by Reinsch's process, were drawn by the aid of the Camera Lucida, and are magnified exactly 100 diameters. (Author.)

Treatment.— The first thing to do is to evacuate the stomach of its contents by the siphon-tube, using in the in-going warm water freshly prepared hydrated ferric oxide, made by acting upon the tincture of perchloride of iron with ammonia or potassium carbonate, and after several washings, the last ferrated water should be allowed to remain in the stomach. Sedatives may thereafter require to be used and careful attention must be paid to feeding the patient.

Chemical Analysis.—In examining the stomach and its contents after death, great care should be paid to the examination of the mucous membrane for the presence of minute gritty particles embedded therein, which will most likely be the case where powdered arsenious acid has been administered. Stevenson[1] affirms from his experience that a person may die quickly after taking a large amount of solid arsenious

[1] *B. M. J.*, vol. i., 1884, p. 485.

acid, and yet not a particle of the solid arsenical compound be found in the organs. This is best done by exploring systematically the whole mucous surface with the finger-tip. Special attention ought to be given, at the same time, to the presence or absence of particles of indigo, or soot, as affording presumptive evidence of the kind of arsenic administered. If such gritty particles be found, they should be detached and preserved, in the meantime, in a clean watch-glass. The same procedure should next be adopted with regard to the contents of the stomach, and any gritty particles found should be placed alongside the others. In order to test whether these are composed of arsenious acid, one or two of these particles should be picked out, washed gently in distilled water, dried between folds of clean blotting-paper, and transferred to a clean flat-shaped reduction-tube. The tube being then heated carefully over a small Bunsen flame, the formation of a sublimate should be looked for, and, if found, should then be examined by a good hand-lens or low-power microscope. If the character of the sublimate be crystalline and the crystals of the octohedral type, the strong presumption is in favour of arsenic. (*Vide* Fig. 121.) The piece of tube bearing the sublimate may then be cut off, ground in a small mortar, acidulated with pure hydrochloric acid, and tested with the liquid tests to be afterwards described. Should the reactions prove that the gritty particles are composed of arsenic, the rest may be washed carefully, dried, and weighed, and the weight noted. They should be preserved after weighing. If, however, no such particles are found, we may employ in testing the liquid contents of the stomach, after acidulating with pure hydrochloric acid to one-sixth the volume, *Reinsch's process* as a preliminary.

Reinsch's Process.—To the mixture, two or three small pieces of pure copper foil about $\frac{1}{4}$ inch square are added, and the whole boiled for about fifteen minutes.

In all cases where Reinsch's test is used for the detection of arsenic, it is imperative that the copper foil should be proved to be pure. Its purity may be established by the following preliminary test proposed by Abel. To some pure hydrochloric acid add five equivalents in bulk of water, and a few drops of a weak solution of ferric chloride or ferric sulphate. After boiling the mixture for a few minutes, add the small pieces of bright polished copper foil while the fluid is still boiling, and continue the boiling for a few minutes longer. If the metal is arsenic-free, its original bright colour will remain unchanged ; but if it be contaminated, it will acquire a darkened or tarnished appearance.

Pure copper foil may now be obtained, however, by electrolysis. To save hunting in the mixture for the small pieces of copper, each may be attached to a convenient length of fine platinum wire, by aid of which they are lifted out at the completion of the process. Should a steel-grey deposit have formed on the copper, the pieces may be detached, dipped in water, ether, and alcohol respectively, dried, placed in a reduction-tube, and carefully heated. Should a sublimate form, the steps already described for identifying its arsenical character, should be taken. Should this test reveal the presence of arsenic, the mixture may then be placed in a dialyser, so as to separate out the arsenic from the organic matter ; after which, it may be treated for quantitative estimation.

It must be borne in mind that, in addition to arsenic, dissolved antimony, bismuth, gold, mercury, platinum, silver, and tin are deposited upon copper when boiled in an acid solution, but only arsenic, antimony, and mercury sublime from the copper when heated in the reduction-tube.

Reinsch's test fails in its action in the presence of chlorates and nitrates, and it also fails to take up all the arsenic which may be present in the material suspected.

Liquid Chemical Tests.—The liquid tests for arsenious acid in solution may now be described. They are as follows :—

1. Ammonio-Nitrate of Silver gives a pale yellow precipitate of the Arsenite of Silver, which on exposure to sunlight changes to a green colour. The precipitate is soluble in excess of ammonia, in nitric acid, and in tartaric, citric and acetic acids. Nitrate of Silver alone gives no precipitate.

2. Ammonio-Sulphate of Copper gives a beautiful light-green precipitate of Copper Arsenite, known as Scheele's green, which is also soluable in excess of Ammonia. Cupric Sulphate alone does not produce a precipitate.

3. Sulphuretted Hydrogen gives a bright yellow precipitate of Arsenious Sulphide, which is soluble in excess of Ammonia. It is important to remember that unless the solution to be tested is acid, no reaction will occur. The sulphide is recognised as follows :—(*a*) By its insolubility in dilute hydrochloric or vegetable acids, alcohol, and ether ; (*b*) by its being decomposed by *strong* hydrochloric or nitric acid ; (*c*) by its solubility in alkalies ; (*d*) by yielding metallic arsenic when treated with soda-flux.

Marsh's Test.—This test, or process, depends upon the fact that soluble arsenical compounds are decomposed by nascent hydrogen. This is commonly generated by the action of dilute sulphuric or hydrochloric acid on metallic zinc, and the arsenic unites with the hydrogen to form arseniuretted hydrogen, AsH_3. By reason of the risk of unreliable results from the use of impure reagents, several modifications of the process of generating the hydrogen have been suggested, as, for example, by Bloxam and others. Although Marsh himself used zinc and sulphuric acid, the use of magnesium has been suggested because of the difficulty of procuring zinc free from arsenic. Another reagent suggested in place of zinc is sodium amalgam, which can be made arsenic-free in the following way :—by melting one part of pure metallic-sodium under solid paraffin, and by gradually adding, by constant stirring, ten parts of purified mercury, a solid crystalline mass of amalgam or alloy is formed, which, when the paraffin is decanted off and the mass is washed with pure, dry benzene, is ready for use. A few small pieces of the alloy are sufficient for one estimation. But if we make sure that the reagents used are pure, those originally proposed by Marsh will equally efficiently serve the purpose. The apparatus for the test consists of an Erlenmeyer flask or Wolff bottle. In the former, which has one mouth, the mouth of the flask is fitted with an accurately ground glass stopper in which two holes have been drilled. Through these holes are passed accurately-fitting glass tubes, one of which is thistle-shaped at the top and is caused to pass to nearly the bottom of the flask, the other at its one extremity just passes through the stopper, and at its other end above the stopper, is bent twice upon itself, and is connected with a calcium chloride tube, which,

in turn, is united with a lengthy piece of hard glass tubing narrowed about two or three inches from its free extremity. In using this test practically, it is of great importance that the medium in which the arsenic is suspected to be present should be in a liquid form and as free from organic matter as possible, since organic matter is apt to interfere with the efficiency of the test. Assuming that either by dialysis, or in some other way, the medium is obtained in the liquid form, several pieces of pure, granulated, metallic zinc are added to some distilled water in the flask of the apparatus; thereafter some of the suspected fluid is added; and, last of all, some pure dilute sulphuric acid is poured down the thistle funnel, the result being the generation of hydrogen, and, if arsenic be present, of arseniuretted hydrogen. If the zinc be pure, it is better to add a drop or two of platinic chloride solution, so as to aid the rate of evolution of hydrogen, since pure zinc is but slowly attacked by the acid. After waiting a few moments to permit of the air of the flask being replaced by the hydrogen-arsenide gas, a light may be applied to the issuing gas at the free end of the tube. Hydrogen arsenide may be recognised by the following properties—viz. (*a*) it burns with a pale bluish, bluish-white, or lilac flame; (*b*) if a piece of white porcelain be held in the point of the flame, a deposit forms upon the porcelain, which may be roughly differentiated into three separate zones or rings, and those, from circumference to centre, are composed as follows:—(1) a whitish ring composed mainly of arsenious acid; (2) a darkish-coloured or brownish ring, composed of a mixture of arsenious acid, arsenious suboxide, and metallic arsenic; and (3) a dark, shining ring of purely metallic arsenic. That these stains are composed of arsenic may be proved by the following tests—viz. (*a*) by their solubility in a solution of sodium hypochlorite, or of chlorinated lime or bleaching-powder; (*b*) by their imperfect solution in ammonium sulphide, which solution, however, on evaporation to dryness, leaves a yellow film of arsenious sulphide; (*c*) by being dissolved on addition of nitric acid, and the resulting solution on being carefully evaporated to dryness, and on addition of a drop or two of a strong solution of silver nitrate, giving a brick-red stain or precipitate of silver arsenate. During the time these tests are being tried, it is advisable to turn the delivery-end of the tube into a solution of silver nitrate, so as to prevent escape of the AsH_3 into the room atmosphere, and also to prevent its possible poisonous action on the experimenter—for this gas is very lethal in its action; or a lighted spirit-lamp may be applied to the issuing-tube, an inch or more on the proximal side of the constriction. The effect of the application of the lamp is to decompose the AsH_3 into hydrogen and metallic arsenic, and a dark brown mirror of metallic arsenic will be deposited within the tube on the distal side of the point to which the heat has been applied. When the tube is sufficiently cooled to enable it to be detached, the mirror may be again heated by the spirit flame, when the arsenic will sublime on a cool part of the tube in the characteristic crystalline form of arsenious acid. The sublimate may then be dissolved in distilled water acidulated with hydrochloric acid, and the liquid tests, already described, can be applied. It is often well to preserve intact a portion of the tube with the deposit thereon, by sealing the ends with the blow-pipe, for presentation as

evidence. Marsh's test is capable of detecting the $\frac{1}{250}$ of a grain of arsenic.

Gutzeit's Test.—When a preliminary test is wanted where only a small amount of material is on hand for analysis, perhaps one of the best tests is that of Gutzeit.

Gutzeit's test, as originally suggested and carried out by its proposer, consisted in the generation of AsH_3 from an arseniferous material by means of zinc and HCl, and passing the gas so liberated upon or against a piece of bibulous paper moistened with silver nitrate. While this salt of silver possesses the advantage of being very sensitive to AsH_3, it unfortunately has the disadvantages that it is liable to be darkened on exposure to light, and is, also, very readily affected by H_2S. The accidental presence, therefore, of H_2S when testing for AsH_3, destroyed the accuracy and reliability of the test. It was for this reason that mercuric chloride was substituted in place of the silver salt, and although it is not so rapidly reactive to AsH_3 as the other, when due precautions are taken, it is a surer indication of the existence of arsenic when a reaction does take place. It must not be considered that the mercury salt is not affected by H_2S; all that can be claimed, indeed, in favour of its use over the other, is that it is less sensitive, and that a stain is only produced when sufficient H_2S is present to be easily detected by lead acetate paper. It will be apparent, therefore, that in this lies the weakness of the test, as commonly carried out, and that the presence of sulphides or sulphites in the material to be examined militates against its accuracy. When these were suspected to be present in the material to be examined, it was necessary to add iodine or bromide to oxidise the sulphur compounds. The effect of AsH_3 upon a dried spot of mercuric chloride is a yellow coloration of the hitherto colourless spot, the depth of the resulting tint depending upon the amount of arsenic present; but it varies from a lemon-yellow, through a bright yellow, to an orange-brown colour.

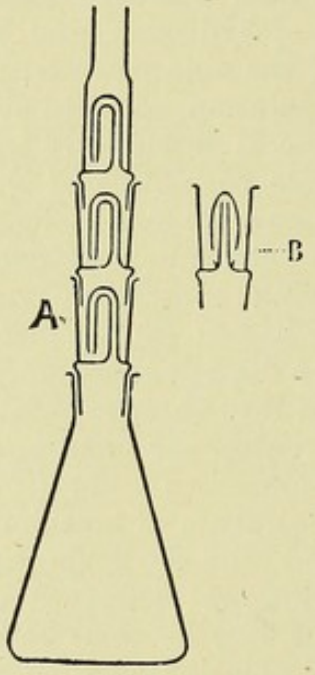

FIG. 122.—Dowzard's Apparatus for Gutzeit's Test for Arsenic. A and B indicate glass cells or traps which contain solutions of Lead Acetate and Copper Chloride for the purpose of fixing H_2S and PH_3 which otherwise would react upon the Mercuric Chloride spot on the filter-cap. The cells are fitted into one another, as shown in the figure.

This test, which is far more sensitive to the presence of minute amounts of arsenic than that of either Reinsch or of Marsh, would, obviously, be practically perfect could adventitious gases be arrested before they could act upon the sensitive mercury spot. Such an apparatus and method of use have been devised by Dowzard.[1] A sketch of the apparatus is given in the article quoted, but we reproduce it here.

The principle of the apparatus is to arrest or trap, and to wash in neutralising solutions, those gases which would interfere with the integrity or accuracy of the test. The apparatus itself essentially consists of an Erlenmeyer flask, and of a series of superposed glass cells which are fitted into the flask after the fashion of a series of fitting hollow stoppers, one above the other. Dowzard's description of the mode of using the apparatus is as follows :—

"A weighed or measured portion of the sample is mixed with 5 c.c. of pure HCl (if the sample is alkaline, it must be neutralised first), four drops of a 15

[1] *Journ. Chem. Soc.*, vol. lxxix. and lxxx., 463, p. 715.

per cent. solution of cuprous chloride in hydrochloric acid are then added, and the mixture made up to 30 c.c. with water ; if it is not convenient to work with such a small bulk as 30 c.c., this quantity may be doubled or trebled, but the same proportion of acid should be used. A rod of pure zinc, 3 cm. long and 5 mm. in diameter, is first placed in the flask, the above mixture is then introduced, and the first cell placed in position ; lead acetate solution (5 per cent.) is now poured into the cell until it is about half full, the second and third cells are filled in a similar manner, a small tuft of cotton wool is introduced into the neck of the top cell, and its mouth capped with mercuric chloride paper, which may be held in position by an elastic band, or a glass collar made from a piece of glass tubing. After forty minutes or more, the cap is removed and examined in full daylight. A minute trace of arsenic is indicated by a lemon-yellow spot, which varies in tint according to the amount present ; and a heavy trace by an orange-brown spot. The mercuric chloride paper is prepared as follows :—one drop of a 5 per cent. solution of mercuric chloride is allowed to fall on the centre of a piece (4 cm. square) of thin, Swedish filtering paper such as Muncktell's No. 1 F. ; the paper is dried before using."

Used in the above manner, sodium sulphite and sodium hypophosphite were tested in the apparatus: it was found that the lead solution completely absorbed the H_2S from the former, but did not prevent the PH_3 from the latter from passing to stain the mercuric paper. But by placing in the other cells a 15 per cent. solution of cuprous chloride in hydrochloric acid, the PH_3 was also prevented from passing to cause a stain. With the cells charged as described, 0·000005 gramme of arsenious acid was added to the solution in the flask, when the mercuric cap was stained a faint yellow colour. Dowzard concluded from his experiments, therefore, that the use of lead acetate and cuprous chloride solutions does not interfere with the passage of AsH_3, but effectually arrests the passage of H_2S and PH_3 respectively. Moreover, he tested the value of the apparatus in respect of SbH_3 and he found, by using amounts of potassium antimony tartrate up to 0·10 gramme, and washing the gas produced in three cells charged with cuprous chloride solution, that in no case was a stain produced, but when the amount was increased to 0·20 gramme, that a faint blackish-brown stain was formed. From the foregoing, it was concluded that arsenic can be detected even in presence of about 2500 times its weight of antimony. Dowzard recommended, when antimony is present, that the proportion of acid to be used should be 1 in 8, and that only *one* drop of cuprous chloride solution should be used, so that the rapidity of evolution of hydrogen may be moderated, and thus enable the cuprous solution in the cells to exercise its full absorbing effect. The presence of selenium and tellurium compounds does not interfere with the usefulness of this method. In order to make the test of value for quantitative estimations, Dowzard suggests that careful attention should be paid to the following points—viz. (1) That parallelism with respect to amounts of reagents and temperature of the experiment be carried out in every particular ; (2) that the reaction should occupy the same time ; (3) that the stain produced from a given sample be carefully compared with stains produced from known standard amounts of arsenious acid ; and (4) that exactly duplicate apparatus be used.

The cuprous chloride solution is prepared in the following way :—dissolve 16 grammes of pure cupric oxide in 110 c.c. of pure hydrochloric acid ; to this solution add 13 grammes of pure thin "electric" copper foil cut into small pieces, and boil the mixture for 25 minutes ; then pour the resulting solution of cuprous chloride into 1000 c.c. distilled water, and wash the white precipitate by decantation ; dissolve the washed precipitate in arsenic-free hydrochloric acid ; evaporate to dryness 5 c.c. of the solution ; weigh the residue ; and from the weight found, dilute the bulk of the solution with HCl until 100 c.c. contain about 15 grammes of cuprous chloride.

For quantitative estimation of arsenious acid in organic mixtures, such as contents of stomach, or in the bodily organs, in view of the fact that dialysis is but a slow way of effecting separation of the poison, a process of distillation has been established on the principle that the Chloride of Arsenic ($AsCl_3$) is volatile. Whatever be the nature of the

organic substance suspected to contain the arsenic, it is finely pounded into pulp, and dried in a water-oven at 212° F. When quite dried, it is placed in a distillation-flask or retort, which can readily be attached to a condenser, the adapter of which dips into a receiver containing sodium or potassium hydrate solution. Thereupon to the flask or retort is added sufficient pure hydrochloric acid to cover thoroughly the dry organic matter; the retort is connected with the condenser —which, like the receiver, must be kept cool by a water-jacket—and heat is applied by means of a sand-bath. The distillation is proceeded with until about three-fourths of the acid have passed over. The retort is now allowed to cool for a little time before it is opened; more hydrochloric acid is then added; and distillation is repeated in the same way. The two distillates are then mixed in an Erlenmeyer flask, warmed to a temperature of 150° F., and arsenic-free H_2S is passed through the liquid for some hours, the temperature of the liquid being maintained as uniform as possible. At the end of this time, the flask is set in a warmed place sufficiently long until the odour of H_2S has practically disappeared. The precipitate is now collected on a tared filter, washed with ether, then alcohol, and, last of all, with carbon disulphide, to dissolve out any sulphur which the precipitate might contain. Thereafter it is dried to constant weight at 212° F., and the weight calculated into terms of Arsenious Acid. The amount of As_2S_3 found, when multiplied by the factor ·6098, will equal the quantity of metallic arsenic, and by ·8049, that of As_2O_3 present in the aliquot weighed quantity used.

It may happen, however, that the quantity found in the body is not sufficient to be ponderable. In such a case, the only means of arriving with approximate accuracy at the quantity is by comparing with stains or mirrors formed in Gutzeit's or Marsh's test from definite known small amounts of the poison, those produced in a like manner in the case in hand. It is only by such a method that very minute amounts can be estimated as quantity. For details of analytical methods for detection of arsenic in animal tissues, the reader is referred to the author's treatise on "Poisoning by Arseniuretted Hydrogen," 1908.

In every case where analyses are made for medico-legal purposes, portions of the materials in which the poison has been found should be retained for the use of the defence if required.

Medico-Legal Cases in which Arsenic was administered criminally

McCracken—tried at Derby Autumn Assizes, 1832.
Mary Ann Burdock—tried at Bristol, April 1835.
Poison used—Orpiment: Death of victim.
Lofthouse—tried at York Lent Assizes, 1835.
Hunter—tried at Liverpool Assizes, 1843.
Thomas—tried at Cardiff Summer Assizes, 1843.
Dazley—tried at Bedford Summer Assizes, July 1843.
Death of victim. Evidence of poison in body, six months after interment.
Lever—tried at Central Criminal Court, London, 1844.
Port—tried at Chester Winter Assizes, 1844.
Death caused by application to breast of arsenical plaster.
Gilmour—tried at High Court of Justiciary, Edinburgh, January 1844.

Jennings—tried at Berks Lent Assizes, 1845.
Poison found in body of victim, 28 days after burial.
Elizabeth Johnston—tried at Liverpool Lent Assizes, 1847.
Poison found in body of victim on exhumation after three months' interment.
Foster—tried at Bury Lent Assizes, 1847.
Cheshams—tried at Essex Lent Assizes, 1847.
Poison found in bodies of victims, 19 months after burial.
Maher and Lynam—tried at Kildare Lent Assizes, 1847.
Franklin and Randall—tried at Northampton Summer Assizes, 1848.
Poison—Schweinfurth green (aceto-arsenite of copper) used to ornamentally colour *blanc mange*, in shape of cucumber. It was found to contain 47½ per cent. of arsenite of copper.
Ann Merritt—tried at Central Criminal Court, London, March 8, 1850.
Poison—arsenious acid—administered in gruel. Amount of arsenic found in stomach of victim, 8½ grains.
Lucas and Reeder—tried at Cambridge Lent Assizes, 1850.
Death of victim.
Maria Gage—tried at Ipswich Summer Assizes, August 1851.
Poison used—packet of rat-poison, consisting of linseed and arsenious acid. Death of husband.
Mrs Wooler—tried at Durham Winter Assizes, 1855.
McCormick—tried at Liverpool Winter Assizes, 1855. (*Med. Gaz.*, vol. xxxiii., p. 434.)
Newton—tried at Hertford Lent Assizes, 1855.
Death of victim.
Bacon—tried at Lincoln Autumn Assizes, 1857.
Madeleine Smith—tried at High Court of Justiciary, Edinburgh, June 30, 1857.
Poison alleged to have been administered in coffee, cocoa, or other food or drink. Amount of arsenic found in body of deceased—L'Angelier—88 grains.
Sagar—tried at York Lent Assizes, 1858.
Mary Ann Cotton—tried at Durham Assizes, 1874.
Kate Dover, 1882 (*B. M. J.*, vol. i., 1882, p. 237).
Flannagan and Higgins—tried at Liverpool Assizes, 1884.
Cross—tried at Munster Winter Assizes, December 15, 1887.
Arsenic and Strychnia found in body of wife.
Michael O'Brien—tried at same Assizes, December 14, 1889.
Arsenic found in body of victim—11$\frac{13}{20}$ grains. (*The Lancet*, vol. ii., 1889, p. 1356.)
Mrs Maybrick—tried at Liverpool Assizes, 1889.[1]
Poison used—Arsenite of Soda,—from solution of "fly-papers" in water. Death of husband. *Vide* also case reported by Dr Letheby, *Med. Gaz.*, vol. xxxix., p. 116.
Ardwick Case—tried at Manchester Assizes. (*Lancet*, vol. ii., 1890, pp. 1357 and 1392.)
John Webster—tried at High Court of Justiciary, Edinburgh, 1891.
Arsenic found in all the organs.
Frost—inquest held at Deptford, July 1899.
Poison found in bodies of three victims, on exhumation of bodies after varying periods of interment. (*The Lancet*, vol. ii., 1899, p. 124.)

Antimony

The principal salt of Antimony with which cases of poisoning have been associated is potassium antimonium tartrate, or tartar emetic ($KSbC_4H_4O_7.H_2O$). This salt is an ingredient of James's Powder. Antimony is much less used in medicine now than formerly, and when used, it is commonly in the form of *vinum antimoniale*. Tartar emetic

[1] Carter, *Lancet*, vol. ii., 1889, p. 506; *ibid.* vol. i., 1889, p. 1268.

occurs in the form of a whitish, or whitish-yellow powder, which contains chemically between 33 and 35 per cent. of antimony. The chloride is corrosive in its action, as we have already seen (p. 589). Tartar emetic is sometimes given to horses to improve the condition of the skin, and it has been known to be administered by wives to their husbands to wean from them drink. It is freely soluble in boiling water—one in three—is five times less soluble in cold water—one in twelve to fifteen parts—and is insoluble in alcohol.

Accidental poisoning may sometimes occur in unexpected ways. In January 1909, in Glasgow, a barrel fell from a dray passing along the street and burst. Several women, evidently thinking the substance

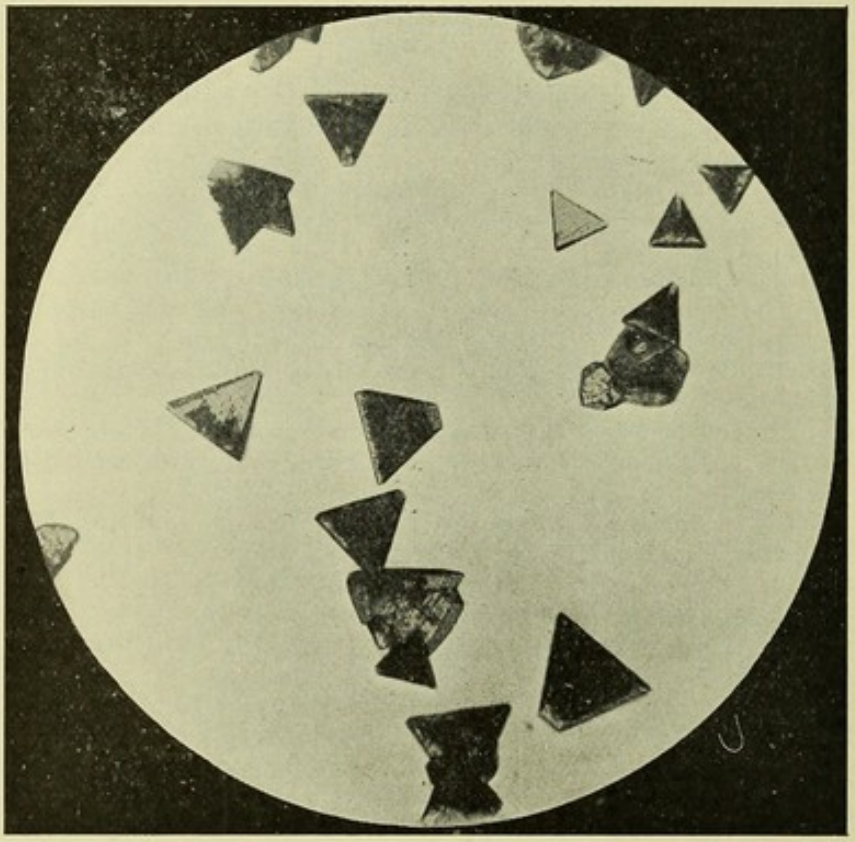

Fig. 123.—Photo-micrograph of Crystals of Tartrate of Antimony. × 50 diameters. (Author.)

to be baking powder, gathered it. One woman put it into a pudding, with the result that she, her husband, and two children became seriously ill after partaking of the pudding. The substance proved to be tartar emetic on its way to a firm of dyers. Page [1] records an interesting case. At Kendal Martinmas Fair, a girl bought some confectionery at a street-stall. She ate a couple of lozenges herself, and gave the like number to two children of the family, aged three and five respectively, who ate them. In about a quarter of an hour, they were seized with violent sickness and retching, lasting an hour, while, in addition, the younger of the children became collapsed, and was unconscious for forty minutes, although she eventually recovered. The lozenges, on being examined, were found to weigh 62 grains, and each

[1] *The Lancet*, vol. i., 1879, p. 699.

approximately contained 0·22 grain of the teroxide of antimony (Sb_2O_3). It was supposed that the antimony had been accidentally put into the mixture of which the lozenges were made. At an inquest on a child who had died unexpectedly while suffering from whooping-cough, it was shown in evidence that five doses of "Holt's Specific" had been administered. On post-mortem examination of the body, patches of inflammatory action were found in stomach and intestines; and on chemical analysis of the "specific," it was found that each dose contained half-a-grain of tartar emetic.[1] There are preparations sold for the "cure" of dipsomania, besides, which contain antimony.

Acute Poisoning—Symptoms.—If we suppose that one or two drachms of tartar emetic have been taken, the following symptoms may be expected to be present:—an astringent metallic taste in mouth; great heat and sense of constriction in the throat; dysphagia, to some extent; great pain in stomach, followed by vomiting of an incessant character; accompanying or succeeding diarrhœa; great feeling of faintness and profound depression; there may or may not be intense thirst; the pulse is small, rapid, and very weak; the skin is covered with a cold, clammy perspiration; there may be cramps in abdomen and limbs, which before death may almost assume a tetanic character; intense giddiness, followed by insensibility, usually precedes death.

Chronic Poisoning—Symptoms.—These consist of great nausea, followed by vomiting of contents of stomach and bile-stained mucus; watery diarrhœa, or diarrhœa alternated with constipation; the pulse becomes small, weak, and contracted; there is great loss of bodily strength, which comes on gradually, and proceeds *pari passu* with loss of flesh and emaciation; the patient loathes the sight of food, because vomiting is associated with it; great weakness, amounting to complete prostration, and increasing emaciation, generally precede death.

Post-Mortem Appearances in Acute Poisoning.—The mucous membrane of throat, gullet, and stomach is injected, inflamed, and, in parts, superficially ulcerated. The mucous lining of stomach, especially, is likely to be found covered with a tenacious mucus, and here and there variable-sized patches of sub-mucous ecchymosis may be seen. These appearances seem to be concentrated on the greater curvature and at the cardiac orifice, although they have been found distributed generally over the stomach. The mucous lining of the duodenum shares the same appearances. The contents of stomach are usually scanty in amount, are dark-coloured in appearance and sometimes bloody, and give an acid reaction.

In chronic poisoning, these appearances are not so marked; the tongue and buccal mucous membrane are likely to be covered with fur, or dotted with aphthous patches; the other reaches of the gastro-intestinal tract are likely to be found in a similar state, but patches of ulceration may be found either in stomach or intestines, or in both. There is considerable emaciation of body.

Antimony, like arsenic, exercises a remarkable preservative effect on the internal organs of persons poisoned by it. This was markedly shown in the cases of more than one of the victims of Klosowski or Chapman.

[1] *B. M. J.*, vol. i., 1884, p. 23.

One of the most important cases of recent years is that known as the Klosowski or Chapman poisoning case. Its importance on the criminal side lies in that the poisoner succeeded in poisoning at least three victims, and from the medical side in that his first two victims were certified by medical persons as having died from natural causes. It is, perhaps, not to be wondered at that the younger generation of practitioners may be unfamiliar with the signs and symptoms of antimonial poisoning, since these preparations are, probably, less used now than at any time within the last century. It is advisable, therefore, to recount the principal features of this remarkable case.

Severino Klosowski, *alias* George Chapman, was a Pole, and was 37 years of age when apprehended on a charge of having poisoned his reputed wife. In his youth he had received some measure of medical training and knowledge of drugs while acting as dispenser and surgical dresser in a hospital in Prague. The facts which emerged at the inquest on Maud Marsh, his reputed wife, held by the coroner for Southwark were as follow:—Maud Marsh had lived with the accused as his wife for a little over twelve months when she died. Two other women, who had lived with him in the same relationship previously, had also died. The accused had a wife who appeared as a witness and identified the accused as her husband. The deceased woman, Marsh, was aged nineteen when she entered the service of accused as a barmaid. It was not accurately known when she first took ill, but by July 28, 1902, she was suffering from sickness, diarrhœa, and abdominal pain, for on that date her sister took her to Guy's Hospital, where she remained as an in-patient until August 20. A provisional diagnosis of peritonitis was then made, although no cause was found. From the published clinical notes of her condition by the obstetric surgeon to that institution, it appears that the above date was correct, and that on admission deceased made complaint of severe abdominal pain and fever. She stated that three weeks earlier she had been seized with pain in the lower part of the abdomen, coming on in attacks generally worse at night. She attended the hospital as an out-patient on July 26, when she said she had been confined to bed for the two previous days. On admission on the 28th, her temperature was 99·4° F., her pulse 108, respirations 28. She said that menstruation had ceased two days before. She complained of very severe pain across the lower parts of abdomen with fulness, and the parts were so tender that she could not bear any examination. Swelling and tenderness were rather more marked above the right groin, and the pain extended up to the right loin, but no definite tumour could be felt either on abdominal palpation or vaginal examination. There was no vaginal discharge or evidence of gonorrhœa. Micturition was normal. Bowels were confined. During the next fortnight, the temperature varied from about 99° F. in the morning to 103°-104° F., in the evening, the highest record being on August 9, when it was 104·6°. Pulse ranged from 90 to 110, and the respirations from 22 to 28 per minute. The pain was often so severe as to require opiates. There was occasional sickness, but it was at no time a prominent symptom. A little blood-stained mucus was observed in motions on one or two occasions. By August 15 she was so much better that she was put on light diet and allowed to be wheeled out into the open air. On the 18th, the abdominal tenderness had disappeared, and on vaginal examination no thickening could be felt. On August 20 she left the hospital quite convalescent and free from pain. The case was regarded as one of acute perimetritis, possibly of tubercular origin.

On October 10, accused called on a local surgeon and obtained from him a bottle of medicine for the deceased, who, he said, was suffering from sickness and diarrhœa. This surgeon called at accused's house the same night, saw the deceased, and continued attendance until she died on October 22. Two days before her decease, the mother of deceased had come to stay with her daughter to nurse her. On the 21st, the Marsh family asked the surgeon in attendance to have their family doctor to see the deceased with him in consultation. After consultation, they arrived at the conclusion that the deceased

was suffering from some form of irritant poisoning, probably ptomaine poisoning. The consultant said at the inquest that as he was going home from the consultation he turned the matter over in his mind and came to the conclusion that the symptoms might be due to arsenical poisoning. Soon after the death of deceased, the surgeon who had been in attendance suggested to accused that a post-mortem examination was desirable, as the cause of death could not be accounted for. Accused asked what was the use of such an examination. The doctor replied, that he did not know the cause of death, whereupon accused said the deceased had died from exhaustion, due to diarrhœa and vomiting. The surgeon said he could not grant a certificate of death, and that there must be a post-mortem examination or an inquest. Arrangements were then made for a private post-mortem examination of the body at the Southwark mortuary.

On the morning of the 23rd October—the day after the death—the consultant, who had heard from the parents of deceased of her death, sent a telegram to the local surgeon warning him to look out for arsenic. This telegram was received before the post-mortem examination was made by the local surgeon and a colleague. At the examination the two doctors found nothing to account for the death, but they submitted portions of the viscera to an analyst for chemical examination. "Traces of arsenic were found in the contents of the stomach, together with antimony in far larger quantity." Later, the late Sir Thomas Stevenson, at the request of the coroner, made a second analysis, and "found antimony in nearly all parts of the body, from which he recovered seven and a quarter grains of metallic antimony, equivalent to twenty and one-eighth grains of tartar emetic. He concluded that death was due to antimony administered in a soluble form, either as tartar emetic or as metallic antimony. From the fact that some of the poison was found in the intestines, he arrived at the further conclusion that a large dose must have been given shortly before death, or otherwise that it would have been absorbed." It was shown in evidence that accused at times prepared with his own hands food for deceased, and that, as a rule, he administered both food and medicine to deceased during the illness ; that sickness often followed immediately after she had partaken of food, drink, or medicine ; and that on the night before the death of deceased, her mother, who was with her, partook of a small amount of the brandy and water which had been brought by the accused for the use of deceased, and that shortly afterwards she was also attacked by violent sickness and diarrhœa, which lasted several hours. It was also shown that on April 3, 1897, accused had purchased an ounce of tartar emetic from a chemist at Hastings, as proved by the chemist's poison sale register.

The same surgeon who had attended the deceased Maud Marsh had also attended Bessie Taylor, the previous pseudo-wife of accused, in February 1901, but at a different address. He had been regularly in attendance upon Taylor from the 1st January. Her symptoms also were vomiting, diarrhœa, and pains in the stomach. She had been seen by three other medical men besides himself, and at least four different diagnoses had been made—viz. uterine mischief, hysteria, cancer of stomach or intestine, and obstruction of bowels. The local surgeon signed the death certificate of Bessie Taylor, the cause assigned being "intestinal obstruction, vomiting, and diarrhœa."

In view of the ascertained cause of death of Maud Marsh, the body of Bessie Taylor was exhumed. "It was found in a remarkable state of preservation after an interment of 21 months, doubtless owing to the preservative qualities of the large quantity of antimony shown to be present in the tissues." From the body Sir Thomas Stevenson recovered antimony equivalent to 29·12 grains of tartar emetic. He found no evidence of uterine disease or of intestinal mischief. The body of the next previous reputed wife, Isabella Spinks, was also exhumed, and the organs analysed. Her body had been interred for about five years. Like the body of Bessie Taylor, her body was not only not putrid, but was found to be in a most remarkable condition of preservation. According to Stevenson, "on opening the coffin, the head and face were those of a woman who might have been coffined the day before, while the eyeballs were found intact." In this body, also, was antimony found in such amount as to suggest that she had been given more of that poison than Maud Marsh.

The certificate of cause of death given in the case of Isabella Spinks was "Consumption"; but no signs of tubercular disease were found on dissection at the exhumation. In 1903, Klosowski was found guilty of the murder of Maud Marsh by the administration of tartar emetic, was condemned to death, and was shortly afterwards executed in Wandsworth Gaol.

The reports of the post-mortem examinations of the bodies of these three women, and the results of the analyses thereof by the late Sir Thomas Stevenson, are full of interest.

He notes in the first place that "the preservative effects of tartar emetic, though previously known, have been insufficiently recognised, though they were noted in the case of Palmer in 1856, and in the case also of Captain Caw poisoned by his son-in-law Hall in New Zealand."

The results of the individual examinations were as follow:—

I. Post-Mortem Examination of body of Maud Eliza Marsh on October 30, 1902, eight days after death.

The weather had been mild for the season. Putrefactive odour very slight; body thin, but not emaciated; skin of a pale yellow-green hue; dark rings round sunken eyes; light livid-green post-mortem discoloration of clavicular fossæ, inguinal region, and back, and to less extent around umbilicus and eyes; finger nails and toe nails normal; eyeballs collapsed; nose pinched; gums pale; *rigor mortis* passed off, except a little in knees and jaw; hypostasis present on back and dependent parts; no marks of previous pregnancy on abdomen; virginal areolæ of breasts; no surface ecchymoses. An antecedent partial post-mortem examination had been made by an incision from top of sternum to pubes. Tongue was thickly coated, and yellow follicles at back of tongue swollen; tonsils normal; air-passages free from obstruction; no hæmorrhage; lungs practically normal; stomach, which had been removed at previous examination (as also rectum), contained about one and a half ounces of yellow turbid fluid, containing much bile and mucus; colour externally was bright pink; blood-vessels were bright pink in colour, were injected; mucous coat vessels were also injected; there was no ulceration or loss of substance; mesenteric glands were somewhat swollen; small intestines showed blood vessels rather red and prominent; mucous membrane swollen, the folds especially at apices being prominent and injected—in a condition, in short, of acute catarrh and streaky congestion; ileum and colon were dilated, their solitary follicles being swollen and hard; there was no ulceration of mucous membrane in either large or small intestine; rectum was hyperæmic; contents of bowel were entirely semi-liquid, with the exception of some pulpy fæces above sigmoid flexure of colon; no fæcal odour anywhere; the liver was of pale yellowish hue, was dry, soft, and slightly fatty in patches; gall-bladder contained one fluid ounce of dark bile. Other organs were practically normal. The summary of the examination was: "Body of an anæmic young woman with no serious organic disease; tissues dry and drained of fluids; acute gastritis; appearances suggestive of an irritant poison, probably not arsenic."

Analysis:—

			Grains
Stomach contained of	tartarated	antimony	= 0·64
Bowel contents	,,	,,	= 16·64
Liver	,,	,,	= 1·98
Kidneys	,,	,,	= 0·39
Brain	,,	,,	= 0·47
	Total		20·12

II. Exhumation of body of Bessie Taylor on November 22, 1902. Died February 13, 1901, aged 36 years. Buried at Lymin, February 15, 1901.

The sound, dry coffin was found beneath those of two relatives who had been buried at later dates.

Body was covered with mouldy growths; no putrefactive odour; a few dead larvæ found about body; fingers friable; breasts shrunken; abdominal walls hard, dry, and cut like soft leather; recti muscles firm and fresh in colour. On opening abdomen, a distinct fæcal odour was perceived.

Skull and meninges of brain normal; brain soft, shrunken, and putrid; no hæmorrhages in head.

Lungs shrunken, doughy, and leathery; no cavities or deposits; pericardial sac empty; heart weighed three and a half ounces, walls being thin, paper-like, and tough, valves healthy; a little tarry dark blood in right auricle; otherwise normal. Stomach weighed the same as heart, walls being thin, leathery to touch and on section, vesiculated; blood vessels full of dark blood: to left of cardiac opening, mucous membrane showed a peculiar cinnabar-red colour over a patch measuring four inches in diameter; no ulceration or perforation; no distension by gases; walls of duodenum thin and parchment-like; mucous membrane covered with cinnabar-red mucus, which, when removed, showed the same colour beneath as in stomach; jejunum showed similar coloured patches; ileum covered with orange-yellow slimy mucus in lower portion; twelve inches above ileo-cæcal valve was a patch of full orange-colour, which proved on analysis to be composed of antimonious sulphide; similar patches in colon and in upper part of rectum, merging into slimy slate-coloured fæces near anus; mucous membrane all through intestines of a dull cinnabar-red colour; no ulcerations. Body generally in a remarkably good state of preservation.

Analysis proved the presence of antimony as follows:—

Stomach and contents contained as tartarated antimony			=	0·32
Intestines and	,,	,,	=	23·43
Liver		,, ,,	=	4·55
Kidneys		,, ,,	=	0·82
		Total		29·12 grains

III. Exhumation of body of Mary Isabella Spinks, aged 41 years. Died December 25, 1897. Buried at Leytonstone, December 30, 1897.

The body was the lowest in a public grave 18 feet deep, seven other coffins having been deposited in the same grave during January 1898. The stench from the other coffins was terrible, but that from Spinks' coffin was much less. "On opening the sound, dry, elm coffin, a female body was disclosed of an almost life-like aspect, except for the pallor of the countenance, which was covered with a fine mealy deposit of earthy phosphates, giving the appearance of the face having been dusted with face powder. Such deposits are not uncommonly met in exhumed bodies. There was no putrefactive odour. The shroud was perfect. There were no larvæ in or around body. The short, dark hair of the head was clean and unchanged. The fingers and hands were of a pink colour, with a few vesicles on them. No fungi were visible on the surface of the body. The right eye was shrunken, the left vesiculated but unruptured. I have never before made an exhumation so long—five years—after burial, or met with so well-preserved an exhumed body."

The abdominal walls were firm and dry, showing usual lines indicative of previous pregnancy. The muscles were firm, dry, and of a fresh colour. All the tissues cut like leather. Scalp was dry and firm; cerebral meninges, normal; brain weighed 19 ounces, and was shrunken, there being no hæmorrhage into its substance or into the meninges.

The lungs and pleuræ were normal. (The death certificate stated the cause of death to be "Phthisis.") Pericardium was normal, the sac being empty; heart weighed 8 ounces, and was normal, excepting a little atheroma of ascending aorta. Stomach weighed a little over 2 ounces, its walls being thin and of a pink colour when viewed externally, with a white phosphatic deposit on its outer surface; internally, at cardiac end, the mucous membrane was of a cinnabar-red hue, and also at pyloric end, where there was, besides, a large patch of tarry black blood overlying the surface of the cinnabar-red mucous membrane; there were some old cicatrisations near the pylorus; the small intestines were distended with gas, but were unruptured; they were pink in colour externally, and the mucous membrane showed the cinnabar-red colour in their whole length, but not of uniform depth of tint; the lower end of ileum was covered with orange-yellow mucus; there were old adhesions about the appendix, but no signs of mischief internally; there were no ulcerations; the large intestine showed in the ascending and transverse colon portions

covered with orange-coloured mucus, but there were no ulcerations; the rectum was normal, and contained a little soft, brown fæcal matter. The other organs were normal in appearance. "Generally, the body was that of a woman showing no signs of fatal disease, except acute gastro-enteritis, with an effusion of blood into stomach, but whether ante-mortem or post-mortem could not be determined."

Analysis.—Antimony was found in all the viscera examined, and, estimated as tartarated antimony, was found as follows:—

Stomach	=	0·08
Intestines	=	1·15
Liver	=	2·42
Kidneys	=	0·18
Total		3·83 grains.

The following references regarding this case may be consulted:—*B. M. J.*, vol. ii., 1904, p. 752; *ibid.* vol. i., 1903, p. 873.

Fatal Dose.—One drachm, less or more; the amount, however, is indefinite, depending much upon the constitution of the individual. The case in which a fatal issue followed one and a half grains [1] must be held to be so very exceptional that it cannot be reckoned as fixing the minimum fatal dose. Ten grains have killed a boy of five, and a like quantity a girl of three. At the same time, recovery has followed doses of 60,[2] 170,[3] and over 400 grains respectively.[4]

Fatal Period.—Sixty grains produced death in an adult in ten hours [5]; ten grains, in the boy above mentioned, in eight hours, and in the girl, in twelve hours.

Treatment.—The prime indication is to empty the stomach of the poison, by the siphon-tube. If vomiting be not free, and where the tube is not available, aid the emesis by simple emetics, and give strong boiled tea or tannic acid. Where the siphon-tube is used, warm water alone is sufficient for lavage. Sedatives ought to be used when the improvement in the pulse and general condition indicate that the patient is out of immediate danger. Careful liquid diet must be pursued for some time after.

Chemical Analysis.—Should any of the suspected powder be obtained, its characteristic action on being heated on a piece of platinum foil will differentiate it from arsenic, since on being heated, instead of being volatilised like arsenic and leaving no residue, it blackens and leaves a dark residue of charcoal and metallic antimony.

In organic fluids, or solids which have been pounded to pulp, it may be detected by Reinsch's and Marsh's tests.

In the former, a deposit is formed upon the copper foil, the colour of which is determined by the amount of antimony present and the period of boiling; if small in amount, the colour is a violet red or purple; if larger, black and pulverulent. Upon the copper foil being dried and heated in a reduction-tube, the antimony sublimes, and the sublimate on microscopic examination is seen to consist of small amorphous particles, composed of antimonious oxide. If this be dis-

[1] *Bulletin de Thérapeutique*, vol. li.
[2] Dobie, *The Lancet*, vol. i., 1887, p. 773.
[3] *New York Med. Rec.*, vol. xxiv., 1883 (Carpenter).
[4] *West. Jour. of Med. and Surg.*, 1848, p. 23.
[5] *Med. Gaz.*, 1850, May, p. 801.

solved in water acidulated with HCl, and H_2S be added, an orange precipitate of the sulphide will be thrown down.

Marsh's Test.—The SbH_3 burns with a greenish-white flame, and gives a black deposit of metallic antimony on a porcelain plate. It is insoluble in a solution of chlorinated lime, but is freely soluble in NH_4HS, which on evaporation to dryness, leaves an orange-coloured film of the sulphide; it is also soluble in warmed HNO_3, and the solution being evaporated to dryness, and a drop of $AgNO_3$ being added, no colour reaction is produced. If the spirit-flame be applied to the exit-tube, a deposit which consists of metallic antimony takes place at the point of application and on its proximal side. On removal of the tubing with the deposit and the fresh application of heat, sublimation takes place and a white sublimate of the oxide forms on a cool part of the tube. If the SbH_3 gas be passed into a solution of $AgNO_3$, the antimony is thrown down as antimonide of silver (Ag_3Sb), as a black precipitate.

Marsh's test, however, is not so applicable for the detection of antimony as of arsenic, since the antimony is liable to be deposited on the zinc in the generating-flask.

There is another test of the galvanic type which differentiates arsenic from antimony. If a portion of the acidulated suspected liquid be placed in a shallow platinum capsule, and a piece of pure zinc- or tin-foil be placed in contact with the vessel through the medium of the fluid, hydrogen is generated and the antimony is deposited on the platinum vessel. If the supernatant fluid be poured off at the end of the reaction—which may take some hours if the quantity be small—and NH_4HS is added, the deposit will dissolve, and the sulphide of the metal will be formed.

Quantitative Analysis.—If examination is to be made of a solid organ, the organ should be mashed into pulp, and a weighed aliquot portion taken, which should then be beaten into a thin paste with water acidulated with HCl (1 HCl to 5 of water), heated to a moderate heat for some time, stirring constantly, and small portions of finely powdered chlorate of potash added from time to time to break up the organic matter. The mixture should then be allowed to cool, strained through a fine muslin cloth, and the residue well washed with distilled water; and the whole finely filtered, and concentrated, if necessary. After which, a stream of washed H_2S should be passed through the fluid for several hours, then time allowed for the precipitate to settle. The precipitate, after being filtered and washed, is collected in a porcelain-boat, which is placed in a hard glass tube through which dried CO_2 is caused to pass, and is heated until all moisture and accidental sulphur from the H_2S are expelled. Thereafter the precipitate is weighed. One part of the precipitate is equivalent to ·7177 parts in terms of metallic antimony.

Medico-Legal Trials for Poisoning by Antimony

1. Dr Pritchard—tried at the High Court of Justiciary at Edinburgh, July, 1865.
   Chronic poisoning of wife by antimony, and of mother-in-law by antimony and aconite, administered in food.
   Antimony was found in the exhumed bodies of both.

Fatal Mercurial Poisoning from Uterine Douching.—ARTHUR J. HALL, M.D., F.R.C.P. (*Lancet*, June 1, p. 1467).—A healthy woman, the mother of two children, had a normal labour. Ten days later the lochial discharge was slightly offensive, and the nurse was given tablets of corrosive sublimate to use as a vaginal douche in the usual strength—1 tablet to the pint. Next day these were repeated, and on the following day the medical attendant gave a uterine douche. On the following day the patient complained of slight soreness of the gums, chiefly on the left side, but this was thought to be toothache, and there was no noticeable salivation. On the following day acute diarrhœa set in with slimy motions. This was followed by a rigor, and another intra-uterine douche of perchloride was given. More diarrhœa followed, consisting chiefly of blood and mucus. A gynæcologist was called in, who found no evidence of uterine disease, and diagnosed mercurial intoxication. At 3 a.m. on the following day the patient was unable to pass urine, and on catheterisation none was found. She was taken to hospital.

The spleen could be felt just below the costal edge, and there was definite tenderness over the sigmoid. The gums were slightly congested at the edges, but not tender, and there was no salivation. The tongue was dry in the centre, not coated. Pulse 108, full volume, normal tension, regular; temperature 98·6°. Diagnosis: Corrosive sublimate poisoning; anuria; acute colitis. Hot-air baths, dry cupping to the loins, hot saline rectal irrigations, etc., were used to promote free action of the skin, and if possible of the kidneys; but for the next 3 days no urine was excreted. The bloody stools continued until the third day in hospital, after which there were loose motions containing occult blood but no visible melæna.

2. Dr Smethurst—tried at Central Criminal Court, July and August 1859. *Vide* Stephens' "History of the Criminal Law of England," vol. iii., p. 438 ; and Sessions Papers, Central Criminal Court, 1859.
   Death of wife.
3. Thomas Winslow—tried at Northern Circuit, Liverpool, Aug. 20, 1860.
   Victim suffered from disease of cæcum.
   Antimony found in vomit, urine, fæces, and in internal organs of deceased.
4. Bravo case—Inquests on body of Mr Bravo, 1876. Verdict of Jury—Death from Tartar Emetic ; Wilful murder by person or persons unknown.
5. McMullen—tried at Liverpool Summer Assizes, 1856.
   Chronic Poisoning. Small doses of tartrate administered at intervals of four months.
   Poison found in liver, spleen, kidney, urine, and fæces.
6. Freeman—tried at Drogheda Spring Assizes, 1857.
7. Hardman—tried at Lancaster Summer Assizes, 1857.
8. Klosowski or Chapman—tried in London, 1903.

For an account of Nos. 5, 6, 7, see "Guy's Hosp. Reports," Oct. 1857.

Mercury

Mercury was at one time freely used in the trade of mirror-silvering, but its use has been largely supplanted by other processes. It is still used, however, by furriers and philosophical instrument makers. In the metallic state, when taken into the system, it is comparatively innocuous. Its salts are largely used in medicine for internal and external treatment, and mercuric chloride has come into wide use as a germicide or disinfectant in the public health service. The principal poisonous salt which is encountered by the medical jurist is mercuric chloride or corrosive sublimate, although poisoning has resulted from other salts.

Corrosive sublimate may be found in heavy crystalline masses, or as colourless, transparent, rhombic prismatic crystals. It has an acrid, styptic, metallic taste, and one part of it is soluble in about fourteen parts of water at the ordinary temperature. It is soluble in alcohol in the proportion of one in three, and more freely in ordinary ether —to the extent of one-third of its weight. It is but sparingly soluble in chloroform. The other salts which are poisonous are mercuric oxide or red precipitate, ammonio-mercuric chloride or white precipitate, mercuric potassium iodide, and mercuric nitrate.[1]

Kennedy [2] records a case of attempted suicide by a woman who took about two drachms of red precipitate, but who recovered. Her symptoms were : burning pain in stomach, vomiting, with hæmatemesis the next day, and bloody stools. Doubtless her life was saved by the early onset of vomiting.

A girl, aged 17, swallowed one ounce of acetic acid, and an unknown amount of red oxide of mercury which she had added to the acid. Thirty grains of the oxide was supposed to be the amount added. Her symptoms were stertorous breathing, vomiting of frothy fluid but no blood, pain in throat and stomach, and frequent bloody evacuations from the bowel, many times copious, clots being passed. Patient was conscious but much collapsed. There was very slight charring of mouth. There were no convulsions.

She died within 30 hours of taking the poison. A post-mortem examination of the body was made eight hours after death. The gullet was found inflamed and congested, and the stomach intensely so. At the pyloric end was a large

[1] Stevenson, Guy's Hosp. Rep., vol. xix., p. 415.
[2] *B. M. J.*, vol. i., 1884, p. 56.

SPECIMEN EXCERPTS FROM

patch quite black and charred, the mucous membrane being quite destroyed. The duodenum was inflamed in patches, but was not ulcerated. There was no peritonitis.[1]

Sugden reports the following case.[2] A young lady, aged 23, took in a little milk a "headache powder," which had been obtained at a chemist's shop. Immediately afterwards she was seized with severe burning pain in the mouth and throat and with vomiting. Her tongue, tonsils, and buccal mucous membrane were found to be white, and corroded, and tender. Three days later, a hæmorrhagic rash appeared on the skin of the face, accompanied by swelling of face and soreness of eyelids. This rash gradually spread over the body and limbs. She had ulceration and sloughing of the mouth, vomiting of blood, and hæmorrhages from the mouth and throat. She died very suddenly from heart failure 23 days after the powder had been taken. The remaining "headache powders" and the vomited matter were analysed, and the former were found to contain acetanilid, caffeine, and corrosive sublimate, the largest amount of the last-named ingredient in any single powder being 2·67 grains. Post-mortem examination showed considerable recent corrosion of lips, nose, tongue, buccal mucous membrane, with extensive sloughing in places, which extended to upper and lower parts of gullet. The stomach was intensely congested around the cardiac orifice, being of a bright red colour, the mucous membrane being swollen and softened and exhibiting numerous ecchymoses. The small intestines showed in places intense injection, and in the cæcum the mucous membrane was of a dark-brown colour, with indications of hæmorrhage. The lungs were engorged. Scattered throughout both lungs were numerous thromboses varying in size from a point to a shilling. The liver and kidneys were enlarged and fatty.

Mercuric potassium iodide has also given rise to toxic effects.

Davies [3] narrates the case of a young man who swallowed with suicidal intent 24 or 25 soloids, each of which contained one grain of this salt. Vomiting quickly ensued, which was encouraged. After treatment by emetics, oils, white of egg, etc., he got well, there being no after salivation observable.

Thorne Thorne [4] relates a personal experience. Suffering from sore throat, he was given by mistake a soloid of the drug to suck. The soloid contained $8\frac{3}{4}$ grains. Although he kept it in his mouth for only a few seconds, within a quarter of an hour afterwards he was seized with pain in the upper abdomen, profuse salivation, and constant vomiting, which continued for about an hour.

Poisoning may also arise from absorption of mercurial preparations applied to the skin.

Mitchell [5] gives an account of a man, aged 36, who, suffering from *pediculosis corporis*, rubbed vigorously into his skin two ounces of mercurial ointment, and next day repeated the dose. Within 24 hours he had violent intestinal pains, followed by vomiting, which continued for some days. Within five weeks thereafter he lost about fifty pounds in weight. Ten weeks afterwards he discovered numbness in his hands and feet, which was followed by violent pains in forearms and lower limbs of a shooting, stabbing, and lightning-like character. He had no stomatitis. Later he had complete paralysis of hands and feet, with wrist-drop and foot-drop. After treatment in hospital, he recovered completely, except for a slight weakness in anterior tibial muscles. He developed pigmentation of skin of forehead of a brownish colour, and, his complexion being fair, it was very conspicuous.

Holloway [6] has recorded the case of a dispenser, aged 29, who dissolved 60 grains or more of corrosive sublimate in about 5 ounces of water intending to

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[1] *B. M. J.*, vol. i., 1896, p. 19.
[2] *Ibid.* vol. i., 1905, p. 767.
[3] *Ibid.* vol. ii., 1907, p. 1775.
[4] *Ibid.* vol. i., 1908, p. 20.
[5] *Jour. of. Nerv. and Ment. Dis.*, Aug. 1899.
[6] *B. M. J.*, vol. ii., 1903, p. 1212.

make a bath for an eruption which he thought to be scabies. Instead, however, he sponged his body with the above solution. Half-an-hour later, his penis and scrotum became red and much swollen, and a papular rash had appeared on skin of groin and abdomen. He suffered from severe pain, was twitching very much, and was jerky in his speech. He complained of burning of lips, throat, and stomach. Four hours later, he retched violently but with little result, and he was seized with a severe general clonic spasm which lasted about twenty seconds. It recurred about every ten minutes, and twice marked opisthotonos was observed. During these spasms there was absolute general rigidity and complete inability to breathe, on one occasion this inability to breathe lasting 90 seconds. He recovered under treatment.

Acute Poisoning—Symptoms.—The symptoms come on almost immediately, or soon after the poison is swallowed. A metallic, acrid taste is perceived in the mouth, with a sense of constriction or suffocation in the throat, accompanied by burning heat, which extends down the gullet to the stomach; violent pain is experienced in the region of the stomach, which is increased by pressure, followed by nausea and constant vomiting. The vomit consists of bloody, tenacious mucus, after the ordinary stomach contents have been evacuated. There is profuse diarrhœa, with severe tenesmus, the stools being composed latterly of bloody mucus. The face is pale, anxious, and at times somewhat swollen; it may be flushed at first however. The pulse becomes small, feeble, and irregular, the skin cold and clammy, respiration difficult, and syncope, convulsions, or general insensibility generally precedes death. The urinary secretion is either entirely suppressed or scanty in amount, and is albuminous and bloody. Klemperer has recorded the results of an investigation respecting the condition of the kidneys of rabbits which were poisoned by corrosive sublimate. He found that the mercury was eliminated by the intestines and kidneys. In acute cases, the dose of the poison being large and death rapid, the kidneys were found to be considerably congested. If life was prolonged from 5 to 10 hours, hæmorrhages were discovered in the kidneys, chiefly in the parenchyma, with cloudy swelling of the epithelium.[1] .

Post-Mortem Appearances.—The tongue is white and sodden-looking, and the mouth generally has a whitish aspect. The mucous membrane of throat, gullet, and stomach is, as a rule, more attacked than that of mouth, is of a whitish or bluish-grey colour, and is inflamed or ulcerated in parts. In the stomach, especially, there is more or less general evidence of inflammation, there may be considerable extravasation of blood, and the muscular coats are often so softened that it is difficult to remove the organ without rupturing them. The inner lining of the intestines more or less shares in the inflammatory condition, and the cæcum, colon, and rectum may be the seat of violent inflammatory action. Perforation of the stomach has been recorded in one case, but is rarely found.

Chronic Poisoning—Symptoms.—Notification of cases of industrial poisoning must be made under section xxix. of the Factory and Workshop Act, 1895, and since May 1899 is compulsory on practitioners. The principal occupations in which mercury is used are philosophical instrument makers and furriers. Of about 300 workers in these occupations, 10 exhibited symptoms of mercurial poisoning. In these, the

[1] *Centralb. f. klin. Med.*, No. 29, 1890.

main symptoms were: increasing anæmia, gastric disturbance, salivation, inflammation and tenderness of gums, and tremor affecting chiefly muscles of face, hands, and arms. Some measure of paralysis may also be present. In the occupation of furrier, in which the worker is exposed to the fumes of mercuric nitrate, the teeth become blackened and loosened, and the gums recede from the teeth. In the occupation of hat-making, particularly in the operation known in the trade as "carrotting," during which the skins are brushed or sprinkled with a solution of nitrate of mercury, chronic poisoning is also not unknown. The symptoms are those described. In December 1900, a circular was issued from the Factory Department of the Home Office, suggesting preventive measures, such as (1) better ventilation of workshops, (2) periodic medical inspection of workers, (3) provision of means of ablution by workers, etc.[1] Where the poison is administered internally in repeated doses, the symptoms are usually somewhat more severe. The patient suffers from colicky abdominal pains, nausea, vomiting, and general depression. The gums are swollen and may slough in patches, salivation is present, the teeth become loosened, and the salivary glands are swollen. A blue line is seen at the junction of teeth and gums, and there is often much fœtor from the mouth. The patient becomes emaciated, may spit blood, may be seized with a cough, has general muscular tremor, becomes paralysed in the limbs, and dies of exhaustion. Before death the patient may be subject to mental disturbance accompanied by hallucinations. There may be skin symptoms.

Fatal Dose.—Three grains have killed a child,[2] and a similar dose, an adult.[3] This amount may be reckoned, therefore, as the minimum fatal dose. Recovery has, however, succeeded much larger doses; after 19 grains;[4] after 30 grains;[5] after 9½ grains;[6] and after still larger doses, and of the red oxide, 30 grains.

Fatal Period.—Probably the shortest recorded is half-an-hour;[7] the next is *two* hours;[8] the time, however, is variable, extending usually into days.

Treatment.—If vomiting be present encourage it; if absent, promote it by the handiest emetic, or wash out the stomach with the siphon-tube, using care in its introduction. Magnesium carbonate may be mixed with the ingoing water. Albumen, in the form of raw white of egg, should be passed in last, and ought to be allowed to remain as long as it will in the stomach. Afterwards, treatment must be followed as symptoms indicate.

Chemical Analysis.—If a portion of the crystalline substance be heated on platinum foil, it first melts, and is then dissipated in the form of a white vapour, leaving no residue. If a portion be heated in a reduction-tube, the same phenomenon is observed, and the sublimate formed by the vapour will be seen on microscopic examination to consist of minute globules of mercury.

In organic substances, such as the contents of stomach, vomited matter, or pulped organ, it may be detected by Reinsch's test. The

[1] *B. M. J.*, vol. i., 1902, p. 377.
[2] *The Lancet*, 1845, p. 297.
[3] *Med. Gaz.*, vol. xxxv., p. 778.
[4] Guy's Hosp. Rep., 1850, p. 213.
[5] *Med. Gaz.*, vol. xxxi., p. 942.
[6] *B. M. J.*, vol. i., 1900, p. 709.
[7] Taylor's "Poisons," p. 462.
[8] *Med. Gaz.*, vol. xxxi., p. 557.

deposit on the copper foil has a distinct silvery appearance. On heating the foil in a reduction-tube, sublimation takes place as described. The sublimate may be dissolved with HNO_3, and the following liquid tests applied—viz.

1. A drop of a solution of KI gives a bright scarlet precipitate.
2. A drop of KHO gives a reddish-yellow or yellow precipitate.
3. H_2S gives a brown or black precipitate, which is insoluble in alkalies or dilute acids.
4. A solution of stannous chloride gives latterly a black precipitate of metallic globules of mercury.
5. If a bright steel needle or knife be immersed in the solution, the mercury will be deposited upon the needle or knife, as a silvery mirror.

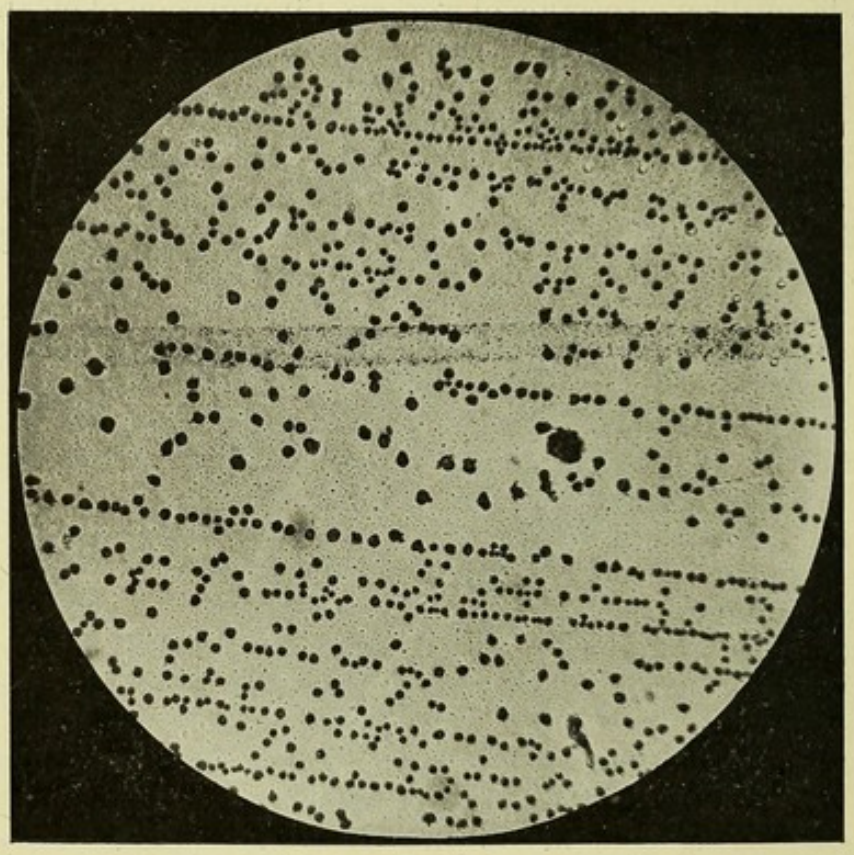

Fig. 124.—Photo-micrograph of Globules of Mercury obtained by sublimation. × 50 diameters. (Author.)

Quantitative Estimation.—This may be done either by the wet or dry method. The first consists in taking a weighed aliquot part of the substance which, by the preliminary test, is known to contain mercury, adding one-fourth of its weight of HCl, and rubbing the whole into a thin paste with addition of water. The whole is now heated and kept at nearly boiling point, pinches of powdered chlorate of potash being added from time to time. The heating is continued until the mass is converted into a homogeneous liquid, and until the odour of chlorine has disappeared. It is then allowed to cool, is filtered, and any remaining residue is well washed with water. The filtrate is concentrated by evaporation, a slow stream of washed H_2S gas is then passed through it for some hours, after which it is allowed to cool, and the precipitate allowed to settle. The precipitate is filtered, dried, and weighed.

Each part by weight of the sulphide corresponds to 1·1681 parts of anhydrous corrosive sublimate. The second, or dry method, consists in the adaptation of the principle of electrolysis. The clear liquid as above prepared is taken, a weighed piece of gold foil is introduced into a platinum vessel with the liquid, and the mercury is deposited upon the piece of gold foil. As one piece is covered, a second is substituted, if required. Thereafter, the foil, being washed in water, alcohol, and ether respectively, is dried and weighed, is then put into a piece of hard glass tubing, and the mercury driven off by heat. The foil, after having cooled, is again weighed; and from the figures so obtained, the total mercury, as metallic mercury, or as corrosive sublimate, may be calculated by difference.

Medico-Legal Trials for Poisoning by Mercury

1. Walsh—tried at Kilkenny Summer Assizes, 1850.
   Poison administered in whisky.
2. Welch—tried at Worcester Summer Assizes, 1845 (*Med. Gaz.*, vol. xxxvi., p. 608).
   Poison applied externally—corrosive sublimate.
3. Robertshaw—tried at Carlisle Lent Assizes, 1845.
4. Daniel—tried at Exeter Lent Assizes, 1855.
   Poison—ammonio-chloride of mercury.
5. E. Smith—tried at Leicester Summer Assizes, 1857.
   Poison—nitrate of mercury.
6. Moore—Lewes Lent Assizes, 1860.
   Poison—white precipitate.
7. Black and Pearson—Armagh Assizes, March 1905.
   Metallic mercury and strychnine.

At the Armagh Assizes, March 9, 1905, Agnes Black and Sarah Anne Pearson were tried for the murder by poison of Alice Pearson, who was the mother-in-law of the one, and the mother of the other accused. Analysis of the viscera of the deceased showed the presence of over 286 grains of metallic mercury and ¼th grain of strychnine in the stomach. It was proved in evidence that the first-named accused had purchased metallic mercury and 10 grains of strychnine, the latter two days before the death of deceased, which was due to strychnine poisoning. The accused were found guilty and were sentenced to death.

Lead

The principal salts of lead which produce toxic effects are the acetate (in powder or in solution), the oxide, in the form of diachylon, the carbonate or white lead, the tetroxide or red lead, and yellow chrome or chromate of lead. The chloride and nitrate, not being easily procured by the public, do not bulk so largely in medico-legal work. All lead salts are less irritant in action than those of arsenic, etc., already considered, but the acetate and chromate are more irritant than the others. Poisoning by lead in the chronic form is very common in those industries in which lead is used or handled in one form or another; as in lead-grinding works, potteries, paint manufactories, diamond-cutting, japanning and lacquer works; dye works in which lead chromate is used, coach-making, tinning and enamelling works, plumbing, file making, and in electric accumulator works. Cases of lead poisoning

may occur in ways quite unexpected. A case is recorded [1] where a habitual beer-drinker developed the chronic symptoms. It appeared, on inquiry, that he got his liquor regularly on draught from a certain beer-shop, that the beer was pumped from the cellar to the bar by lead pipes of twenty feet in length, and, on examination of the pipes, that they were found much worn. Samples of beer drawn from this tap gave unmistakable evidence of lead.[2] Symptoms of acute poisoning have also been observed after drinking home-made wines ; [3] in one case from red-currant wine, and in another from cherry wine. In the former, the wine was made in a large earthenware pan, highly glazed inside. The wine was proved on analysis to contain "considerable quantities of lead." Both husband and wife exhibited acute symptoms, and the wife, who was then pregnant, aborted. Under the same reference are recorded two other cases of acute poisoning in a husband and wife, due to the use of cherry wine which had been prepared in a similar way as above. This wine was found to contain, per pint, 20 grains of lead, in terms of the sulphate. Stokes records lead poisoning from ginger beer.[4] Four cases have also arisen from drinking botanic herb beer.[5] Cadman [6] records the poisoning of an infant from the use on the nipples of the mother of metallic nipple shields. The infant was attacked with colic and vomiting of curdled milk. It was very ill, the face assuming a peculiar grey colour. The metallic shield was placed on the nipple of the mother during the intervals of suckling, and removed when the child was being put to the breast. It was mainly composed of lead. A napkin of the infant, saturated with its urine, was analysed, and was found to contain traces of lead. On disuse of the shield and by appropriate treatment, the child recovered. Zinn [7] reports a case of acute poisoning in a woman who had taken, by mistake for carbonate of soda, a powder containing 15 grammes of lead oxide and 5 grammes of barium sulphate. She recovered, but, being pregnant, she aborted a month later. Porritt [8] shows the pathological affinities of lead and alcohol. We have seen two cases in domestic life, in which the cause was a cracked frying-pan, the cracks in which had been soldered with lead, which had been partly dissolved by the fat of ham. The use of diachylon as an abortifacient [9] being now comparatively common, it may be necsssary to examine excretions or the bodily organs for lead, where death results. Cattle may be poisoned by lead where a preparation of lead is used as a paint pigment on fences surrounding their pasture grounds. In 1902 we investigated an unusual outbreak of illness and death in cattle which were grazing in a field close to a mansion house. The symptoms pointed to gastric disturbance. The fences had been newly painted, and suspicion pointed to these, as cattle are liable to lick surfaces. We sub-

[1] *B. M. J.*, vol. ii., 1900, p. 1313.
[2] *The Lancet*, vol. ii., 1889, p. 126. (Beer poisoning in Liège from same cause.)
[3] *Lancet*, vol. i., 1889, p. 728.
[4] *Ibid.* vol. ii., 1900, p. 1342.
[5] *Ibid.* vol. ii., 1890, p. 644.
[6] *Ibid.* vol. ii., 1902, p. 1458.
[7] *Berl. klin. Woch.*, 1899, No. 50 ; *B. M. J.*, vol i., 1900, s. p. 9.
[8] *Lancet*, vol. i., 1889, p. 164.
[9] *B. M. J.*, vol. ii., 1901, p. 72. (For other references see Criminal Abortion, p. 400.)

Table showing the Differences between Arsenic, Antimony, and Mercury in respect of Deposits on Copper Foil in Reinsch's Test, and of Deposits on Porcelain between the two former in Marsh's Test

	Copper-Foil Deposit.	Character of Sublimate.	Porcelain Deposit.	Reaction with Chlorinated Lime.	Reaction with NH_4Hs.
Arsenic . . .	Steel-grey with metallic lustre.	Octohedral crystals of As_2O_3.	Three concentrated rings: (1) whitish; (2) brownish; (3) black, metallic; from without inwards.	Dissolves easily.	Dissolves sparingly.
Antimony . .	Violet-red, violet, or black.	Amorphous particles of antimonious oxide.	Black, and sooty in appearance.	Does not dissolve.	Freely soluble.
Mercury . .	Silvery, and metallic in lustre.	Tiny globules of metallic mercury.	..	..	..

Table showing Differences between Crystalline Forms of, and the Effect of Heat upon, Arsenious Acid, Tartar Emetic, and Corrosive Sublimate

	Crystalline Form.	Effect of Heating on Platinum Foil.
Arsenious Acid	Octohedral or tetrahedral crystals.	Sublimes in white vapour, without residue.
Tartar Emetic	Rhombic octohedral crystals.	Becomes charred; leaves a black residue.
Corrosive Sublimate . . .	Rhombic prisms.	Melts; sublimes in white vapour; no residue.

mitted to analysis (*a*) a portion of intestine, (*b*) a portion of lung, and (*c*) a portion of liver of one of the animals, and (*d*) a portion of the stomach contents of a second animal. Lead was found both in (*d*) and (*c*), which indicated that the lead had entered the bodies of the animals with their food.

Symptoms of Acute Poisoning.—Lead acetate and other lead salts in large doses produce an astringent metallic taste in the mouth, a burning, pricking sensation in the throat and gullet, and a like sensation in the stomach with pain, succeeded, after an interval, by nausea and vomiting, the vomited matter being latterly streaked with blood. Diarrhœa may supervene early. There is much dryness of fauces and great thirst. Colicky pains develop in abdomen, the abdominal walls are tense and contracted, and the pains are relieved by pressure. Instead of looseness of bowels, there may be constipation; if, however, stools are passed, they are black in colour and have a very offensive odour. Symptoms of collapse set in before death. Should, however, the case be protracted, pains in calves of legs and thighs develop, and there are likely to be numbness and paralysis of limbs. Coma or convulsions may, in these cases, precede death.

Symptoms of Chronic Poisoning.—These may be summed up as follow:—colic, which is very intense; general malaise, prostration, and great debility; obstinate constipation; gradual emaciation; appetite lost, or capricious; face sallow; and, in most cases, there is a blue line on the gums. This is not constant, however. Sir W. Gower records a case in which it was absent.[1] The nervous symptoms almost characteristic of this poison are: "wrist-drop"—due to paralysis of extensors and supinators of forearm, accompanied not infrequently by muscular degeneration and wasting. In several cases seen by us in pottery-dippers, the scapular muscles and those of the arms were very much wasted. There may be paralysis of the limbs, or head symptoms in odd cases.

The following figures will indicate the prevalence and extent of industrial lead poisoning. In 1896, of 1050 cases which were reported to the Chief Inspector of Workshops and Factories of poisoning by lead, phosphorus, and arsenic of industrial origin, and of anthrax, 1030 were caused by lead. Of these, 432 occurred from the use of lead in glazes in china and earthenware works, 239 in white lead manufactories, and the remainder in glass workers, metal smelters, tin workers, enamellers, file makers, paint and colour mixers, coachmakers, and others. From industrial lead poisoning in this country, the Home Secretary reported to Parliament in 1903 that in 1899 the total number of cases was 1258, in 1900, 1058, in 1901, 863, and in 1902, 629. In July 1902, the French Government forbade the use of white lead in certain processes of internal decoration, and for three years lead compounds were not to be used in the external painting of buildings, zinc-white to be substituted. An outbreak of lead poisoning occurred in 1906 among yarn workers at Accrington, involving 9 persons.[2]

Cicconardi has suggested a method of diagnosing lead poisoning where the cause of colic—often the main symptom—is obscure—viz.

[1] *B. M. J.*, vol. ii., 1898, p. 1504.
[2] *Ibid.* vol. i., 1906, p. 310.

to paint the skin of the body with a 6 per cent. solution of sodium sulphite. If lead be the cause, the skin assumes a darkened appearance over the painted parts. It is well worthy of trial.

In small doses, and in the form of diachylon, lead is largely used as a means of procuring abortion. (*Vide* p. 400.)

Post-Mortem Appearances.—After acute poisoning, the appearances are mainly those of gastro-enteritis. The mucous membrane of stomach may be softened, and there may be eroded patches. In deaths after chronic poisoning, the intestines are found contracted and thickened, and cirrhosis of kidneys is commonly present. There is likely to be marked atrophy of muscles of the shoulder, arm, or forearm.

Fatal Dose.—This has not been accurately determined; but Christison has recorded a case in which two drachms of sugar of lead, taken in two separate doses of one drachm each with several hours' interval, produced serious symptoms, but after treatment the man recovered. In another case, recovery followed the taking of one pennyworth of sugar of lead dissolved in hot water.[1]

Fatal Period.—Children of four and six years respectively, who had taken Goulard's Extract, died within 36 hours; and a man, after having taken the same preparation, died at the end of three days.

Treatment.—The indication is to empty the stomach, either by emetics, or preferably by stomach-tube. The ingoing water should be mixed with the sulphates of soda or magnesia, or dilute sulphuric acid, with which the insoluble sulphate will be formed, which can be washed out by lavage. After preliminary danger is over, demulcent drinks and milk should be given, and the treatment regulated otherwise as the symptoms indicate.

Chemical Analysis.—When a piece of the acetate is heated on platinum foil, it first melts, then solidifies, and then becomes darkened in colour, giving off fumes of acetic acid.

The liquid tests applicable to lead in solution are the following:—

1. Dilute H_2SO_4 gives a white P. of the sulphate, which is insoluble in HNO_3, but soluble in HCl, and in excess of liquor potassæ, and in ammonium acetate.
2. A solution of KI, gives a bright yellow P. of the iodide, soluble in liquor potassæ, and in boiling water.
3. H_2S or NH_4HS, gives a black P. of the sulphide.
4. K_2CrO_4 gives a yellow P.

Detection in Organic Mixtures.—Acidulate the organic substances reduced to fine proportions, with nitric acid, heat for some time, then permit to cool; filter, wash residue, and mix washings with filtrate; concentrate filtrate; pass H_2S; place mixture in warm place, to allow precipitate to settle. After which, decant supernatant fluid, collect precipitate on tared filter, thoroughly wash, dry on water-bath, and weigh. One part of sulphide is equivalent to ·9331 part of lead oxide, and 1·5837 parts of acetate of lead.

The electrolytic method is better adapted for the detection of minute quantities of lead, as for example in the urine or fæces, or

[1] *B. M. J.*, vol. i., 1900, p. 1221.

in vomited matter; the urine may be evaporated to a viscous state, the others, finely broken up, are treated in the same way, after HCl is added, the mixture heated, and pinches of powdered chlorate of potash also added, as necessary, to break down organic matter. The heating is continued until the odour of chlorine disappears, after which it is filtered, and the filtrate allowed to cool. The filtrate is then placed in the outer cell of a two-celled arrangement, not unlike a dialyser, the bottom of which is formed of vegetable parchment, the outer cell containing distilled water acidulated with H_2SO_4. Into the inner cell is placed a piece of platinum foil measuring about 50 cm. square of exposed surface, which is connected with the cathode or positive pole of four Grove cells, and into the outer cell is placed a like-sized piece of platinum foil connected with the anode or negative pole. These pieces of foil are so placed in relation to one another that they are only separated by the parchment. The galvanic circuit being now closed for some hours, any lead in the filtrate will be deposited on the platinum foil connected with the cathode in the inner cell. The foil is then removed, carefully washed, and the metallic lead dissolved by dilute nitric acid, aided by heat, after which the solution is concentrated until most of the free acid is driven off, dilute sulphuric acid is added to throw down the sulphate, alcohol being also added to expedite precipitation. The precipitate is allowed to settle for 24 to 36 hours, filtered on a tared filter, washed with water containing 12 per cent. of alcohol, dried, ignited, and weighed. One part of sulphate is equivalent to 0·68319 part of metallic lead, and to 1·25 parts of acetate of lead.

The estimation of the lead, especially if the amount be small, may be more accurately made by the volumetric colorimetric method. The metallic lead deposited on the platinum foil or vessel is dissolved in nitric acid and distilled water added, the whole being placed in a Nessler glass. A few drops of freshly prepared H_2S water, or H_2S gas itself, may be added to or bubbled through the contents of the glass so as to form lead sulphide. The colour formed is now matched in a similar glass, using a standard solution of lead nitrate, and forming the lead sulphide, as before.

Some have advocated the Magnesium Wire Deposition test originally devised by Von Jaksch, and modified by Hill Abram, for the detection of lead in the urine of persons who are suspected to be suffering from chronic lead poisoning. The test is as follows :—A strip of pure magnesium is placed in the fluid to be examined, ammonium oxalate in the proportion of 1 gramme to 150 c.c. of the fluid having been added. If lead be present it will be deposited on the magnesium. The magnesium is now removed from the fluid, is washed with distilled water, and dried. The magnesium strip is then warmed with a crystal of pure iodine placed on it. If a yellow colour appears, it will be due to the iodide of lead, as cadmium is not likely to be present. The yellow deposit may now be dissolved in nitric acid, and confirmatory tests for lead may be used. From experiments which have been made, this yellow deposit will form on a strip immersed in a 1 : 50,000 aqueous solution of lead, and the flat yellow crystals of lead iodide may be recognised. But Jacob and Trotman and others affirm that the test is not applicable to urine because they have found that normal urine gives an identical

result to lead-containing urine. Such a result is most probably due to the organic matter contained in urine.[1]

Copper

All copper salts when taken in large doses exercise toxic effects; even in smaller doses they may be legally considered as "noxious things." Probably the most poisonous are the sulphate or blue vitriol, and the subacetate or verdigris. They are seldom used for criminal purposes because of their striking colour—blue or green. The sulphate, however, has been used to procure abortion. Copper, it must be borne in mind, exists in a variety of objects in nature, even in some which are used as food, but only in very minute quantities. In the metallic form, as when bronze coins are accidentally swallowed, it does not usually exercise any appreciable effect upon the system. Workers in copper are said to suffer occasionally from toxic effects produced by the inhalation of copper dust. A case is recorded [2] in which the death of a boy, aged 13, was attributed to the inhalation of bronze-powder, which consists of an alloy of copper in fine powder. He suffered from sickness, pain in bowels, and great distension of abdomen, but with no diarrhœa. Post-mortem examination revealed that he died from peritonitis, and chemical analysis of the viscera, that they contained copper. The sulphate is used for the purpose of giving an artificial colour to preserved vegetables such as peas and others. From a personal and family use of such preserved peas over continuous lengthy periods, we have not discovered any unusual effect.

From the public health point of view, the question has frequently been tried in courts of law whether peas, so greened, are prejudicial to the health of the consumer, and in contravention of the Foods and Drugs Acts. We have been engaged in three or four cases of this kind, and have made many experiments with respect to the precise combination which copper forms with the substance of the pea, to the digestibility of the product, both *in vitro*, and in our own person and that of others, with respect to prejudice to health. From these experiments, we have arrived at the following conclusions:—first, that the copper unites with the legumin—the vegetable albumin—to form a leguminate of copper, just as it forms with animal albumin an albuminate of the metal; second, that the quantity of copper which can so be taken up by peas to form this combination in no way effects their digestibility in the average person [3]; and, from personal experiment in the eating of such peas for three weeks daily at dinner, that neither could any taste of copper be perceived, nor was any bodily discomfort experienced; further, that the same facts were noted as the result of experiment upon the children of our own family. Tschirch [4] is of opinion that the copper primarily unites with a derivative of chlorophyll of the peas—phyllocyanic acid—to form the phyllocyanate of copper, and, secondarily, should any excess of copper have been added, that it combines with the legumin to form the leguminate. From the difference in judgments by magistrates in different cases, the whole legal question as to the innocuousness or harmfulness of the use of copper within certain limits is very unsettled. In two Glasgow cases, judgment was given for the defenders, and in one of these in which an

[1] *Lancet*, Jan. 16, 1897; *ibid.* vol. ii., 1903, p. 746; *B. M. J.*, vol. i., 1903, p. 403.

[2] *B. M. J.*, vol. ii., 1880, p. 138.

[3] Charteris and Snodgrass, *The Lancet*, vol. i., 1892, p. 190.

[4] *Das Kupfer vom Standpunkte der Gerichlichen Chemie*, 1893.

appeal was taken to the Court of Session, the judgment of the Sheriff was upheld. In a Liverpool case, in which we gave evidence, judgment was also in favour of the defendants. But in many other cases in England judgment has been in favour of plaintiffs.

The Committee appointed by the President of the Local Government Board in July 1899 to Inquire into the Use of Preservatives and Colouring Matters in Food, in their Report recommended that the use of copper salts in the so-called greening of preserved foods should be prohibited. From this finding one of the Committee—Dr Tunnicliffe—dissented, on the ground that copper formed with the substance of the pea a relatively insoluble and unabsorbable compound, and that he could not conceive conditions under which a small quantity of copper so combined in properly preserved peas could be injurious to any consumer to whom the peas themselves would be harmless. These opinions which he gives are founded upon the evidence of witnesses called before the inquiry, and from certain experiments he himself made upon children with peas greened with copper with the object of discovering the extent to which the copper ingested was absorbed and retained by the human body. (*Vide* Report of Committee, p. 312 of Appendix.)

Dauscher reports in a Vienna medical journal [1] a case of poisoning by verdigris in a cook, who, engaged in drawing wine from a cask by means of a brass tube, drank some. In ten minutes afterwards, she was seized with severe pain in stomach and vomiting, and became unconscious, with the signs of shock. Slight icterus appeared the following day. The wine from the brass tube was found on analysis to contain " a considerable quantity " of copper, while that of the cask had none.

Murray has drawn attention to the occurrence of chronic brass poisoning among brass turners, brass polishers and filers, and those occupations associated with fine particulate brass, but not so commonly among brass workers, chain makers, and those working with brass in the mass. Brass is an alloy of copper and zinc in the proportion of about three parts of the former to one of the latter, and Murray acknowledges the difficulty of apportioning the toxic effects produced to the one metal or the other.

The earlier symptoms are (1) gradual anæmia, (2) green line at bases of teeth (not on the gums), which may vary in tint from a faint green through a brilliant green to a dark olive, (3) nausea, vomiting, thirst, and colic, (4) headache, malaise, debility, nervousness, and (5) a waxy-white complexion. The later symptoms consist of emaciation of a progressive character, normal or exaggerated knee-jerks, neuralgic and myalgic pains, chiefly in abdomen, but also in other parts of body, headache, dyspepsia, sometimes sickness and vomiting, with furred tongue, which is also moist and tremulous, complexion sallow, dirty, and unhealthy-looking, marked feelings of oppression or nervousness, sweatings, the perspiration in marked cases being of a green tint and staining undershirt of a green colour, skin eruptions, acneform or eczematous in type, and ataxic peripheral neuritis.[2]

Roberts has recorded the facts of a case in which the symptoms pointed definitely to chronic copper poisoning. The patient, a young man of 20 years, was employed in the brush-grinding department of a brass work. His chief symptoms were : gradual loss of appetite and

[1] See *The Lancet*, vol. i., 1889, p. 1155.

[2] *B. M. J.*, vol. i., 1900, pp. 1334 and 1364; see also Arlidge, "Dis. of Occup.," p. 443.

strength, progressive emaciation, slight jaundice, a green line on gums, colicky abdominal pains, obstinate constipation, attacks of faintness, and marked dyspnœa on slightest exertion. Tremors brought on by the most trifling excitement had been present for some months. Although respirators are provided for the employees, it would seem that they do not use them [1]

Symptoms—If it be assumed that ℥ss of the sulphate or subacetate has been taken, the following are the symptoms which may be looked for :—pain and heat in mouth, gullet, and stomach ; bluish or greenish coloration of mucous membrane of mouth ; vomiting, which exhibits bluish or greenish vomit ; there may be violent diarrhœa with bluish or greenish stools accompanied by colicky abdominal pains ; convulsions and cramps of limbs may sometimes be seen. If the case go on to a fatal issue, death is preceded by convulsions, paralysis, or coma. In chronic poisoning, which is but rarely observed even among workers in the metal or its salts, the main indications are on a parallel with salts of lead. There are evidences of progressive emaciation, gastro-intestinal catarrh—vomiting, gastric irritability, loss of appetite, looseness or constipation of bowels—a coloured line on the gums, and, perhaps, a coloration of the teeth, the colour being bluish, greenish, or purplish. The evidences of implication of the nervous system are also much alike to those from lead poisoning—viz. peripheral neuritis, degeneration, and atrophy of muscles of shoulder, arm, and forearm, with wrist-drop in some cases.

Post-Mortem Appearances.—Perhaps the most striking appearance is the bluish or greenish appearance imparted to the lining wall of stomach. The mucous membrane is swollen, softened, and inflamed, and, it may be, ulcerated in patches. The intestinal mucous membrane shares the same appearances ; and in some few cases, perforation of intestine has been seen. The coloration by bile may be mistaken for that of copper, but on touching the latter with ammonia, the blue colour becomes intensified, or the green is changed to blue.

Fatal Dose.—Half-an-ounce of subacetate [2] and upwards. One ounce of the sulphate in an adult. A child has been killed by twenty grains of the subchloride. Recovery, however, has followed the swallowing of an ounce.[3]

Fatal Period.—Four hours in a child which swallowed an unknown quantity of the sulphate. Twelve hours in the case of a man who took one ounce.

Treatment.—As in lead poisoning : the use of the siphon-tube and free lavage with albuminous and demulcent fluids.

Chemical Analysis.—The greenish or bluish appearance of vomit gives a clue to the poison. The blue colour is quite evident in 500 grains of a solution containing only the $\frac{1}{100}$th part of its weight of copper oxide. The liquid tests for the detection of copper in solution are as follows :—

1. Dilute NH_3 gives a bluish-white ppt. soluble in excess, and leaving a deep blue colour.

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[1] *B. M. J.*, vol. ii., 1909, p. 702.
[2] Taylor, " On Poisons," p. 524.
[3] Stillé, *Mat. Med.*, vol. i., p. 325.

2. H_2S and NH_4HS give a deep chocolate-brown ppt., or, if the quantity of copper be small, a light brown coloration only.
3. Ferrocyanide of potassium gives in very dilute solutions, a claret, or port-wine red ppt. soluble in ammonia to a bluish-green liquid, which distinguishes it from a nearly similar reaction with salts of uranium, which, however, turns yellow on addition of excess of ammonia.
4. If a polished steel needle be put into an acidulated copper solution, the copper is deposited on the needle, as a reddish-yellow deposit of the metal.
5. If the acidulated copper solution be placed in a platinum capsule, and a piece of zinc foil be brought in contact with the capsule through the medium of the fluid, the metallic copper is deposited on the sides of the platinum vessel.

Examination of Contents of Stomach.—Placed in a large porcelain dish, the material is strongly acidulated with HCl, and water added if necessary. The mixture is then heated for some time, and after cooling is filtered ; the filtrate is then concentrated, and H_2S is slowly passed through it for some time. The sulphide is allowed to settle, is then passed through a filter, washed, and then dissolved by dilute HNO_3 with the aid of heat. Sulphuric acid is cautiously added, drop by drop, to throw down the sulphate, which will be recognised by its blue colour. It is then carefully evaporated to dryness. It may then be dissolved in water and the liquid tests used for corroboration.

Quantitative Estimation.—After solution of the organic matter has been obtained, the copper may be thrown down either by H_2S, as the sulphide, or by potassium hydrate solution. In the former case, after filtering the precipitate, it is dissolved in strong HNO_3 ; the solution is evaporated to dryness in a tared platinum capsule, then heated to redness to drive off the nitric acid, leaving cupric oxide in the capsule. One part of cupric oxide is equivalent to 0·7985 part of metallic copper. In the latter case, the ppt. produced by addition of potassium hydrate is filtered on an ash-tared filter, washed with warm water, and dried. The ppt. is detached from the filter into a tared platinum vessel, and strongly ignited. The remains of the ppt. on the filter is burned separately with the filter-paper, and the ash added to the capsule. After cooling in a desiccator, it is quickly weighed as cupric oxide, after deduction of ash of filter used.

Zinc

The toxic effects of zinc are confined to the use of two salts of the metal—viz. the sulphate or white vitriol ($ZnSO_4$, $7H_2O$), the action of which is irritant, and the chloride ($ZnCl_2$, $2H_2O$), which is corrosive and which has been already noticed (p. 589). Zinc fumes, also, exercise toxic action upon persons engaged in such occupations as zinc-smelting. Mackintosh gives an account of a fatal issue in a woman of fifty-three who had taken at least one ounce of the sulphate. Her symptoms were : severe pain in stomach and bowels, pallor of face, coldness of limbs, cold sweats, irregularity of pulse, and purging. She had vomited only about one teaspoonful of fluid. She died about twenty-four hours after taking the poison. The post-mortem symptoms, generally, were those of asphyxia. The gastro-intestinal mucous membrane showed patches of intense inflammation, which was more

marked, however, in the small intestines, these being inflamed throughout. The congestion of the latter was indeed so marked that it was visible through the muscular wall.[1]

Symptoms : From the Sulphate.—These are mainly of gastric disturbance, and consist of violent vomiting, pain in stomach and abdomen, diarrhœa, and, where a considerable quantity has been taken, symptoms of collapse. The sulphate has been taken in mistake for Epsom salts in a dose of one and a half ounces, causing a fatal effect.[2] In this case, the vomiting and diarrhœa were almost incessant for half-an-hour, and continued at intervals for three hours. The pulse was small and frequent, there were great prostration and anxiety, coldness of body, and violent pain in abdomen and limbs. Three old women were given a medicinal mixture intended to contain magnesium sulphate but for which zinc sulphate had been substituted by mistake. They suffered from severe vomiting, but they recovered.[3]

From the Chloride.—The symptoms are of a somewhat different kind, because of the corrosive character of this salt. They are : an immediate burning sensation in mouth, throat, gullet, and stomach; violent and, perhaps, bloody vomiting; diarrhœa, and symptoms of shock.

The symptoms of chronic poisoning are closely allied to those of lead and copper.

Gimlette [4] has recorded the facts of an epidemic of zinc poisoning through drinking contaminated water, among Sikh and Pathan soldiers in the Malay Peninsula. The water-supply was obtained from the rainfall which was collected from the galvanised iron roofs of the barracks by means of zinc gutters, and was stored in a galvanised iron tank. There was no provision for separating the first part of the rainfall from the succeeding. From March 1898 till April 1900, in all 329 men and women were affected. The chief symptoms were dysenteric in character—viz. diarrhœa, colic, sometimes vomiting and violent retching, the vomited matter sometimes streaked with blood, stools containing ropy mucus and blood, loss of flesh, dyspepsia, anæmia, and in certain cases atrophy of muscles of calves and thumbs. The gastro-intestinal symptoms, however, predominated over the nervous. When suspicion centred upon the water as the cause, it was analysed, and was found to contain zinc. The water collected directly from the galvanised iron roof contained 1·115 parts per 100,000 and that taken from the tank, ·482 parts. This is accounted for by the fact, that in the former, the zinc was present in the form of carbonate formed by the CO_2 in the rain-water, but that on standing in the tank the CO_2 being partially liberated, the zinc was thrown out of solution as the oxide. A like outbreak occurred at Cwmfelin, near Llanelly, some years ago,[5] and the quantity of zinc found in the water there was over fifteen times greater than that found in the tank in the foregoing case. Other cases are to be found recorded in the following references.[6]

At an inquest held in New Zealand in 1907, on the cause of death of a lady who had been ailing from Dec. 19 till her death on Jan. 23, the jury returned a verdict that death was due to zinc poisoning due to drinking water from a tank which collected the water from a zinc-iron roof. The Government analyst testified to finding zinc in the body of deceased, and on the assumption that

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[1] *B. M. J.*, vol. ii., 1900, p. 1706.
[2] *Brit. and For. Med. Chir. Rev.*, April 1849.
[3] *Lancet*, vol. ii., 1889, p. 864.
[4] *B. M. J.*, vol. ii., 1901, p. 615.
[5] *The Lancet*, vol. ii., July 29, 1893.
[6] *Ibid.* vol. ii., 1897, p. 157 ; *ibid.* vol. ii., 1896, p. 766.

deceased weighed twelve stones, that the amount of zinc in her body would amount to 16·4 grains of metallic zinc. He had also analysed the water from the tank and found it to contain an unusually large amount of that metal.[1]

Post-Mortem Appearances.—In the case where the large dose of sulphate caused death, the appearances were as follow :—the inner surface of stomach was covered with yellowish, viscid material, below which the wall of the organ was ochrous yellow in colour, the mucous membrane being softened into a gelatinous condition. In other cases, patches of ecchymosis and erosion have been discovered. The small intestine shared the same appearances. From the chloride, signs of corrosion are present. In a case where death resulted from Burnett's fluid, the mucous membrane of mouth, throat, and gullet was found white and opaque, the stomach was hard and leathery, and contained a fluid not unlike a mixture of curds and whey. In another case,[2] the stomach was quite destroyed, its cavity resembling the interior of a chronic abscess.

Fatal Dose.—One and a half ounces of sulphate. One ounce of Burnett's fluid killed a woman. Recoveries from the former, however, are more common than deaths.

Fatal Period.—Thirteen and a half hours from foregoing dose of sulphate. Four hours in above case from one ounce of Burnett's fluid.

Treatment : As for Lead.—Where the chloride has been taken, an alkaline carbonate may be used with benefit.

Chemical Analysis—Liquid Tests.—(1) H_2S in neutral and alkaline solutions throws down a white ppt. of the sulphide, soluble in the mineral acids.

(2) Ferrocyanide of potassium gives a white ppt. insoluble in mineral acids.

(3) Ferricyanide of potassium gives a yellow, reddish-brown, or greenish ppt. soluble in potash and ammonia.

Quantitative Estimation.—Heat solution to about 180° F. ; add dilute solution of sodium carbonate until ppt. no longer forms ; then boil for a few minutes ; allow ppt. to settle ; filter ; wash with hot water ; dry ; ignite. The zinc now exists as oxide. One part of zinc oxide is equivalent to 0·8026 part of metallic zinc.

Tin

The main danger of poisoning by this metal arises from " canned " goods, particularly those which contain acid fruit juices, or, occasionally, from " loaded " fabrics. Jolles gives the facts of a case in a woman, in whom toxic symptoms apparently arose from the wearing of silk stockings which were " loaded " with tin chloride ($SnCl_4$). It appears that this metal is added to the silk for the purpose of giving it weight, and especially to silk of delicate colours. On analysis of the stockings, tin was found in considerable quantities, and the metal was also detected in the patient's urine. The symptoms were : partial paralysis of legs, accompanied by anæsthesia, coldness, and ataxic gait ; emaciation ; urine contained albumen and tube casts.[3] In like manner lead poisoning may originate. In addition to mineral poisoning from canned

[1] *Wairarapa Age*, Ap. 13, 1907.
[2] *Brit. Med. Jour.*, vol. i., 1887, p. 1387.
[3] *Wien. med. Presse*, Mar. 17, 1901.

goods, cases of ptomaine poisoning are by no means uncommon, so that no one is justified in diagnosing mineral poisoning because of irritant symptoms developing in those who have consumed such foods, not, indeed, until mineral poison has been found in such amount as to justify the conclusion that this alone was the cause of the mischief. In the few cases which have been recorded, tin salts were found in the fluids of the " canned " fruit.[1] In one case 1·9 grains of stannic oxide per ounce of cherry juice were found, and in another, the juice of pears contained a larger amount.

Symptoms.—These are mainly indicative of irritant poisoning, and, relatively to the amount of tin found, are very severe ; in other words, tin is more toxic than lead, copper, or zinc, for equal amounts.

The *Treatment* is the same as for lead or other irritant poison.

Chemical Analysis.—The contents of the stomach, or of a " can " of fruit having to be examined, the organic matter, having been reduced to a thin pulp, is treated by hydrochloric acid, is heated, and powdered potassium chlorate added to it in pinches as required until the fluid becomes homogeneous. H_2S gas is then passed through it, and the sulphide precipitated ; the ppt. is allowed to settle and cool, is thereafter filtered through an ashed filter, washed, and dried, and then scraped into a platinum vessel in which it is ignited strongly to convert the sulphide into the oxide. The filter-paper is ignited separately, and the ash added to the platinum capsule. After cooling, the capsule and contents are weighed, and, after the necessary deduction for the ash of filter-paper, the weight represents the amount of tin in the weighed quantity of organic substance treated. One part of the oxide is equivalent to 0·7838 part of metallic tin.

In testing liquid solutions, the following tests may be used :—

1. H_2S gives with stannous salts a dark brown, and with stannic salts a yellow, ppt. or coloration.
2. Mercuric chloride and dilute HCl give with stannous chloride, first, a white precipitate of mercurous chloride, which turns grey, and later, black, owing to the ppt. becoming changed into metallic mercury.
3. $AuCl_3$ (gold chloride) gives a beautiful purple ppt. or coloration—the purple of Cassius.

Manganese

Little has been recorded in this country respecting any toxic effects seen in workmen from working with manganese, but it has attracted the attention of foreign observers. Von Jaksch[2] states that powdered manganese oxide sometimes gives rise to nervous symptoms amongst workers. He has seen three cases, in whom the chief symptoms were impulsive laughing, impulsive crying, monotonous scanning speech, and changes in psychical condition, but no disturbance of sensation. The knee-jerks were exaggerated. One of his patients committed suicide. Electrical tests gave normal muscle reactions. In none of the cases

[1] *B. M. J.*, vol. i., 1890, p. 883 ; *The Lancet*, vol. ii., 1888, p. 1129.
[2] *Münch. med. Woch.*, May 14, 1907 ; *B. M. J.*, vol. ii., 1907, s. p. 37.

Herald —— 22 May 1912

POISON INSTEAD OF EPSOM SALTS.

A man named Thomas Carey, who resided at Dovecothall Street, Barrhead, lost his life yesterday through mistaking barium chloride for Epsom salts. Carey was employed in the dye-house at South Arthurlie Print-Works, and in the forenoon he took a dose of what he thought was Epsom salts. Quickly recognising his mistake, the man went to the laboratory, where he was given an emetic. In spite of this, however, he endured terrible agony, the chloride acting as a powerful irritant on the stomach. Medical assistance was procured, and the unfortunate man was taken home, where everything possible was done for him, but without effect. He became unconscious, and died in the afternoon. He was a married man, and leaves a widow and four children.

was manganese found in the urine. He is of opinion that there is room for little doubt that the cause is manganese, because it is only in workers among potassium permanganate and manganese dioxide that the cases have been observed, the intimate cause being, probably, the inhalation of manganese dust.

Boron (Boric or Boracic Acid)

Acute poisoning by boric acid is relatively infrequent, but chronic poisoning following internal administration or as a bladder irrigation is, perhaps, more common.

The following fatal case is, perhaps, rare. At a coroner's inquest held at Yelverton in 1907 relative to the cause of death of a domestic servant, aged 27, who was pregnant, the question put to the jury for a verdict was, whether a powder which she had swallowed had been taken with intent to produce abortion or to end her life. The evidence showed that while out on leave she had fainted, and on her return home at night was looking very ill. Next morning she was still ill, and vomited considerably. After midday she was heard groaning, and on a witness entering her room she was seen to fall on the floor unconscious. She died almost immediately, froth coming from her mouth. Analysis of the stomach contents revealed the presence of boracic acid. She was found to have heart disease. The medical opinion was that death was due to the drug acting on a weak heart.[1] Rinehart [2] and Wood [3] have each recorded two cases. In those by the latter, the symptoms were nausea and vomiting, hiccough, an erythematous skin eruption, fall of temperature, collapse, but the mind remaining clear to the very end. In those by the former, the erythematous rash was also present, accompanied by papules, vesicles developing between the fingers and on back of hands, the other symptoms being as described. We have seen one case in which 5-gr. doses were administered internally for a chronic bladder ailment, in which the patient developed symptoms of weakness out of all proportion to the ailment, and a papular rash over certain parts of the body.

Metallic Salts

There are certain salts of the metals, which, by reason of their producing serious toxic effects, even death itself, after being swallowed in mistake for Epsom and Rochelle salts, deserve some consideration. These are salts of Barium, Nitrate of Potash or Saltpetre, and Potassium Chlorate.

Barium Salts.—The principal salts are the chloride, nitrate, and the carbonate, the first being the most poisonous. These are constituents of certain rat poisons. Taylor [4] quotes a case from Wildberg, where a woman, aged 23, took a dose of about half-an-ounce of the chloride dissolved in warm water. Her *symptoms* were as follow: nausea and

[1] *B. M. J.*, vol. ii., 1907, p. 1695.
[2] *Therap. Gaz.*, Oct. 15, 1901.
[3] *B. M. J.*, vol. ii., 1901, s. p. 91.
[4] *Op. cit.* p. 220.

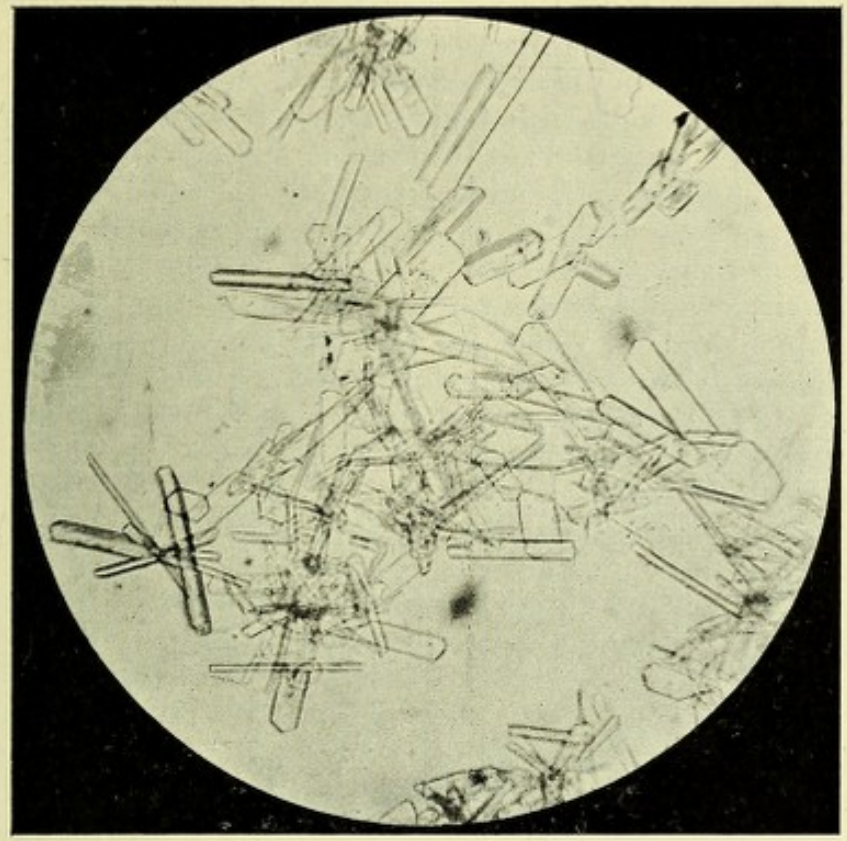

FIG. 125.—Photo-micrograph of crystals of Potassium Nitrate. × 500 diameters. (Author.)

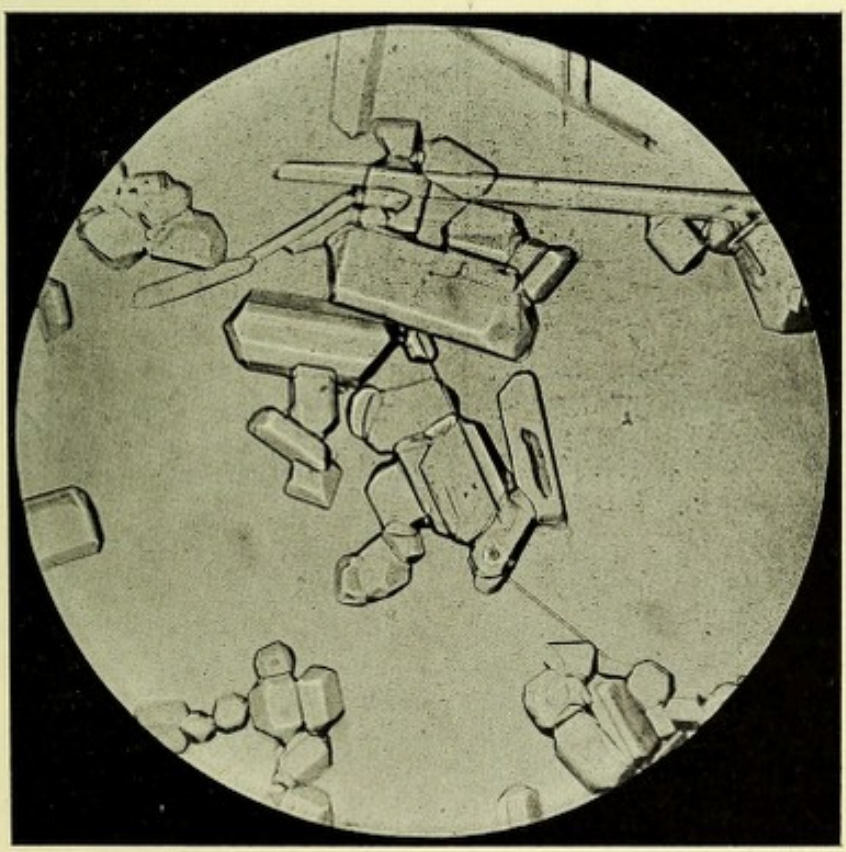

FIG. 126.—Photo-micrograph of crystals of Magnesium Sulphate. × 500 diameters. (Author.)

vomiting, the vomit consisting of a watery mucus; convulsive movements of hands and feet; these symptoms becoming intensified, she died at the end of two hours in violent convulsions. To these symptoms must be added diarrhœa with tenesmus, grave signs of shock, loss of motor power and sensation; the heart is embarrassed in its action, and the breathing laboured and slow. It would thus appear as if this poison acted not only locally, but also, on being absorbed, on the brain and nervous system.

Fatal Dose.—One teaspoonful has destroyed life. A man died who took a mouthful of a solution containing 130 grains of the chloride.[1]

Fatal Period.—From two hours upwards.

The nitrate and carbonate [2] have also caused fatal results, although cases have recovered from the latter salt.

Chemical Analysis—

1. *Flame Test.*—The characteristic green flame reveals barium at once in an organic fluid.
2. Dilute H_2SO_4 gives a white heavy-looking ppt. of the sulphate, which is insoluble in NHO_3.

Quantitative Estimation.—This is based on the insoluble character of the sulphate.

Nitrate of Potash.—This salt has frequently destroyed life. It is found in well-formed prismatic crystals. Taken accidentally, as it usually is, in mistake for Epsom salts, the quantity is generally large.

Wolstenholme records a case in which a man took by mistake for Epsom salts an (avoirdupois) ounce of this salt. He at once experienced great pain in the stomach, became sick, but only began to vomit four hours after taking it. He then vomited freely, however, the vomit containing a quantity of dark "coffee-grounds" material. After the administration of purgatives, he passed tarry stools. For the first four hours he had an intense desire for micturition. He gradually recovered.[3]

Symptoms.—The symptoms which followed the taking of one ounce were as follow:—vomiting, accompanied by severe gastric pain, and diarrhœa with bloody stools; symptoms of collapse; lividity of the face; insensibility; followed by death.

Post-Mortem Appearances.—The mucous lining of stomach is of a bright red, or brownish-red colour; indeed, it has been likened to scarlet cloth. The vessels of the mucous membrane are highly reddened and injected, as if by vermilion. The blood is fluid, and seems hyperoxygenated.

Fatal Dose.—One hundred and twenty grains killed a man of 40 years. This may be said to be exceptional, because it has been administered medicinally in from three to five drachm doses,[4] or in even larger doses, with no toxic results. The usual fatal quantity is about one ounce, although recovery has followed even that quantity.

Fatal Period.—This is usually comparatively short, and varies from two or three to thirty-six hours.

Treatment.—Siphon-tube; free lavage; hypodermic injection of stimulants; warmth to body; and treatment of prominent symptoms.

[1] Stern, *Zeitschrift f. Med. Beamte*, 1896.
[2] *Med. Gaz.*, vol. xiv., p. 448.
[3] *B. M. J.*, vol. i., 1882, p. 304.
[4] *L'Union Médicale*, June 1847, p. 274.

Chemical Analysis.—There is no characteristic chemical test. Perhaps the easiest and best mode of testing is to filter a portion of the contents of the stomach, concentrate one portion, and with it saturate a small piece of bibulous paper, and dry. This, when ignited, burns like touchpaper. Evaporate the other portion nearly to dryness, allow it to crystallise out over sulphuric acid in a desiccator, and examine for the characteristic crystals.

Chlorate of Potassium ($KClO_3$).—This salt is a very lethal poison. In some respects, it might be mistaken for poisoning by arseniuretted hydrogen, or for such diseases as hæmoglobinuric fever. If blood be mixed *in vitro* with this salt, it becomes thicker in consistence like syrup, and the spectrum of oxy-hæmoglobin is changed into that of met-hæmoglobin. When taken into the living body in large doses, the salt produces profound symptoms, which may be summarised as follow :—severe vomiting, pain in stomach and intestines, signs of shock, cyanosis, oliguria, or, it may be, anuria. Should any urine be passed, it is dark like porter, containing in solution the colouring-matter of the blood, renal tube-casts, and albumen. Jaundice, of an unusual hue, is commonly present. It is an open question whether this is hepatogenous or hæmatogenous. The following may be taken as typical cases [1] :—

The first was that of a woman, aged 20, who took by mistake for Rochelle salts two tablespoonfuls of the chlorate. About twenty-four hours thereafter, her symptoms were these: she was profoundly prostrated; her temperature, 99° F., and pulse, 136; respirations, 32 per minute. The body surface was cyanotic, the breathing rapid but not laboured, and the pulse rapid but not feeble. She had vomited freely, and was still vomiting after admission to hospital. Two hours later, the temp. rose to 104° F. Three dark brown motions had been passed, and dark-coloured urine was voided involuntarily. The urine contained many blood-discs, large masses of altered hæmoglobin, and much albumin. Next day, her skin, conjunctivæ, and lips had an extraordinary colour—something between anæmia cyanosed and a sepia-brown chocolate tint. She died in 37 hours after the poison had been taken, having been in a state of stupor till her death. On post-mortem examination, the blood in the large vessels was fluid and of a very dark chocolate colour. The heart was soft and flabby; the lungs normal, but on section very brown in colour. The spleen was large, firm, and of a very distinct chocolate hue; the kidneys large, containing chocolate-coloured blood. The bladder contained three ounces of urine of a dark brown colour. Spectroscopic examination of the blood gave the spectrum of met-hæmoglobin. Microscopic examination of tissues of heart showed extensive fatty degeneration of muscle, and the tubules of kidney filled to distension with broken-down corpuscles and blood-pigment.

The second case was that of a man, aged 53, who took an overdose of this salt. His symptoms were as described above. He died comatose. On post-mortem examination, the appearances were as the foregoing, and, in addition, the gall-bladder was full of thick, very dark green bile. Another fatal result following the taking of 7 drachms is recorded.[2] Jacob [3] has recorded another case where a woman took about 25 grammes (about 385 grains), the symptoms being as described. He points out that this poison destroys the red-blood corpuscles, dissolving the hæmoglobin out of their stroma and liberating it into the liquor sanguinis, as indicated by the reduction in number of red corpuscles per cub. millimetre, and in amount by 20 per cent. of hæmoglobin. Another case indicates its toxic effects upon children. Three of them took altogether between 3 and 4 drachms, and one died.[4]

Another case came under the cognisance of the Scarborough Burgh Coroner

[1] *New York Med. Jour.*, July 21, 1888. [2] *The Lancet*, vol. i., 1879, p. 206.
[3] *Berl. klin. Woch.*, 1897. [4] *The Lancet*, vol. i., 1879, p. 206.

in January 1907. A man, aged 41, had been advised by a friend to take tablets or lozenges of this salt for sore throat. Acting on this advice, he took half-an-ounce of the lozenges on a Thursday morning, repeating the dose in the evening. He was taken seriously ill thereafter, with symptoms resembling caustic poisoning. He died. Each lozenge contained 5 grains, and there were about 80 lozenges to the ounce, so that deceased must have swallowed about 400 grains. The verdict was "death from misadventure." [1]

Fatal Dose.—About 380-390 grains, and upwards.

Fatal Period.—This usually extends into days.

Treatment.—Evacuate contents of stomach by siphon-tube and free lavage. Bleeding from the arm, and transfusion of blood from the body of another.

Chemical Analysis.—The poison may be obtained from organic matter by dialysis.

In addition to these salts of potash, the sulphate and bi-tartrate have caused fatal results in isolated cases.

Pyrogallic Acid ($C_6H_6O_3$)

This substance, which is now so commonly used by reason of the spread of amateur photography, and in the manufacture of hair dyes and marking inks, has very toxic properties, not only when swallowed, but even when it is absorbed through the skin. Some cases of poisoning from both causes have already been recorded. Its toxic action is very serious, since like several other poisons, as arseniuretted hydrogen, chlorate of potash, and others, it has a hæmolytic action, that is, it destroys the red corpuscles, liberating the hæmoglobin of the stroma of the discs into the liquor sanguinis. From this effect follow dyspnœa, insensibility, subnormal bodily temperature, bloody urine, and other symptoms. Poisoning by this acid might reasonably be mistaken for an attack of paroxysmal hæmoglobinuria. Neisser [2] records a case in which toxic symptoms followed the external use of an ointment containing ten per cent. of the acid, in the treatment of psoriasis. Six hours after its application to one half of the body of the patient—who was, but for the skin disease, a healthy strong man—he was seized with violent shivering, vomiting, and intense collapse. He died on the fourth day, his death being preceded by coma, and a very low bodily temperature. During the time he lived, he passed but little urine, which was dark brown in colour, was very thick, contained no blood corpuscles, but a considerable amount of hæmoglobin. On post-mortem examination, the kidneys were of a uniformly bluish-black colour, and the blood of the body generally had a dirty brownish-red tint, and contained *débris* of red discs. Reilly [3] records the facts of a case in which a woman of 32 years swallowed, with suicidal intent, about half-an-ounce of the acid dissolved in water. Her symptoms were these: her face generally was of a dirty-grey colour, except the lips, cheeks, and ears, which were dark blue. Her skin was cold, the heart acting feebly, but she was conscious. She had been vomiting for two hours. Diarrhœa then set in, which was continuous for about

[1] *B. M. J.*, vol. i., 1907, p. 116.
[2] *Annal. d'Hyg. Pub.*, May 1881.
[3] *B. M. J.*, vol. ii., 1897, p. 81.

twelve hours. Her urine consisted principally of blood. Next day intense headache supervened, along with drowsiness. In this condition she continued till the following day, when she became comatose, and died sixty-eight hours after the onset of the first symptoms. Post-mortem examination showed all the internal viscera to be intensely congested, the kidneys of a dark purple colour, the bladder to contain blood, and the stomach and intestines, patches of congestion. Other cases have been recorded by Dalché,[1] Benerji,[2] and others.

Treatment.—Use of a siphon-tube with free lavage of stomach; inhalations of oxygen; stimulants; maintenance of bodily heat; and if these fail, transfusion of live human blood.

Chemical Analysis.—If any of the acid exists in the contents of the stomach, after drying them, it may be extracted by digestion with alcohol; the alcohol is then filtered and evaporated to dryness; the residue is then treated with water and shaken up with ether, which dissolves the acid: on evaporation of the ether, the acid is left behind. To this the following tests may be applied:—(1) On adding lime-water or liq. potassæ, a purple-red colour is produced; (2) with a solution of ferrous sulphate, a bluish-black colour is formed.

[1] *La Semaine Méd.*, 1896.
[2] *The Lancet*, vol. ii., 1892, p. 308.

CHAPTER XIX

NON-METALLIC POISONS

Phosphorus

THERE are two kinds of phosphorus, the crystalline and the amorphous. The former is found in commerce as yellow, translucent, waxy-looking sticks, which are usually kept submerged in water to prevent oxidation. It is but slightly soluble in oil, alcohol, ether, naphtha, and other liquid solvents, but freely soluble in carbon disulphide, and chloroform. When exposed to the atmosphere, it gives off dense white fumes, composed, by union with the oxygen of the air, of phosphoric and phosphorous acids. The amorphous or allotropic form, invented by Schrötter, is made by exposing the ordinary crystalline form to a temperature of 240°–250° F., in its own atmosphere, for a period of 50–60 hours; but if heated to 260° F., it is reconverted into ordinary phosphorus. It is red in colour, quite opaque, and is not soluble in CS_2. It does not give off fumes in the air, nor does it become luminous in the dark as the other form, except when heated to a temperature of 200° F.

Poisoning from Phosphorus is infrequently homicidal—a case was tried, however, at the Bodmin Autumn Assizes, 1857—but it is often taken accidentally and suicidally. It is obtained for suicidal purposes in rat-pastes, and in the heads of lucifer matches. One adult swallowed the heads of six packets of matches. Another, who died, drank the liquid in which fifteen boxes had been steeped.[1] The makers of lucifer matches, exposed to the fumes already mentioned, suffer from necrosis of the jaws and caries of the teeth, the necrosis being most apt to occur at points where the teeth are carious. This affection does not happen so often in the manufacture of "safety matches," since these are made of amorphous phosphorus. Stockman,[2] from experiments made on guinea-pigs, came to the conclusion that the fumes of phosphorus simply weakened the nutrition of bone and periosteum, and thus afforded a *nidus* for the tubercle bacillus, which produced the caries. This view, however, is not accepted by Oliver, one of the members of the Home Office Committee on the Use of Phosphorus in the Manufacture of Lucifer Matches. The Blue Book containing the Reports of this Committee must be studied by those who desire exhaustive information on the whole subject. According to Mr Dearden,[3] *fragilitas ossium* is another effect of exposure to phosphorus fumes. He adduces statements of other observers in this direction, as well as observations of his own.

[1] *The Lancet*, vol. i., 1889, p. 912.
[2] *B. M. J.*, vol. i., 1899, p. 9.
[3] *Ibid.* vol. ii., 1899, p. 270.

Of 1032 cases of poisoning in Hungary in 1887–1897, 297 cases were due to phosphorus in some form. By Act of Parliament which came into operation in the beginning of 1910, the use of yellow phosphorus in the manufacture of matches in this country is forbidden, as is also the importation of matches from abroad so manufactured.

Symptoms.—When phosphorus—say in the form of rat-poison paste—is swallowed in a poisonous dose, pain quickly develops in the stomach, which may, however, not be marked, and is succeeded by vomiting. The person may complain of a garlic taste in the mouth, and a garlic odour may be perceived by an observer in the person's breath. Along with these there is an acrid, burning sensation in throat and gullet, accompanied by great thirst. The vomited matters are usually dark in colour—dark green, coffee-coloured, or quite black—have a garlicky odour, and, if exposed in the dark, become luminous or phosphorescent. If diarrhœa be present—for it is a variable feature in such cases—the fæces are likewise dark and luminous. The main signs of shock develop—the pulse becomes small, irregular, feeble, and, at times, imperceptible, there is cold, clammy skin, anxious, pinched face, and subnormal temperature. Coma or convulsions usually precede death. In most cases, however, the progress is not continuous to a direct fatal termination; there is usually an intermission or lull in the severity of the symptoms, so much so, at times, as to give the impression that the worst is over. But sooner or later—it may be two or more days—a new set of symptoms appear—viz. jaundice, which is a marked and notable appearance; the epigastric pain, not yet gone from the original attack, increases in severity, and the abdomen becomes distended. On examination the liver will be found enlarged, as probably also the spleen. Vomiting returns. Hæmorrhages may set in from the nose, or from other mucous surfaces, or (in addition, or alone) subcutaneous hæmorrhages—purpura—may appear. The urine becomes scanty, strongly acid in reaction, high-coloured, and contains blood, albumin, and bile-colouring matter. The nervous system becomes implicated—sleeplessness, pains in the head, etc., show themselves. Gradually, the patient gets weaker, the pulse becomes weaker, irregular, and more compressible, and some degree of hyperpyrexia sets in. The patient becomes apathetic, and thereafter appears coma or convulsions, which usually precedes death.

Grose [1] records a typical case from swallowing rat-paste, in a girl of three and a half years, death following on the fifth day. Post-mortem examination revealed enlargement of liver, which was in a state of acute fatty degeneration; and the heart and kidneys felt greasy on section. The urine passed during life reduced Fehling's solution.

Post-Mortem Appearances.—The appearances, generally, are those of a highly irritant poison, consisting of inflammation and erosion of mucous membrane of throat, gullet, stomach, and intestines, or it is completely destroyed in patches. The stomach may contain some dark-coloured or bluish matter, which may have a garlicky odour, consisting of mucous and altered blood, and in addition, where rat-paste has been taken, of Prussian blue. The contents may give off white fumes on exposure to air, in which case they will be luminous in the dark.

[1] *The Lancet*, vol. ii., 1899, p. 902.

The liver is the seat of considerable disorganisation, being usually found in a softened condition and enlarged. Its colour varies. On microscopic examination, extensive destruction of liver cells is found, besides the presence of considerable quantities of fatty globules. Fatty degeneration of the muscular fibre of the heart, and also of voluntary muscular fibre is present. The blood of the body is of a dark appearance, fluid in consistency, does not redden on exposure to air, and on microscopic examination it is seen that the hæmoglobin is dissolved out of the stroma into the liquor sanguinis. The diagnosis of the liver conditions from phosphorus and of those in acute yellow atrophy have been the subject of much discussion. Some observers are of opinion that they are pathologically different as to their causation; others that they are closely allied. The former pin their faith upon the fact that in the liver condition due to phosphorus there is enlargement of the organ, and that on microscopic section the acini are distinctly visible, whereas in the other there is atrophy of the organ, and the acini have disappeared. This seems to be a question for the future yet to decide.

Fatal Dose.—The smallest recorded fatal dose is 1½ grains; in another case 2 grains was the fatal dose. Both of these cases are quoted by Christison. Recovery, however, has followed doses of 4 and 6 grains.

Fatal Period.—Four hours (Orfila). The period, however, is usually longer, extending even into days.

Treatment.—Early use of the siphon-tube, and free lavage with warm water and "Sanitas," or rectified turpentine, or potassium permanganate, 5 grains per pint of water. Evacuation of bowels with castor oil and small addition of turpentine. Thereafter, the most prominent symptoms must be treated.

Chemical Analysis.—Some dependence must be placed on the garlicky odour of vomited matter, fæces, and contents of stomach, and much importance should be attached to these giving off white fumes, and to their luminosity in the dark. In dealing with the contents of the stomach especially, careful search should be made, under water, for solid particles of a suspicious appearance—of phosphorus, or of Prussian blue. Thereafter, a portion of the contents should be taken up in a separator with carbon disulphide, and after separation of the fluids, the disulphide is drawn off and allowed to evaporate spontaneously in a dark place, the observer keeping watch for any appearance of luminosity. Any phosphorus present will show as oily globules, which, on being touched with a red-hot wire, will burst into a bright yellow flame.

Mitscherlich's test or process, which is intended to detect small quantities of phosphorus, is carried out as follows:—the suspected material is mixed with water acidulated with sulphuric acid; it is then transferred to a glass retort fitted with a long condenser, and to the tube from the retort is fitted an adapter which ends in a receiver containing a solution of silver nitrate. Distillation is conducted in the dark, luminosity in the tube being an evidence of the existence of the poison. This process will detect one part of phosphorus in 100,000 parts of material. Luminosity, however, may be prevented by the

very substances used in the treatment of the case before death, as turpentine, ammonia, or alcohol, but even in that case the phosphorus will blacken the silver solution by reducing the silver to the metallic condition.

Dusart-Blondlot's test depends upon the combination of phosphorus with nascent hydrogen and formation of phosphuretted hydrogen (PH_3). The gas is generated as in Marsh's process. It gives on ignition at a platinum jet a flame which is somewhat greenish in colour, particularly in its middle. Some of the gas may be passed into a silver nitrate solution, when a precipitate of phosphate of silver will form.

Scherer's test depends upon the reducing effect of phosphorus fumes on silver nitrate. If a portion of the suspected material be placed in Dowzard's apparatus for Gutzeit's test for arsenic, and lead acetate solution, to fix any H_2S which may be present, be placed in one or more of the cells, and the top of the apparatus be capped with paper moistened with silver of nitrate—the whole being kept in the dark—the reaction will be obtained after some hours, even with minute quantities of phosphorus.

Gaseous Poisons

There are certain gaseous compounds of metallic and metalloid bodies which exert a poisonous action, and of some of them especially the toxic effects are rapidly produced and are very lethal. These gases of the metallic bodies are the hydrogen compounds of arsenic, antimony, and phosphorus, and of these, probably the most common is the first named; of the metalloid bodies, there are certain compounds of sulphur and of carbon, in addition to chlorine. Bromine and iodine in the form of vapour are also irrespirable and produce poisonous effects; so also is the vapour of hydrocyanic acid which, however, will be considered under the head of vegetable poisons.

We shall, therefore, divide this group into two sub-groups—viz.

I. The Gaseous Compounds of the Metals, including—
   (*a*) Arseniuretted Hydrogen,
   (*b*) Antimoniuretted Hydrogen,
   (*c*) Phosphuretted Hydrogen.

II. The Gaseous Compounds of the Metalloids, including—
   (*a*) Carbon gases,
   (*b*) Sulphur gases,
   (*c*) Chlorine.

I. Gaseous Compounds of Metals.

A. Arseniuretted Hydrogen (AsH_3).—This gas is formed in a variety of ways:

(1) By solution of arsenides of the metals in water;

(2) By the action of dilute HCl or H_2SO_4 on alloys of Zinc, Copper or Tin, or on ores which contain arsenic;

(3) By Marsh's test; (4) by dissolving, Zinc, Tin, or Iron, containing Arsenic Acid with dilute HCl or H_2SO_4: ($2AsH_3O_4 + 8Zn + 16HCl = 2AsH_3 + 8H_2O + 8ZnCl_2$); (5) by electrolysis of

water containing Arsenious or Arsenic Acid; (6) by the growth of moulds in starch-paste put on wall-paper which contains arsenic.

It is a colourless gas, possessing a disagreeable odour of garlic, but does not redden litmus. It burns in the air with a bluish-white flame, forming water and arsenious acid.

Poisoning by this gas has arisen in a variety of industrial and scientific pursuits. Of 120 cases the records of which we have recently investigated, including two which came under our personal observation, the following is a classification of their origin :—

Groups	No. of Cases
I. Chemical operations in laboratories	
(*a*) Operation with *known* arseniferous materials	8
(*b*) ,, ,, *unknown* ,, ,,	14
(*c*) ,, ,, not known ,,	1
II. Trade processes	73
III. Military ballooning	16
IV. Domestic environment (wall-papers)	6
V. Causes not known	2
Total cases	120

The following table summarises the professions and occupations, the members of which are exposed to risks of poisoning by this gas :—

I. Professional chemists—
   (*a*) In medico-legal analyses in cases of arsenical poisoning.
   (*b*) In preparation of AsH_3 for demonstration purposes.
   (*c*) Researches in aniline colours and in arsenical compounds.

II. Physicists and physiologists—
   Inhalation of arseniferous hydrogen in experiments on the voice, or as to pulmonary capacity, or other like experiments.

III. Workers in aniline colours—
   Preparation of arsenic acid; working at retorts; treatment of raw materials.

IV. Chemical workers—
   (*a*) Manufacture of iron sulphate.
   (*b*) ,, ,, zinc ,, and chloride.
   (*c*) Zinc-smelting.
   (*d*) Roasting and extraction of mineral ores.
   (*e*) Manufacture of bleaching-powder.
   (*f*) ,, ,, soda sulphate by treatment of soda lye with arseniferous sulphuric acid.

V. Ballooning for military and other purposes—
   (*a*) Inflation and deflation of balloons.
   (*b*) Leakages during balloon flights.

VI. Plumbers in brazing processes.

VII. Galvanisers.

Poisonous results were produced from such laboratory experiments as the generation and inhalation of hydrogen to produce Tyndall's experiment of the altered " timbre " of the voice, the demonstration

of Marsh's test to students, the intentional generation of the gas for experimental purposes, and testing for arsenic by Marsh's test in the bodily organs of a girl poisoned by arsenic; also from such trade processes as the following:—researches in, or manufacture of, aniline colours; filling of balloons with hydrogen; extraction and treatment of ores; manufacture of zinc chloride; utilisation of galvanisers' zinc flux skimmings, the manufacture of bleaching-powders, and others.

Ferro-silicon is one of the materials used in the manufacture of steel which in presence of moisture is liable to give off the poisonous gases arseniuretted hydrogen and phosphuretted hydrogen, the latter, perhaps, predominating. It is an alloy of iron and silicon. There are two grades of it; one containing not more than 15 per cent. of silicon, which is made in blast furnaces in this country, the other, a high-grade compound, which contains from 25 to 95 per cent., and which can only be manufactured at the much higher temperatures of the electric furnace, and which, therefore, is mainly imported into Great Britain from France, Austria, etc. It appears that attention was first drawn to the danger of transport by sea of ferro-silicon by a series of explosions which occurred on board a ship in a Liverpool dock which carried a consignment. Dr Dupré, who investigated these, believed that they were due to the presence in large percentage of PH_3 gas, while another observer found, in addition to that gas, smaller proportionate amounts of AsH_3 and acetylene in the gases given off.

The first recorded fatalities to human beings occurred in January 1905, on the s.s. *Vaderland*, during a voyage from Antwerp to New York. Fifty steerage passengers lodged over a hold containing a consignment of ferro-silicon were seized with an obscure illness, of whom eleven died. The doctor of the ship certified the deaths to be due to pneumonia, and on account of the suspicions of the U.S.A. port authorities that the illnesses and deaths were due to plague, the ship was quarantined. Further investigation, however, led to the conclusion that the illnesses and deaths were due to poisonous fumes,[1] or gases given off from the ferro-silicon. Since the true character of the compound has become better known, more than one fatal occurrence has been reported. One of the most recent was the deaths of five Jewish emigrants during a voyage between Antwerp and Grimsby in December 1908. Their deaths were at first attributed to cholera, and then to ptomaine poisoning, before it was discovered that the cause was fumes or gases from the ferro-silicon of which the ship carried nine tons in casks. The thirty-five casks were stowed in a hold just below the cabin occupied by these men. On the day they fell ill all the port-holes and doors had to be kept closed on account of bad weather. Post-mortem examination revealed evidences that the deaths were more likely to be due to the inhalation of poisonous gases than to the other causes at first suggested. Ferro-silicon contains arsenic and phosphorus, and when it is moistened arseniuretted hydrogen and phosphuretted hydrogen gases are given off.[2]

Robertson records a like incident which occurred in October 1905, on a canal boat plying from Hull with a cargo of this material. After

[1] Report Med. Off. L. G. B. for 1908-1909.
[2] *B. M. J.*, vol. i., 1909, p. 127.

leaving that port all the family on board suffered from a feeling of sickness and from giddiness on getting up in the morning, but which passed off during the day. The following day there was a repetition of the symptoms, and, in addition, pain in the body, headache, and vomiting. On the third day the symptoms were again present in the parents, but were more pronounced in the case of their children, who were prostrated. He was called to see two children, aged 3 and 4 years respectively, who were very ill on this boat, and on arrival found one to be dead, and the other in an unconscious condition, the skin covered with a cold clammy perspiration, pulse hardly perceptible, breathing shallow and slow, and pupils somewhat dilated. Crepitant râles were heard all over the chest. The child died soon afterwards. The mother had observed a peculiar smell in the cabin, and the doctor himself found it to be very pronounced when he went on board. On post-mortem examination nothing more positive than congestion of the lungs was found. The viscera were sent for analysis, but the analyst could find no poison. Part of the cargo was found to consist of ferro-silicon.[1]

In another instance, four passengers died on board a Swedish steamer from the same cause. The steamer carried 15 tons of ferro-silicon.[2]

Symptoms are as follow :—(*a*) an indefinable feeling of illness and great weakness ; (*b*) giddiness ; (*c*) faintness ; (*d*) pains in head and epigastrium ; (*e*) coldness of the body ; (*f*) sense of oppression of breathing, with, perhaps, some cyanosis ; (*g*) nausea, sickness, and vomiting. These are quickly followed by : (*a*) continuous vomiting of bilious matters, and, very often, of blood ; (*b*) jaundice, which may vary in tint from golden-yellow to mahogany, ranging through coppery, bronze, and mulatto tints ; (*c*) thirst and dryness in throat, with weakness of voice ; (*d*) pains in loins ; (*e*) pains or sense of fulness over region of liver; (*f*) hæmorrhages from one or different parts of the body ; (*g*) hæmoglobinuria or hæmaturia, oliguria, or, it may be, complete anuria ; (*h*) usually clear intellect, but generally before death, coma or delirium ; (*i*) subnormal temperature ; (*j*) hiccough.

The reader is referred to " Poisoning by Arseniuretted Hydrogen," published by the author in 1908, for a comprehensive treatment of the subject.

Post-Mortem Appearances.—First, so-called jaundice, which is found not only on skin and conjunctivæ, but also in internal organs ; in certain cases, a blue line on the gums has been seen. There is little abnormal change in the brain. The lungs have been found collapsed and congested. In the pericardium and pleuræ reddish or reddish-brown coloured serum may be found. In the heart, ante- and post-mortem clots are commonly found. The liver is more or less enlarged, and the gall-bladder distended with bile. The colour of the liver is often abnormal ; ranging from a simple yellow to a deep indigo colour. The kidneys are also changed in colour, from dark red to indigo, and they are also enlarged. The spleen is frequently also enlarged, and altered in colour. In the stomach there is congestion of the mucous membrane, sub-mucous petechial hæmorrhages, and patches of erosion,

[1] *B. M. J.*, vol. i., 1909, p. 1179.

[2] *Ibid.* vol. ii., 1909, p. 42.

in which changes the intestines often share. Microscopic examination of the blood reveals solution of the hæmoglobin from the corpuscles into the liquor sanguinis, " shadows " of red corpuscles, and destruction of the red discs. Fatty degenerative changes are found in muscle-fibre of heart, and in tissues of liver and kidney. The urine contains hæmoglobin, *débris* of red-blood discs, granular matter, exudation cells, red-blood corpuscles, tube-casts, fatty, hyaline, bloody, and amorphous urates or phosphates. Bile-pigment may also be found, but no bile-acids. Further microscopic examination of the blood will show the additional following changes—viz. (1) considerable reduction in number of red corpuscles per cubic millimetre ; (2) reduction in hæmoglobin-value of blood ; (4) alteration in shape and colour of red corpuscles. The blood-spectrum is, sometimes, that of met-hæmoglobin.

Fatal Quantity.—Very small. The mere act of sniffing the gas has produced serious symptoms, so that a very small quantity of it is toxic.

Fatal Period.—Usually about five days after inhalations.

Treatment.—Inhalations of oxygen. We believe that bleeding, followed by transfusion of blood, would be of the highest value. Baths or hot packs are of great service in stimulating excretion by the skin. Other treatment must follow lines indicated by individual cases.

B. Antimoniuretted Hydrogen (SbH_3).—This gas is not so toxic in its effects as the hydrogen gas of arsenic, and we are not aware of any published case of fatal poisoning from it alone. In the treatment of ores, however, there can be little doubt that from those which contain both arsenic and antimony, the same operation which will liberate the one will also free the other. This took place in Llanelly on one occasion, and death resulted.[1]

C. Phosphuretted Hydrogen (PH_3).—The only cases with which we are acquainted, and in which a fatal accident resulted, arose during the progress of a chemical experiment.[2] A young chemist, shortly after making experiments with this gas on a fairly large scale, was seized with symptoms of poisoning from the effects of which he died. The other case is recorded by Bremner.[3] By reason of the former case, a series of experiments as to the effects of this gas upon animals was instituted by Henderson (*loc. cit.*). When a rat was exposed to an atmosphere containing one per cent. of the gas, death resulted within half-an-hour ; a second, the atmosphere containing only ·2 per cent., died in 33 minutes ; and a third, where the gas only amounted to 1 in about 5000 of air, died within 24 hours. In another experiment made by subjecting a rat to spontaneously inflammable PH_3 generated by the action of impure phosphide of calcium on water, a fatal result also ensued. The symptoms observed in these animals were, chiefly, (*a*) great irritation of the skin, (*b*) rapid breathing at first, and, later, slow and laboured respiration, and (*c*) convulsions. The post-mortem appearances were : (*a*) anæmia of brain, (*b*) engorgement of lungs, liver, and brain membranes with dark venous blood, and (*c*) engorgement of heart with dark-coloured blood. The presence

[1] " Public Health," vol. iv., 1892, p. 317.
[2] Henderson and Clark, *Proc. Phil. Soc. of Glasg.*, vol. xi., p. 517.
[3] " Syd. Soc. Biennial Retrospect," 1865-1866, p. 443.

of phosphorus in the organs of the animals was detected by Marsh's test, a green tongue being visible in the hydrogen flame, confirmed to be phosphorus by the spectroscope. Phosphuretted hydrogen is disengaged from ferro-silicon in presence of moisture. (*Vide* p. 645.)

Hydrofluoric Acid.—The gaseous acid which is used for the purpose of etching is poisonous in its action, producing corrosion of the skin and, later, painful ulcers which are difficult to heal. King records[1] the case of an adult who swallowed about half-an-ounce of the liquid preparation, and who died in 35 minutes thereafter. The chief symptoms were violent pain in the mouth, throat, œsophagus and stomach, and severe vomiting. The post-mortem appearances consisted of corrosion of the parts with which the poison came in contact; the mucous membrane of mouth, and that of the œsophagus, were in patches whitened in appearance and denuded of epithelium, while that of the stomach was blackened, the organ itself containing a blackish fluid. Sir Charles Cameron has recorded a case which indicates poisoning by the gaseous form of silicon fluoride, in a young man who was employed in the manufacture of superphosphate of lime for manurial purposes. In the process the crude phosphate is subjected to the action of sulphuric acid, and during the operation such gases as carbon dioxide, nitrogen oxides, fluoric acids and fluoride of silicon are evolved. An analysis of the lungs of the deceased showed that one entire organ contained at least 0·75 gramme of silica (SiO_2), and of the crude phosphate used in the works that it contained 6·36 per cent. of calcium fluoride. He carried out a series of experiments upon animals to investigate the toxicity of the fluoride of silicon, and demonstrated that exposure to an atmosphere containing 0·5 per cent. killed a guinea-pig within half-an-hour, and to one containing 2 per cent. within four minutes. A glass embosser at Wimbledon "for fooling" swallowed about a tablespoonful of the acid diluted with water. Shortly after he became white and clammy, and began to vomit. He was removed to hospital, but died about an hour afterwards. Post-mortem examination of the body showed the blood to be dry and tarry, but uncoagulated; the lips were very charred; the tongue denuded of papillæ, dorsum brownish in colour, but not much burned; the back of tongue, fauces, and epiglottis congested and ecchymosed; the pharynx and gullet in like condition, the gullet being generally of a slatey colour, with here and there deep red patches; the cardiac portion of stomach markedly ecchymosed, the pyloric end, slightly so; no denudation of mucous membrane of stomach; the lungs congested and almost black in colour.[2]

Salufer, an antiseptic or disinfecting preparation, is composed of silico-fluoride of calcium, the preparation being put up in the form of cubes. Walton[3] records a fatal case of poisoning by this substance. A box containing some of these cubes fell into the hands of a child of two years. One was swallowed, and the child had a second in its mouth when discovered. When medical assistance arrived, the child was found to be collapsed, the pulse being feeble, the breathing laboured and slow, with occasional laryngeal spasms, the pupils equal and of

[1] *The Lancet*, vol. i., 1873, p. 203.
[2] *B. M. J.*, vol. ii., 1899, p. 1145.
[3] *Ibid.* vol. i., 1900, p. 1505.

medium size, and the skin cold and dry. There had been vomiting and diarrhœa. The child was quite sensible, but died about two hours afterwards.

II. Gaseous Compounds of the Metalloids.

A. Carbon Gases.—It may be said generally, that whatever carbon gas or mixture of gases takes the place of the air which is breathed to an amount that substantially reduces or supplants oxygen, places life in peril. The gases which, however, specially prove toxic in their effects, are Carbon Monoxide and Carbon Dioxide, of which some detailed consideration is necessary.

1. *Carbon Monoxide.*—The sources of carbon monoxide gas are various. Among the principal are the resultant gases from ignition of explosives, from blast furnaces, the slow combustion of " blaise " or iron-waste heaps, coal-gas itself, and coal-gas admixed artificially with variable proportions of " water-gas," the use of " geysers " in bath-rooms, lime-kiln burning and the air of mines. As exemplifying the former, the Crarae disaster at the quarries of that name on Loch Fyne may be cited, wherein several citizens of Glasgow, who rushed into the quarry to witness the effects of the explosion of some tons of gunpowder, fell as if shot dead, and of whom some did actually die. They had walked into an invisible atmospheric lake of CO_2 and CO gases. Most high explosives yield this latter gas in poisonous quantities, as dynamite, gun-cotton, nitro-glycerine, tonite, roburite, sicherheit, and others, especially when the explosions have occurred in confined spaces, as mines. In the manufacture of roburite, which is composed of dinitro-benzene, chloro-nitro-benzene, and ammonium nitrate, danger occurs to the workmen in cleaning out the flues. The operation is so dangerous, that although the men are each provided with a special suit of clothes and respirator for the purpose, they are only permitted to work for three minutes at a time in the flue, and are bound to remain out for twenty.[1] So dangerous and injurious to health did it prove in the experience of workmen, that in certain works where it was used as an explosive, the men refused to work if its use were continued; consequently a Committee of Inquiry, composed of Prof. Dixon, Dr Mouncey, and Mr Hannah, was appointed to investigate its effects. This Committee reported that when roburite is fired in a coal mine, a recognisable quantity of CO is given off, but if in a boiler, no CO can be detected. They therefore recommended that, when it was used in mines, the products of combustion should be rapidly diluted with large quantities of fresh air.[2] Sicherheit (the German word for " security ") is also chiefly composed of dinitro-benzene ($C_6H_4(NO_2)_2$), and its manufacture is attended with danger. The symptoms of poisoning are almost identical with those from roburite, consisting of unconsciousness, cyanosis of face, lips, and finger-tips, weak, irregular pulse, and general collapse. Particulars of individual cases of poisoning may be studied in the following references.[3]

[1] *The Lancet*, vol. ii., 1889, p. 81.

[2] *Ibid.* vol. i., 1889, p. 1100; *ibid.* vol. ii., 1889, p. 124; *Manchest. Med. Chron.*, May 1889.

[3] *B. M. J.*, vol. ii., 1889, p. 127; *ibid.* vol. ii., 1889, p. 244; *The Lancet*, vol. ii., 1889, p. 368.

Fr

seen two deaths

30 March 1911

SUICIDE BY INHALING GAS.

Thomas Cape (62), of Cockermouth, an overman employed at Harris's thread mills, committed suicide at Cockermouth yesterday in a singular manner.

On rising at 8.30 his daughter, with whom he lived, was astonished to find that her father had not gone to work, and that he was sitting in the kitchen with a woman's skirt over his head. The removal of the dress revealed her father with a rubber tube from the gas jet in his mouth. The gas was still on, and life was extinct.

Cape had been depressed for some months over his wife's death.

A verdict of "Suicide whilst temporarily insane" was returned by the Coroner's jury.

From the second [illegible] cause, we have seen two deaths result. Within a fortnight of one another, two tramps lay down on the banks of a smouldering " blaise-heap," for the purpose of warmth, and were found dead in the morning, with marks of burning upon those parts of their bodies which were in contact with the ground.

At Polton Hall, Durham, in 1906, two elderly persons, a man aged 61 and a woman aged 73, living a few doors from one another, were found dead in bed. The houses which they inhabited were built thirty-two years before on the edge of a ravine, into which, within recent years, colliery owners had tipped refuse consisting of shale and pyrites behind the houses. A month prior to this occurrence the waste-heap took fire. Evidence of CO in the blood of the deceased was found on spectroscopic examination.[1]

From coal-gas, we have seen several cases of poisoning. Perhaps the most notable example was that in which in January 1895, we were called upon to examine the bodies of members of a family under the following circumstances. By reason of the fact that the occupants of a cellar-dwelling were not astir in the morning, and from the oppressive odour of coal-gas which was perceived in the passage leading to the house, it was feared that some grave mischief had happened to the father, mother, and four children, who inhabited the apartment. Consequently, the door was forced by the police. When we entered the room a few minutes thereafter, the mother and children were found to be dead, and the father to be deeply comatose but still living. An interesting fact, worthy of note, was observed : a paraffin oil-lamp, which stood on a low shelf near the fireplace, was found to be burning freely, and the flame gave no indications that it was not receiving sufficient oxygen for efficient combustion.[2] No gas was used in the house. On examination later, it was found that a gas-supply main—one and a half inches in diameter—had burst in the ground outside of the dwelling, and that the issuing gas had found its way into the apartment through the foundations of the building and the flooring. Altogether, we have seen fifteen to eighteen cases of coal-gas poisoning, which, however, with the exception of the six cases above narrated—for the father also died—made good recoveries, although in several instances the persons were deeply comatose. In September 1909, at Kilburn, an aged actress in want committed suicide by stopping up the keyhole and crevices around the door with rags and turning on the gas-taps of the cooking-stove. She was found dead, as were also the canaries which were in the apartment. It will be remembered that the defence in the famous Chantrelle case, Edinburgh, was that deceased had died from coal-gas poisoning from a gas-pipe instead of from opium administered by accused. The following case has points of interest in that an explosion having taken place in a room on the introduction of a lighted candle, and the explosion having blown out the upper part of the door, and done other damage, none of those who approached the door and broke it open perceived any odour of coal-gas, and also that the blood of a dead woman, who was found in the room, failed at first to yield spectroscopic evidence of carbon monoxide. In the blood from the viscera, however, CO-hæmoglobin was found, and the degree of satura-

[1] *B. M. J.*, vol. i., 1906, p. 530.
[2] See a similar case, *B. M. J.*, vol. ii., 1896, p. 1443.

tion to be 18 per cent. The verdict of the jury was one of suicide, the cause of death being CO poisoning from the gas which produced the explosion, and that the gas was composed of 75 per cent. coal-gas and 25 per cent. carburetted water-gas, in which there was 10 per cent. of carbon monoxide.[1]

Pettenkofer in a communication to the journal, *Nord und Süd*,[2] gives several illustrations of the poisonous effects of coal-gas entering dwellings from street main-pipes. Out of twenty-two instances recorded in Munich, twenty occurred in the winter months, and Pettenkofer's explanation of this is that the heated houses in winter act like so many cupping-glasses on the air of the soil. In one of the instances mentioned, two persons were found dead, and one living but insensible who afterwards died, a canary was found dead in its cage, and a dog lay senseless on the floor, from the effects of the gas which had entered the house from a leak in a pipe in the street 35 feet from the wall of the house. In some of the other cases, however, he points out that the source of the leakage was as much as 100 feet from the affected dwelling. At Glossop, in 1884, four deaths occurred in a house from the same cause.[3]

The practice of municipal corporations in permitting the admixture of water-gas with coal-gas cannot be looked upon as otherwise than a dangerous one to the gas consumers. In Belfast, Liverpool, Edinburgh, and other large cities, this practice prevails, but it is not followed in Glasgow. From the Parliamentary Returns of Gas Undertakings in the United Kingdom for 1905, it will be found that of 454 gas undertakers, other than local authorities, in England and Wales, 68 supply mixtures of water-gas and coal-gas, the percentage amount of the former ranging from 3 per cent. up to 60 per cent., and of 208 gas undertakers who are local authorities, 28 supply such admixtures. Of the former class of gas undertakers in Scotland, none supplies such admixtures, and in Ireland, numbering 10, 3 supply admixtures. Of 46 of the latter class in Scotland, 3 only, and of 11 in Ireland, 1 only, supply admixtures. It is obvious that where such admixtures are purveyed, the risks from leakages in the gas-carrying apparatus are considerably increased. This water-gas, or producer-gas, is made by passing air and steam through incandescent coke or other carbonaceous fuel at a temperature of about 2000° F., whereby the oxygen of the air and steam unites with the carbon from the fuel to form a gaseous mixture, of which CO is one of the principal ingredients, forming about 47 per cent. According to Cayzer,[4] who has collated the reports of the Lighting Commissioners of various American cities in the State of Massachusetts, during 1896 there were 76 cases of escaping gas, from which 51 persons died and 118 others were injuriously affected; the gas used being carburetted water-gas, which is made by passing water-gas over a large surface of material charged with vaporised oils containing hydrocarbons. In the same State in 1897, 60 persons died and 74 were injured. In Liverpool, Birmingham, Stockport, Leeds,[5] and other places, deaths from

[1] *B. M. J.*, vol. ii., 1907, p. 1750.
[2] *Ibid.* vol. i., 1884, p. 822.
[3] *Ibid.* vol. i., 1884, p. 121.
[4] "Carburetted Water-Gas and Carbon Monoxide Poisoning."
[5] *The Lancet*, vol. ii., 1889, p. 1358.

this gas have also happened. It was stated, as the result of inquiry,[1] that in a certain district of Liverpool, the night supply of gas contained 17 per cent. of carbon monoxide. Coal-gas normally contains from 6 to 9 per cent. of CO, but when water-gas, or carburetted water-gas, is mixed with coal-gas, the proportion of CO rises much higher, depending upon the ratio of admixture.[2] Carbon monoxide is an odourless gas, but when mixed with olefiant gas the odour of the latter is always perceptible. Coal-gas poisoning may result from ignorant persons blowing out the gas-light, from overturning an unchecked tap, from the accidental fracture of a gas-supply pipe, and in a variety of other ways.[3] A considerable number of deaths have been caused by the use of gas "geysers," or so-called "instantaneous heaters" in bathrooms, in the use of which CO is generated. Such cases are frequently recorded.[4]

Louis le Dosseur (Thèse de Paris, 1901) gives a valuable account of a large number of cases of the toxic effects of CO from the fumes of charcoal fires used in rooms, and especially of the mischief to the nervous system which follows. The novelist Zola met his death by asphyxiation from CO_2 and CO in his bedroom in Paris. His servant had lighted a stove-fire, built of blocks of compressed charcoal. Unknown to the servant, the flue of the stove had become choked, and the charcoal having smouldered all day and during the night, these gases had entered the room atmosphere. Having retired with Madame Zola to rest, it appears that Zola felt ill and tried to get out of bed, when he was seized with vertigo and collapsed on the floor. Madame Zola, rising to his aid, was similarly affected. On assistance arriving, Zola was found to be dead, but his wife to be living, although unconscious. CO was found in the blood and viscera of the deceased.[5]

As the result of lime-burning, deaths from this gas are also common. A unique case of this kind which came under our observation is as follows. In an inhabited street in Glasgow is a lime-burning work consisting of three kilns, one of which abutted closely—within some inches—on the gable-end of a newly built tenement property of two flats, occupied by different families. During the night of November 30, 1899, the members of the family living in the ground-floor apartments next this gable were seized with faintness, sickness, and vomiting, which they attributed to a disagreeable pungent smell in the house. They took refuge in the house of a neighbour. By next day they were comparatively well. Their neighbours on the flat above, however, had not been seen since the night before, and vigorous rapping at the door elicited no response. Fearing some mishap, the police entered by the window, when it was found that a woman and her two children were lying dead in the bed of the back apartment, and a man, who was occupy-

[1] *Public Health Engineer*, 1901, p. 289.

[2] "Water-Gas, Carburetted Water-Gas, and Carbon Monoxide Poisoning," by the author, *Lancet*, Dec. 8 and 15, 1906; for other cases, see Lorrain Smith, *B. M. J.*, vol. i., 1899, p. 780; Haldane, *Jour. of Physiol.*, vol. xviii., pp. 201 and 430; *B. M. J.*, vol. i., 1910, p. 228.

[3] *B. M. J.*, vol. i., 1899, p. 780; *ibid.* vol. i., 1898, p. 858; *ibid.* vol. ii., 1897, p. 1772.

[4] *The Lancet*, vol. ii., 1889, p. 710.

[5] *Ibid.* vol. ii., 1902, p. 1019; *ibid.* vol. i., 1889, p. 391.

ing the bed in the front apartment, was deeply unconscious but still living. He was at once removed to the Infirmary, where he was treated; it was only, however, after he had been freely bled that he showed signs of improvement. He recovered. We made a post-mortem examination of the dead bodies the day after.[1]

Haldane's "Report on the Causes of Death in Colliery Explosions and Underground Fires" (1896), the Report of Professor Le Neve Foster on the Snaefell mining disaster, and other like documents, show how common is this cause of death in mines and collieries. The source of the CO in the Snaefell case was burning timber, in which combustion was not active because of imperfect supply of air due to falling-in of the roof through the burning of the wood-supports; in the Whitwick Colliery disaster in April 1898, fire in the pit was also the cause. Choke-damp, which is a mixture of CO and CO_2, may, however, be present in mines from other causes than fire; indeed, it is liable to form in all collieries, but in some more than others, at "dead-ends," where the ventilation is imperfect. In fires in buildings, the CO in smoke is, doubtless, the cause of a certain number of deaths of persons. Occasionally cases occur under unusual circumstances. In 1905, at Blantyre, Lanarkshire, a workman mounted a roof to place a chimney-can on the top of a flue from a bakery, the flue being used as an escape for gas fumes. He became unconscious while so engaged, but was timeously rescued by his employer, who was superintending the operation. He recovered. In 1909, a workman engaged at work at an ironwork on the top of a high chimney stack was overcome by the gases escaping therefrom, but was rescued.

Another source of this poisoning is in ironworks flues connected with the processes for saving ammonia and other valuable bye-products. Dr Scott has recorded [2] the case of a man who was found insensible at the front of one of the flues connected with the above process at the Clyde Ironworks near Glasgow, and the notes of a second case which happened at Coltness Ironworks. In April 1901, we made a post-mortem examination of the body of a vigorous man who was found dead in a boiler which he had been sent to repair, and his body bore unmistakable evidence of death from this gas.

Dangerous effects may also result from heating domestic apartments by coke-stoves; and the use of flueless charcoal braziers is a source of many deaths, by accident or suicide, especially in France. These effects may also be produced in unlooked-for ways. Carbonic oxide forms with Nickel a compound $Ni(CO)_4$ which is a clear liquid of considerable refractive power, of a sp. gr. of 1·3185 at 17° C., and which is soluble in alcohol, benzene, chloroform, and olive oil. It evaporates on exposure to the air. McKendrick and Snodgrass [3] have investigated its physiological action. They have demonstrated that it is highly toxic not only when injected into the body but also when inhaled as a constituent of the atmosphere. From a series of experiments they proved that the vapour of this substance when present in the air to the extent of less than 0·5 per cent. was dangerous to life.

[1] *Vide* also *Lancet*, vol. i., 1889, p. 357.
[2] *Ibid.* Jan. 25, 1896; *ibid.* vol. ii., 1900, p. 389.
[3] *Proc. Phil. Soc. Glasg.*, vol. xxii., p. 204.

In 1903, two deaths of workmen in Mond's Chemical Works, Clydach, were attributed to this substance. Both men had been exposed to the vapour of nickel carbonyl. Dr Jones reported that there had been 26 cases of slight poisoning from this cause during the previous summer among workmen under his care. Dr Tunnicliffe, who examined the viscera of one of the above two men, concluded that death was due to this substance. An examination of the brain of one of the deceased was made by Dr F. W. Mott, who found capillary hæmorrhages throughout the substance of the organ, as well as chromolytic changes in the nerve cells of the medulla and pons, especially of the cardio-respiratory centres.[1]

The reaction of CO to form with nickel or iron volatile compounds known as carbonyls is utilised commercially in the recovery of metallic nickel from its ores, the carbonyl formed being decomposed by a temperature of 150° C. into metallic nickel and CO gas. The latter gives rise to poisoning of workmen engaged in this work, their preliminary symptoms being giddiness, dyspnœa, and vomiting. These pass off when the workman is taken to fresh air. But within 36 hours afterwards the dyspnœa is apt to return, along with cyanosis and a rise of temperature, with delirium in the more serious cases. In fatal cases death supervenes between the fourth and eleventh days. As Mott has shown by sections of the brain substance, multiple small hæmorrhages are found therein, and there may also be hæmorrhages into and œdema of the lungs. Up till recently it was believed that the CO was the sole lethal cause, but recent observers, as Armit [2] and Harden [3] in this country, and Vahlen abroad, from further experimental investigation have arrived at the conclusion that this gas alone will not account for the conditions found in fatal cases. Armit's conclusions are founded upon the following reasons—viz. (1) in fatal poisoning from minimal doses, the amount employed is not sufficient when combined with the hæmoglobin to produce more than 5 per cent. saturation of CO, (2) that the blood of an animal saturated with CO to the extent of 32 per cent. loses some of that gas during subsequent poisoning with nickel carbonyl, and (3) that although *iron carbonyl* contains more CO than the nickel compound it is less toxic. As throwing some possible light on the action of the latter compound on the animal or human economy, he points out that the nickel compound in the presence of air and moisture decomposes, liberating the CO, and leaving a deposit of hydrated basic nickel carbonate, and, further, that nickel carbonyl is more soluble in blood serum or in blood itself than in water. He believes, therefore, that the toxic effects following exposure to nickel carbonyl are due to deposition of the metal, in a slightly soluble form and very finely subdivided, over a large area of respiratory surface.

The exhaustive work of Mott on the pathology of those poisoned by this substance is most praiseworthy. The multiple minute hæmorrhagic lesions which are found in the brains of those poisoned by CO gas appear to us to account in great measure for the nervous and mental changes observable in those who recover from its immediate toxic effects.

[1] *B. M. J.*, vol. i., 1903, pp. 214 and 467.
[2] *Jour. of Hyg.* July 1907, and Nov. 1908.
[3] *Proc. Roy. Soc.* 13, vol. lxxvii.

Chronic Poisoning.—Owing to the more general use of gas in laundries and other occupations, there seems to be good ground for believing that a chronic form of poisoning by CO gas exists. The symptoms which more or less rapidly appear among women who work daily with irons heated by gas are chiefly anæmia and obscure nervous symptoms. Observations are, however, being made with a view to determine how far the inhalation of minute amounts of this gas daily is the cause of the symptoms.

Symptoms.—The symptoms of coal-gas poisoning are as follow :—deep coma, weak fluttering pulse, heavy breathing, with puffy or blowing expiration ; contraction of pupils, which do not respond to stimuli ; cyanosis of face ; lividity of lips, with froth at mouth ; sub-normal temperature ; and coldness of body. Those of carbon monoxide poisoning differ in some measure. They are as follow :—deep coma ; pallor of face ; eyes staring and glassy, pupils being dilated and fixed ; froth at mouth ; breathing shallow and quiet ; pulse weak, almost imperceptible ; sub-normal temperature ; coldness of body. Should the person recover from the severe symptoms of CO poisoning, it may take months before he is restored to his former health, or he may never quite recover. Dr Scott in the case already recorded, states that the man whose case he described suffered from *dementia* for months after, which he ascribes to the effect of the blood-poisoning from this gas ; and in the Coltness case, the patient was maniacal for three days, insensible for eight, and his vision was imperfect for seventeen days. Even at the end of two years, although his bodily health had been fairly restored, he still remained facile in mind, and could not be trusted with any responsible work. In certain circumstances of occupation or otherwise, persons may be exposed to the repeated inhalations of small amounts of CO gas. From these, sooner or later, pernicious effects follow, such as : anæmia, malnutrition, headache, neuralgia, symptoms resembling peripheral neuritis, and, it may be, mental disturbances, such as those already indicated.

Post-Mortem Appearances.—In the cases which we have examined from coal-gas poisoning, where there was no admixture with water-gas, or carburetted water-gas, the signs were mainly these : the blood of the body generally is dark and fluid. The internal signs, in short, are those of asphyxia. But in the series of cases published by Lorrain Smith, which occurred in Belfast from illuminating gas which contained about 40 per cent. of carburetted water-gas, the bodies of the victims showed externally the pinkish colour of skin and lips characteristic of CO poisoning.[1]

In Carbon Monoxide Poisoning.—There is a rosy or pink coloration of the skin of the body on face, neck, shoulders, breast, and front and back of thighs, and the same rosy colour is present on the dependent parts of the body instead of the usual livid colour, but the tint is not so bright as on the anterior aspect of the body ; the blood of the body generally is of a bright cherry-red colour ; there is likely to be some measure of congestion of bases of lungs, and clear-coloured froth in the windpipe. If the blood be examined spectroscopically it will be found that the spectrum consists of two bands between D and

[1] *B. M. J.*, vol. i., 1899, p. 780.

E, which, however, are nearer the violet end than those of oxyhæmoglobin, which occupy a nearly like position. (*Vide* Fig. 94 viii.) This gas forms with hæmoglobin a stable compound called Carboxyhæmoglobin, on the formation of which the oxygen-absorbing and carrying property of the red corpuscles is weakened or destroyed. The physical appearance of the blood varies as is the percentage amount of CO in the air which is inhaled and the time of exposure and inhalation. In like manner, the spectroscopic appearances vary; in certain cases, instead of two bands remaining after the addition of a reducing agent, a single broad band of reduced hæmoglobin may be seen. Moreover, although the proximate fatal factor in ordinary coal-gas cases is the contained CO, which will, probably, be found spectroscopically, the rosy-coloured markings on the body are not likely to be found, since the unconsciousness and symptoms of asphyxia are produced from the combined gases which compose olefiant gas. In order to detect the presence of CO in blood, the easiest and best method is as follows :—dilute a drop of blood from the finger with water in a watch-glass or test-tube, until the solution appears yellow; take next a drop of the suspected blood and dilute it exactly in the same degree. If CO be present, the latter will remain distinctly pink, compared with the normal blood, which will be a faint yellow. Let each now be examined by the spectroscope; probably in each case, two bands will be seen between D and E; now add a drop of NH_4HS to each test-tube, and again examine with the spectroscope, when it will be found that the normal blood spectrum of oxyhæmoglobin will have disappeared, and instead of two bands, there will now be only one band of reduced hæmoglobin, while the spectrum of the other remains unchanged. There are certain chemical tests which may be applied to blood to detect the presence of CO, but they do not compare in absolute reliability with the spectroscope. They are, however, as follow :—(*a*) Hoppe-Seyler's test, which consists in adding sodium hydrate (sp. gr. 1·34) to the blood. If CO be present, a bright red colour develops; if the blood be normal, a dirty-green colour; (*b*) Kunkel's test consists in adding to the blood, which is diluted with nine parts of water, a few drops of a 3 per cent. aqueous solution of tannin; in the presence of CO a pinkish-white precipitate forms; if the blood be normal, a brownish-white.

Of the various methods for estimating quantitatively the precentage degree of saturation of the blood with CO, perhaps that of Haldane [1] is the easiest of application. It is a purely colorimetric method, and depends upon the colour of the blood under inspection relative to that of an equal quantity of blood saturated with CO. A one per cent. solution of the blood to be examined is put into a tube; into a second like tube is placed a solution of normal blood of like strength; and into a third, a solution of blood of like strength, but saturated with CO gas. The testing solution to bring up the colour is a standard solution of carmine.

The solution of carmine is made by mixing one gramme of pure carmine with a few drops of ammonia in a mortar, and dissolving, thereafter, in 100 c.c. of glycerine. The *standard* solution is made from the above by diluting 5 c.c. of

[1] *Jour. of Physiol.*, 1895, vol. xviii., p. 430.

the original solution to 500 c.c. with distilled water. When about 6 c.c. of this standard solution are added to 5 c.c. of ox blood diluted so that the mixture with water contains one per cent. of blood, the colour or tint formed will be equal to that of blood similarly diluted but saturated with CO gas.[1]

The blood under inspection is first compared with that of normal blood, and if it be brighter in tint the presence of CO is indicated in a certain unknown proportion. Then the blood under examination is compared with that of the sample saturated with CO, and if it be less bright than the latter, to it is added the carmine solution until the colours are alike, the amount added being noted. From the figures so obtained, the degree of saturation of the blood-sample under inspection is ascertained. Assuming that the carmine solution used is of such exact strength that 6 c.c. added to a one per cent. solution of normal blood will exactly produce a similar tint in quality and intensity to that of a one per cent. solution of blood saturated with CO gas, the calculation of percentage saturation of any given sample of blood under examination may be arrived at in one of two ways—viz. (1) either by adding the standard carmine solution to the normal blood till the tint equals that of the blood-sample, or (2) by adding the carmine solution to the blood-sample until the tint produced is equal to that of the blood saturated with CO gas. Suppose that the former method be adopted, and that 1·5 c.c. of carmine solution are needed to bring up the sample of diluted normal blood to the tint of the diluted blood under inspection, then $\frac{100 \times 1{\cdot}5}{6} = 25$ per cent.; in other words, the hæmoglobin has taken up CO to the extent of 25 per cent. If the latter method be adopted with the same sample, and it be found that 4·5 c.c. of carmine solution are needed to bring up the tint of the suspected blood to that of the CO-saturated sample, then $\frac{100 \times 4{\cdot}5}{6} = 75$ per cent. Therefore $100 - 75 = 25$ per cent., the extent to which the hæmoglobin of the blood-sample is already tinted with CO.

Treatment.—In coal-gas poisoning, the patient must at once be removed to the open air where the air is in motion. If the body be cold, as is likely, it should be well wrapped in clothing after warming-pans or bottles have been applied. Artificial respiration will only be necessary if voluntary breathing be embarrassed or irregular. Inhalations of oxygen should be given. If in spite of these measures no sign of recovery appears, bleeding and transfusion of live human blood should be carried out. Farrah, in a paper read before the Philadelphia Pathological Society, November 1899, found experimentally on dogs that transfusion gave good results, the transfused blood being obtained from the carotid artery of a healthy dog and allowed to pass into the jugular vein of a dog almost lifeless from the gas, while saline solutions were only of temporary value, and hydrogen peroxide injected subcutaneously and intravenously yielded no beneficial effect. In carbon monoxide poisoning, removal into the open air is not so urgently called for, although plenty of fresh air is necessary. The difficulty here is to obtain dissociation of the CO from the hæmoglobin, even by the

[1] Haldane, *op. cit.* p. 465.

administration of oxygen, because of the diminished capacity of the red corpuscles to absorb and carry oxygen. While artificial respiration, oxygen inhalations, and measures for the restoration of body-heat should be persevered in until, at least, the animal heat is restored, should no further improvement be manifested, bleeding and transfusion should be resorted to. It was only when this course was adopted in the Infirmary in one of our cases that sensible improvement set in.[1] Stimulants administered hypodermically, or *per rectum*, will also prove of service.

2. *Carbon Dioxide* (CO_2).—This gas, as has been pointed out, is often associated with carbon monoxide, as in choke-damp, lime-burning, and brick-burning. It is the cause of fatal results in such occupations as well-sinking and well-cleaning, in breweries, in fermentation vats, and in aërated water factories. In such circumstances, where it exists in large percentages, it quickly produces powerlessness and insensibility, and death; in lesser percentages, it produces a somnolent tendency and lassitude, and should the person yield to these influences, it endangers life by preventing the excretion of CO_2 from the lungs. If an animal be exposed to an atmosphere of CO_2, and, when death has resulted, if the blood of the heart be at once examined, spectroscopic investigation will reveal the formation of a compound of CO_2 with the hæmoglobin, which, however, is of transient existence. Should the blood of the animal not be examined till some hours after, the spectrum will be that of oxyhæmoglobin. Constant exposure to the air of ill-ventilated apartments produces anæmia, malnutrition, and other symptoms.

Treatment.—Fresh air; artificial respiration; oxygen inhalations; restoration of bodily heat.

3. *Acetylene* (C_2H_2), which is a gas of unpleasant, pungent odour, and one of the sources of which is a "clogged" Bunsen burner, exerts prejudicial effects upon the body. The very common use of gas-stoves for cooking and heating purposes demands that attention be paid to it. It is now used also for illuminating purposes, being generated by the action of the water upon calcium carbide. There is no recorded case of acute fatal poisoning in the human subject, but there can be little doubt that regular exposure to an atmosphere in which even small percentage amounts of it are present is inimical to health, producing anæmia, malaise, malnutrition, and certain ill-defined nervous symptoms.

As a connecting link between the carbon and sulphur gases, we may next consider—

4. *Carbon Bisulphide.*—This gas, or rather vapour (CS_2), has but rarely given rise to fatal poisoning in the acute form, but chronic poisoning is not infrequently found in those employed in occupations in which it is used, as in india-rubber and gutta-percha works. Acute poisoning is usually due to swallowing the liquid, and chronic poisoning to exposure to the vapour or gas in the "curing-rooms" of rubber and gutta-percha factories.

Symptoms.—The symptoms in the acute form are: (1) unconscious-

[1] See also a case treated in Berlin by Prof. Leyden. *The Lancet*, vol. i., 1889, p. 51.

ness ; (2) dilated and fixed pupils ; (3) embarrassment of breathing, with cyanosis of lips ; (4) general symptoms of shock, due to absorption of the liquid ; (5) odour of CS_2 in breath.[1]

The symptoms in the chronic form are very well described in a case by Edge.[2] The patient enjoyed good health until he entered the employment of a rubber factory. He had been a total abstainer for sixteen years previously. Soon after beginning work—which was in the " curing-room," where the fumes of CS_2 are given off largely from the goods in process of manufacture—he suffered from headache, giddiness, and drowsiness, dryness of tongue, and a constant taste of the stuff in his mouth. These symptoms disappeared a few weeks later, as he became accustomed to his environment. But the headache returned, accompanied by delirium and delusions of sight, and by frequent attacks of giddiness. His legs became weak and numb, and ultimately, before he went to hospital, he could neither walk nor stand without support ; in short, he had the marked symptoms of peripheral neuritis. After treatment he recovered. In other cases, however, the same nervous symptoms present themselves in the upper extremities.[3] In addition to the foregoing symptoms, vomiting and abdominal colic may be found in certain cases.[4]

Post-Mortem Appearances.—These are mainly comprised as follows : —(*a*) odour of CS_2 in internal cavities of body, especially in the abdominal, and marked presence of odour in stomach ; (*b*) congestion of lungs and other organs ; (*c*) markedly dark colour of blood of body ; (*d*) congestion of walls of stomach, and punctiform hæmorrhages into mucous membrane.

Fatal Dose.—About half-an-ounce.

Fatal Period.—In a few hours. The above dose killed in $2\frac{1}{4}$ hours.

Treatment.—Siphon-tube and free lavage of stomach, until returning fluid ceases to be odorous ; stimulants hypodermically, or *per rectum* ; restoration of bodily warmth ; artificial respiration, if required.

Chemical Analysis.—The poison may be detected by distillation of contents of stomach. It may, thereafter, be precipitated by a soluble salt of lead, as the sulphide of that metal. Its odour is an excellent guide to its presence.

5. *Petrol Fumes.*—Owing to the more prevalent use of petrol as fuel for the engines of motor vehicles, toxic effects from the fumes or gases have been observed from time to time in chauffeurs and others, and have been recorded. The following may be taken as typical cases :—

1. Sir William Gowers narrates the case of a military officer who came to him for advice, and whom he found to be suffering from symptoms of an unusual character, after exposure to petrol fumes. At first he had perversion of taste, sweet things tasting saltish, then definite and persistent dysphagia, so marked that not only was he not able to swallow, but he was unable to masticate solid foods. He recovered after treatment by strychnia and rest from work. Then he returned to his work, which was that of testing petrol engines, but the symptoms returned and he had to give it up. Gowers believed that the toxic

[1] See cases recorded by Davidson, *Med. Times and Gaz.*, 1878 ; and by Foreman, *The Lancet*, 1886.

[2] *The Lancet*, vol. ii., 1889, p. 1167.

[3] *Med. Chron.*, June 1887 ; *L'Union Médicale*, Sept. 1886.

[4] *Edin. Med. Jour.*, May 1884 (Bruce), p. 1009.

effects arose from the fumes developed in the imperfect combustion of the petrol and not unlikely to carbon monoxide gas.[1]

2. Box records the following case:—A young man in charge of a 40 h.-p. car returned with it to the garage, accompanied by another chauffeur. They closed the garage. This was about 4 P.M. They then began to practise manœuvring the car up and down the garage, the engine being, of course, in action. At 4.30 P.M. they felt giddy with constriction of the head, but they had no nausea. They went upstairs to a room above the garage to have tea. At 5.45 P.M., when another car returned, both men were found upstairs insensible. The windows of the room were found open. The men were carried outside and soused with water. When seen by the doctor they were unable to stand. One was pale and shivering, and drummed his feet on the ground. He did not understand what was said to him, resented any interference, and hit out when spoken to. The other was deeply flushed and cyanosed, but seemed more sensible; but when moved, he struck out at the door, injuring his knuckles. They were taken back to the room and laid near the fire. By next day they were both apparently well, but they had only an imperfect recollection of what had happened after they left the garage to go upstairs to tea.[2]

3. Petrie tells of a chauffeur, who, getting into the garage pit under a motor to empty the petrol tank, was found about ten minutes later, by a lad who was working near, lying unconscious on the bottom of the pit, his clothes being saturated with petrol. His face and hands were blue; he was foaming at the mouth; no pulse could be felt; and his eyes were open, and the eyeballs turned upwards so that the pupils were rendered invisible. After a short time he began to struggle, beating the floor with his feet and throwing himself from side to side, fighting with his hands. The pulse returned, and the blueness of face disappeared. He retched several times, but did not vomit. An hour later he became violent, trying to bite himself, and those about him. He gradually recovered, but was much confused mentally. Later, he became quite conscious, but complained of headache and burning pain wherever the petrol had soaked through his clothing and had wetted his skin. Blistering occurred in various places on the skin, and erythema in others.[3] Houghton records a case in which toxic effects followed the use of petrol as a hair-wash.[4] Owing to the use of petrol in the engines of submarine boats, several cases of poisoning from the fumes have been recorded; indeed, it has been asserted that a leaky exhaust valve from the petrol engines of a submarine is deadly owing to CO gas. In one instance two crews were successively disabled within a few hours from this cause.[5]

Treatment.—Removal to open air, maintenance of bodily heat, artificial respiration, warm stimulating enemata, and removal, when present, of petrol-soaked clothing.

Symptoms.—The chief symptoms are, first, giddiness, feeling of contraction of head, and headache; later, partial or complete insensibility, facial cyanosis or flushing, tendency to mania during return of consciousness. It is necessary to distinguish between cases the effects in which are due to inhalation of fumes or gases of imperfectly consumed petrol, and those which are due to the inhalation of the vapour of raw or unburned petrol. There is likely to be present in cases due to the latter cause more marked facial cyanosis and carbonisation of the blood than in those due to the former.

Massanek of Buda-Pesth records the case of two boys who were in a closed room with a smoking petrol lamp. One of them was found dead, and his blood gave the spectrum of CO hæmoglobin. The other, a few days after, fell into a state of idiocy with a transient hemiplegia, which was followed by peripheral neuritis in legs and arms.

The composition of the fumes and gaseous products of consumed petrol will vary with the completeness or incompleteness of the combustion. Theoretically, complete or perfect combustion will produce mainly CO_2 and CO and water; but this in the usual motor vehicle is practically never attained. During imperfect combustion, various intermediate products are given off, among these being methane or marsh-gas and acetylene.

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[1] *Rev. of Neur. and Pyschiatry*, 1908.
[2] *B. M. J.*, vol. i., 1908, p. 807.
[3] *B. M. J.*, vol. i., 1908, p. 987.
[4] *Ibid.* vol. ii., 1908, p. 1747.
[5] *Ibid.* vol. ii., 1908, p. 1306.

6. Naphtha, Benzol, or Benzene (C_6H_6)

This substance, which in commerce is found as a clear, colourless or faintly straw-coloured, volatile liquid with a suffocating, disagreeable odour, akin somewhat to coal-gas, produces toxic effects not only when swallowed, but also when the vapour is continuously inhaled for a period of time, as in glove-cleaning, in waterproofing, in dyeing operations and in aniline manufactories. The term "naphtha" is used commercially, however, to cover substances which have distinctive chemical characters and different compositions.

Kelynack [1] records the facts of a case in which a woman drank about an ounce of benzene from which she died twelve hours afterwards.

The effects are more common, however, after inhalation of the vapour.

Foulerton narrates the case of a man who, entering a tank in which this vapour had accumulated, was found unable to stand, and although partly insensible was able to answer questions. He was excited. His face was flushed, but his body was cold. Pupils were dilated, but mobile. His respirations numbered only 8-9 per minute, and were deep, stertorous, and irregular in rhythm. He recovered.

In 1909, at a work in the neighbourhood of Glasgow, a workman, aged 28, when engaged in emptying a benzol tank into separators, found a bad leak had occurred. He prepared a wooden plug to stop the leak, and was in the act of knocking the plug into the breach when he was overcome by the fumes, and, attempting to escape, dropped dead a few yards from the spot.

In 1903 we had to investigate a case in which a young lad, employed in a work in which waterproofed material was made, was alleged to have died from exposure to the fumes of naphtha. It appears that after fabrics have been saturated with the waterproofing material dissolved in naphtha, they are placed in a drying-room to enable the naphtha to evaporate. It was the duty of this lad and others to suspend the fabrics to be dried upon wooden suspended rollers, and thereafter to descend to the floor of the drying-room—about ten feet lower than the platform where suspension was made—and give a signal to those on the platform when each roller had descended sufficiently. At this stage of the process the fabrics are highly charged with naphtha, which gives off a penetrating, suffocating odour. The deceased on the day of his fatal seizure had been engaged in the above-described operations. After about 400 yards of the waterproofed fabric had been suspended, during which he had made several descents to the floor of the drying-room, and after, in his last descent, he had been more than ten minutes on the drying-room floor, he ascended by means of a ladder to the platform, there staggered, and fell to the floor. On being attended to, he was found to be unconscious. He was removed outside into the open air, and while attempts were being made to revive him, he died. During our investigation we went into the floor of the drying-room, while a small quantity of fabric was suspended to be dried, but we were unable to remain any length of time owing to the suffocating sensation produced. The drying-room was supposed to be ventilated (1) by the suction action of a mill-race or water-course which passed underneath the main building a little below the level of the drying-room floor, and the course of which was along the narrower end of the room, and (2) by the action of a mechanically worked fan. The latter, however, was found to be in a dismantled condition, and had not been in working order for some time before. From the accounts given us by the co-workers of the deceased, there could be no doubt that intoxication, amounting in certain instances to complete insensibility, was not unknown amongst them prior to deceased's death, and all of them were able to describe more or less graphically their personal experiences of the effects of the fumes.

Another fatal case arising from naphtha fumes was treated in the Western Infirmary, Glasgow, in 1902. On the evening of Sept. 23, 1902, a man was brought there in an insensible condition. Although originally a seaman, he had been working for several weeks in a rubber and gutta-percha factory, his special occupation there being to dip crude rubber in naphtha. On the day in question, alone in an outhouse barricaded from the rest of the buildings, he

[1] *Med. Chron.* vol. xix., 1893, p. 112.

was engaged at this work. He was last seen well between 1 and 2 P.M., and from the amount of work he had done when he was found, it is supposed that he had been working till about 4 P.M., but from about 2 P.M., till 6.30 P.M., when he was found lying unconscious in his workshop, nothing was definitely known of his movements. When found by his foreman, he was lying on the floor, not beside the naphtha vat, but some distance from it and in close proximity to the water-pipe, which had been leaking. The leak was found to be partly covered with red lead. It was supposed that he was in the act of repairing this pipe, as indeed he had been told to do, when he was overcome by the fumes.

The day in question was a dull, muggy day, and although both window and door of his workshop were wide open, there was probably but little movement of air in the workshop. The leaking pipe was on the floor of the workshop, the floor itself being about 3 feet lower than the ground outside and the window and door levels. It was conjectured that as the density of naphtha vapour is about five times greater than atmospheric air, the vapour may have been so concentrated at the floor level that, stooping to mend the leak, he had been so rapidly overcome that he had not time to try to save himself. No other chemical but the naphtha was used in that workshop that day. On discovery, he was removed at once into the open air, and means of resuscitation, including artificial respiration, were tried. He reached the Infirmary at 7.40 P.M. He was then found to be deeply unconscious, and lay breathing heavily, the respirations being 24 per minute ; the face was slightly cyanosed ; lips were covered with a white froth ; breath had a sweet, heavy odour not unlike that of amyl nitrite ; pupils were slightly dilated, responsive to light, conjunctival reflex being present ; limbs were slightly rigid, and the jaws tightly clenched, the latter having been marked from the time he was found ; pulse at wrist could not be felt ; and temperature was slightly subnormal. After use of restoratives, he began to show signs of returning consciousness about 9 P.M., but afterwards became very restless and almost maniacal. He vomited several ounces of greenish fluid, in which no odour of naphtha could be detected. By 1 A.M. of next day, his temperature rose much above normal, his breathing had become more rapid, and diarrhœa began, and continued till the following day. Pneumonia gradually developed, and he died at 1.15 A.M. of Sept. 27, his whole illness having lasted a little over 3 days. Post-mortem examination of the body showed pneumonic consolidation of the bases of both lungs, and in parts the bronchioles and alveoli were coated with a thin film of fibrinous exudation. In upper part of left lung were a number of small ragged cavities where the lung tissue was beginning to break down. Both lungs showed signs of an acute bronchitis. Diplococci, probably the pneumococcus, and some of a larger size, were found. Stomach and intestines were œdematous, with patches of congestion, but no patches of erosion. Spleen was large, weighing 24½ ounces, due to attacks of malaria acquired during his seafaring life, liver and kidneys showed some slight changes ; the former, cloudy swelling, the latter, catarrhal changes in the tubules. The heart and brain were practically normal.

Oliver[1] says that "inhalation of the vapours of benzene affects people differently. Some persons are more susceptible than others, and are obliged to retire from the work, while others can remain at it. Its effects are more noticeable in young women than men. Females on the whole are more readily intoxicated, they become excited and hysterical. The power of walking is not interfered with. Both men and women complain of headache and giddiness after working in an atmosphere laden with benzene vapour. Occasionally they vomit. Although women seem to be more susceptible than men, yet even the men become intoxicated and feel as if they were drunk. On a sultry afternoon, the effects are more pronounced. . . . Naphtha produces similar symptoms."

Symptoms.—Excitement ; partial or complete insensibility ; dilatation of pupils ; symptoms of shock ; embarrassed and slow respiration ; gastro-intestinal irritation, as vomiting and diarrhœa ; collapse.

Post-Mortem Appearances.—Bodily cavities yield odour resembling coal-gas. Signs of death by asphyxia. Stomach conditions usually negative, but there may be œdema.

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[1] "Dangerous Trades," 1903, p. 492.

Fatal Dose.—When swallowed, one ounce or less. When vapour inhaled, amount not known.

Chemical Analysis.—Distil contents of stomach, or large portions of lungs; recognition of odour in distillate.

B. Sulphur Gases

The principle irrespirable gases of Sulphur are the Dioxide and Hydrogen Sulphide, the former because of its extremely pungent character, and its consequent irritant action upon the mucous membrane of the respiratory tract, and the latter chiefly because of its lethal action upon the blood after absorption. Sulphuretted hydrogen poisoning is recorded mainly of workmen employed in chemical works,[1] and in connection with sewers. Fatal accidents from the latter cause have been recorded as occurring in London, Belfast, Glasgow, and other towns. In London, four men lost their lives, in Belfast, two died and two recovered, and in the Glasgow case (1901), one died. While sewer-gas is a mixture of several gases, H_2S is undoubtedly the most lethal. Even in small percentages, it causes prejudice to the health of those exposed constantly to it. In amounts of 0·05 per cent. according to Lehmann's experiments,[2] it produces alarming symptoms, and of 0·2 per cent., fatal effects upon animals.

In Union Street, Southwark, London, in September 1903, a series of cases of sewer-gas poisoning occurred during operations for the substitution of a new for an old sewer. About 7 A.M. the men, ceasing their work, walked along the sewer toward the manhole to get to the ground level. As they neared the manhole one man after another was overpowered and dropped down insensible, until five in all were *hors de combat.* A sixth, although feeling like to be overpowered, managed to get to the foot of the manhole and to shout for assistance. This being quickly at hand, the men, one by one, were hauled out in an unconscious condition, and artificial respiration was applied by men of the Fire Brigade, who had been summoned. The men, as soon as signs of returning animation were apparent, were conveyed to Guy's Hospital, where under treatment they recovered sufficiently to be able to be discharged in three days.

The medical opinion formed at the time as to the cause was against that of sulphuretted hydrogen, although the blood was not examined spectroscopically.

In Dublin, during sewer operations, three workmen, one after the other, were rendered unconscious by an escape of foul sewer-gas. A police constable went to the rescue, but failed to appear. Another man went down, and he next failed to appear. To the rescue of the five men now below in the sewer, a sixth man descended. He was able to fix a rope around two, who were hauled up, before he became unconscious. Yet another volunteer descended, who succeeded in getting four of the unconscious men to the surface before he succumbed. It took seven more men, each in his turn, to complete the work of rescue. The constable and one of the workmen lost their lives, and the others were seriously ill for a time, but recovered.

Symptoms.—These are chiefly unconsciousness, cyanosis, and, generally, those of asphyxia due to stimulation of the vagus nerve, direct irritant action upon the alveolar mucous membrane of the lungs, and the combination of sulphur in the gaseous form with the hæmoglobin of the blood. This sulph-hæmoglobin is a comparatively stable compound, and may be detected in the blood of those poisoned by

[1] *B. M. J.*, vol. ii., 1892. [2] *Arch. für Hygiene*, 1892.

this gas by the following spectrum—viz. two bands as in oxyhæmoglobin, with the addition of a third narrow band in the red, between C and D, which does not disappear when a reducing agent is added. At the same time, it cannot be detected in the blood in every case of H_2S poisoning.

Post-Mortem Appearances.—These may be considered as those of death by asphyxia; but the blood has a darker due than in ordinary cases from this cause. On examination of the blood, a spectrum will perhaps be found which, at first sight, looks like that of met-hæmoglobin, —viz. two bands as in oxyhæmoglobin with a third narrow band between C and D toward the red end of the spectrum. It is, however, distinguishable from that of met-hæmoglobin by the fact that this third band does not disappear after addition of a reducing agent to the sulph-hæmoglobin, but does disappear in that of met-hæmoglobin.

Fatal Quantity.—Not well ascertained.

Fatal Period.—From some minutes to hours.

Treatment.—Removal to fresh, moving air; artificial respiration; oxygen inhalations; restoration of bodily warmth; and stimulants. The recommendation proposed by some to give inhalations of chlorine is, to our mind, so dangerous on the ground of the likelihood of its increasing the irritation of the already irritated respiratory mucous membrane, that it should on no account be tried.

Chemical Analysis.—The presence of this gas in the stomach and tissues may be detected by the addition to the filtrate of a soluble lead salt; but this when found in small quantity may only be the result of decomposition. The discovery of the spectrum of sulph-hæmoglobin is far better proof of its presence in the body, since it shows that the gas must have been exhibited during life.

C. Chlorine, Bromine, and Iodine

These three substances in the gaseous or vaporous form exert a highly irritant action upon the respiratory mucous membrane, characterised by violent convulsive coughing of an irrepressible kind and dyspnœa, which are followed by bronchitis or pneumonia. Chlorine inhalation is not an uncommon occurrence in chemical workers engaged in the manufacture of hydrochloric acid and bleaching-powder, but fatal results even from such occupations are very rare, and when they do happen are more likely to be due to the local inflammatory lung mischief than to any constitutional effect of the gas.[1] The chronic effects of exposure to an atmosphere containing chlorine soon become apparent on workmen. They become anæmic, lose flesh, and their teeth rapidly decay. Sooner or later, also, they develop lung complaints, which ultimately take the form of chronic bronchitis and emphysema; and, in addition, dyspepsia, which is not altogether due to this gas, but to the irregularity of their lives consequent upon day and night shifts of work. Sir Charles Cameron records a case in which a sailor died from having slept in a cabin containing a quantity of chloride of lime. Before death he was comatose. During the post-mortem examination of the body a marked odour of chlorine was given off when the ventricles of the brain were opened.[2]

Following upon this case, Binz of Bonn experimented upon rabbits, and showed that chlorine, as well as bromine and iodine, paralysed the nerve-centres and that the proximate cause of death was asphyxia.

Treatment.—In men who have been "gassed" by this substance, removal

[1] *Vierteljahrssch, f. ger. Med.*, 1888; *Dub. Quart. Jour. of Med. Sc.*, 1870.

[2] *Dublin Jour. of Mental Science*, Feb. 1870.

from the works is the first consideration, and thereafter confinement to bed, with treatment of lung sequelæ.

Fatal Quantity.—Not certain.

Fatal Period.—In the case mentioned in the first reference, the patient died at the end of 48 hours.

Bromine.—This substance both in the liquid and vaporous form has caused death. Internally, when taken as the fluid, it acts corrosively, and when inhaled, as an irritant upon the respiratory membrane. The compounds of bromine with ammonium, sodium, and potassium act as sedatives upon the nervous system, and in overdoses, produce unconsciousness and signs of collapse, and put life in jeopardy. Dr Dougall has recorded a case in which a patient took one ounce of potassium bromide one night, and half-an-ounce the following night. When admitted to hospital, he was unconscious, his face was livid, his extremities cold and blue, and his temperature 96·8° F. It was only after two weeks' treatment that symptoms of improvement manifested themselves.[1] Where liquid bromine has been taken, unconsciousness and collapse quickly supervene. Skin eruptions of different characters are occasionally produced from the internal administration of potassium bromide. (Fig. 127.)



Fig. 127.—Case of Anthracoid Acne from internal administration of Potassium Bromide. This illustration was kindly lent to the author by Professor Hall, University College, Sheffield.

Post-Mortem Appearances. — In the case where liquid bromine has been taken, there will be inflammation of gullet and stomach, with extravasations of blood into the mucous membrane, which, generally, presents a very dark, leathery appearance. When the substance has been inhaled, the burden of its action will have fallen upon the respiratory tract, and will be indicated by bronchitis or pneumonia.

Iodine.—Liquid preparations of iodine—such as the liniment or tincture—have been used for suicidal purposes, and cause corrosion of the parts with which they come in contact in swallowing, and also of the stomach. Its vapour is very irritant on the respiratory tract. Its potassium salt, which is now largely used in medicine, has given rise upon occasion to dangerous symptoms; but in the cases recorded, its exaggerated action—because the doses were not exceptionally large—must be considered as the effects of the patient's idiosyncrasy.

Symptoms.—In the liquid forms, when swallowed, the symptoms are those of a corrosive and irritant poison—viz. swelling of mucous membrane of mouth, throat, gullet, and stomach, accompanied by dark brown, or yellowish staining of parts; intense, burning pain in mouth, gullet, and stomach; vomiting; and generally, signs of shock.

Post-Mortem Appearances.—Are indicative of corrosive action by a brownish or yellowish substance.

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[1] *Glasg. Med. Jour.*, 1893.

Fatal Dose.—One drachm of the tincture has killed, but recovery has followed the taking of one ounce.

Fatal Period.—Is uncertain.

Treatment.—Siphon-tube with free lavage of starchy fluids, such as thin boiled arrowroot, cornflour, etc. Treatment, otherwise, should be conducted on general lines.

CHLOROFORM AND OTHER ANÆSTHETICS, GENERAL AND LOCAL

Chloroform ($CHCL_3$).—Deaths by chloroform may result from drinking the substance itself, or from inhalation of the vapour. Chloroform is but rarely taken, however, in the liquid form for suicidal purposes, but cases have been recorded where death followed at variable periods of time thereafter, after doses of one ounce, one and a half ounces, two ounces, and three ounces respectively, and on the other hand where recovery has followed the use of four and five ounces respectively.[1] We know of another case in which a medical man committed suicide in this way, but the quantity taken was not definitely known, although it was reckoned to be more than one ounce.

There have been but few cases recorded of its homicidal administration.[2]

The total number of deaths from anæsthetics reported in England and Wales in 1902-1906 was 786.[3]

Various views have been expressed by different individual writers and by Commissions regarding the intimate cause of death by chloroform during anæsthesia. All of these, however, agree upon two facts—viz. (*a*) that the drug has a paralysing effect upon respiration, and (*b*) that it causes a fall of blood pressure. Several hold the view that respiratory failure is the cause of circulatory failure, but acknowledge that in some cases circulation ceases before respiration. It is also generally agreed that the drug exercises a direct toxic action on the myocardium.[4] Experimental observation has also shown that safety or danger lies in the percentage amount of chloroform vapour which is exhibited during administration. Even a small quantity will kill when exhibited in a concentrated form, while a comparatively large amount will be safe if exhibited in a vapour below 2 per cent., because it is the amount which circulates through the heart and not the length of time of administration which is the important factor.[5]

Unexpected toxic effects have been observed both on patients and administrators when chloroform has been administered in the near vicinity of illuminating coal-gas. The symptoms in the latter take the form of headache, sickness, and vomiting. Such effects have been recorded by different observers. In those cases in which the administrators have exhibited symptoms, the patients have much more severely suffered, and in one or two instances have died after an interval of some hours after the operation was over. Betagh[6] observed that such effects followed the giving of chloroform under the following circumstances. A gas-stove had been introduced into the operating theatre for the purpose of warming the room. It was situated about 10 feet from the head of the operating table. Two operations were performed, chloroform being the anæsthetic employed. During the administration the anæsthetist began to suffer from headache and afterwards vomited, and his two assistants similarly suffered from headache. One of the patients operated on suffered afterwards from severe vomiting and convulsions. For some hours, her pulse was very feeble and frequent, and her urine, free from albumen before the operation, was now found to contain albumen, and also blood and hæmoglobin. Her skin for some days showed a yellow tint. The other patient some hours after the operation, exhibited signs of collapse, and in spite of prompt

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[1] *Cf.* thefollowing references:—Bridgman, *Lancet*, vol. ii., 1897, p. 384; *Brasch. Deutsche med. Zeitung*, 1890; *B. M. J.*, vol. ii., 1897; *ibid.* vol. i., 1898; *ibid.* vol. i., 1886, p. 541; *Med. Gaz.*, vol. xlvii., p. 675; *ibid.* 1866, p. 34.

[2] Caspar-Liman, *Handb. d. Gerichtl. Med.*

[3] *Lancet*, vol. i., 1908, p. 1235.

[4] Embley, *B. M. J.*, vol. i., 1902, p. 817.

[5] *B. M. J.*, vol. ii., 1903, p. 152.

[6] *Il Policlinico*, Dec. 1904; *B. M. J.*, vol. i., 1905, s. p. 64.

treatment died twelve hours after the operation. In order to discover whether the gas had exercised any influence on the vapour of chloroform inhaled, Betagh experimented upon twelve dogs and rabbits. Some of these he chloroformed in the immediate vicinity of a lighted gas-jet, in others, he conducted to the chloroform mask the products of combustion from a distant gas-jet. He found that the most harmful effects were produced when the chloroform was administered in close proximity to the gas flame, and on post-mortem examination of those animals, that microscopic examination of the lung tissue revealed small extravasations of blood therein. It is now well ascertained that the toxic effects occurring under the conditions described are due to the presence of gaseous oxychloride of carbon, a product of the decomposition of chloroform by the combustion products of coal-gas.

Armand and Bertier [1] have also drawn attention to the danger of chloroxycarbonic vapour in anæsthesia by chloroform. They affirm from experimental observations that the burning of coal-gas in a closed room pervaded by chloroform vapour, or the vapour of any mixture containing that drug, produces this poisonous vapour which, when abundant, is rapidly fatal to mammals and birds, that the presence of this vapour is evidenced in the form of visible white fumes which set up severe irritation of the mucous membranes of eyes, nose, and air-passages, that systemic poisoning is produced without any signal of danger, in the form of cyanosis and respiratory failure, and that the toxic agent in the fumes is not carbon monoxide but oxychloride of carbon, or, as they call it, chloroxycarbonic acid. They recommend that the use of naked gas-lights or of gas-stoves in operating rooms should be avoided if possible, but if the use of the former is unavoidable, that they should be placed near the ceiling, and that the room should be well ventilated.

There can be little doubt, also, that the severe after effects, sometimes observed after anæsthesia, are attributable in many instances to acetonuria set up by the anæsthetic. The subject of post-anæsthetic aceéonuria has been worked by Beasly.[2] He states that the administration of chloroform or ether invariably induces a temporary acute acetonuria, and that this is accompanied by symptoms of acid intoxication, sometimes ending fatally, where the kidneys fail adequately to excrete the acetone. This may not be an unimportant factor in those cases which are described as " delayed chloroform poisoning." [3]

Mortality Statistics.—So far as these are available they must be looked upon only as approximately accurate, since different recorders name different rates of mortality. It will, perhaps, be near the truth to say that the mortality from chloroform anæsthesia is about 1 in 2500 administrations, from ether about 1 in 12,000, and from nitrous oxide about 1 per million. Some observers are inclined from data in their possession to put the chloroform mortality nearer 1 in 1000 than 1 in 2500. The commonly accepted figure for chloroform is 1 in 3000, and for ether 1 in 15,000. Wendel [4] quotes different observers on this subject. He states that Gurit, basing his figures on the records of 330,000 administrations, declares the mortality from chloroform to be 1 in 2075, and from ether, 1 in 5112 ; Poppert, from chloroform, 1 in 2647, and from ether 1 in 1167 ; while White says the mortality from the latter is 1 in 16,000. On the other hand, it has been recorded that Von Nussbaum in 15,000 chloroform administrations has not had a death.[5]

Poisoning by Drinking Chloroform

The following are typical cases:—

1. Gibb Dun records the case of a man who was admitted into the Western Infirmary, Glasgow, at 1.10 P.M., on Sept. 22, 1895. He appeared almost dead. No respiratory effort was visible, and pulse could only be felt with difficulty. Face was very pale ; lips were cyanosed ; pupils were widely dilated, there was almost no ocular tension, the eyes looking as if in a dead subject, and eye re-

[1] *Rev. de Chir.*, No. 7, 1905.
[2] *B. M. J.*, vol. i., 1906, p. 1142.
[3] Renton, *ibid.*, vol. i., 1907, p. 617.
[4] *Münch. med. Woch.*, Aug. 14, 1906.
[5] *Vide* also Magaw, *Surg. Gynæc. and Obstet.*, vol. iii., Dec. 1906, pp. 795-799; Gould and Warren, "Internat. Text-book of Surgery," vol. ii., pp. 446-447; *B. M. J.*, vol. i., 1908, p. 405.

flexes were absent; the voluntary muscles were flaccid; and the extremities were very cold. Artificial respiration was started at once. With the expired air came the distinct odour of chloroform. The stomach was well washed out, the food particles not having any special odour. Synchronously with the establishment of good natural respiratory movements the pulse improved, though feeble, numbering about 120 per minute. Strychnia was administered subcutaneously, and hot applications were made over cardiac region. By 5.30 P.M. the patient became conscious, though he was very dazed. He owned that he had swallowed about 5 ounces of pure chloroform with suicidal intent. Two days later a scarlatiniform eruption appeared on his limbs, resembling the rash sometimes seen after use of belladonna. He was able to leave the Infirmary the day following.[1]

2. Hayward records a fatal case of a woman, aged 39, who had taken 2 ounces of pure chloroform. She had been drinking heavily for some days before. She was found in bed unconscious, and an empty bottle which had contained the chloroform was found lying by the bedside. She had been seen by a servant at 11 A.M., who thought her to be sleeping naturally. At 2.30 P.M. she was found to be deeply comatose, her face blanched, her lips and fingers livid, the body and extremities cold, pulse imperceptible at wrist, heart sounds very feeble, breathing shallow but regular, corneæ insensitive, pupils equal, semi-dilated, and feebly responsive to light. Her breath smelled of alcohol, with a suspicion of chloroform. There was no staining or whitening of lips or mucous membrane of mouth. She had evidently vomited prior to being discovered, and, soon after being found, vomited again, the vomited matter consisting of a dark chocolate-coloured fluid. She had passed *per rectum* a few ounces of bright blood. Under treatment she seemed at first to improve, but at 4.30 P.M., when she had recovered consciousness sufficiently to be able to complain of pain in the abdomen, she was seized with a violent attack of retching and suddenly collapsed and died. Post-mortem examination of the body twenty-four hours after death showed that the right heart contained dark cherry-red-coloured, uncoagulated blood, and the left heart to be empty. The stomach contained about an ounce of dark chocolate-coloured fluid which smelled of chloroform, the walls of stomach were slightly congested, with a few scattered extravasations of blood and patches of post-mortem digestion. The small intestines were intensely congested throughout, the mucous membrane being swollen, velvety, and of a dark cherry-red colour with numerous extravasations, and contained a quantity of dark-red fluid smelling strongly of chloroform. The presence of chloroform in intestines was confirmed by distillation of the fluid contents, and by heating the glass tube leading from the retort, evidence of chlorine gas was obtained by its action upon iodised starch and litmus papers.[2] In a Glasgow lodging-house in 1906 a woman was found dead in bed with a handkerchief over her face, and a phial containing a few drops of chloroform beside her. It was supposed that she had put herself under the influence of the drug, and died from its effects.

Criminal Administration by Inhalation

3. At the Central Criminal Court, London, in April 1904, George Hallam was found guilty of administering chloroform to his two children, aged 11 and 14 years respectively, with intent to murder. Accused took the children to a flat, and after administering the chloroform left them there. He was sentenced to penal servitude for life.

4. On Feb. 22, 1902 at the Liverpool Assizes before Mr Justice Bucknill was tried the case Rex *v.* Lancaster and Cook. The accused were unregistered dentists, and the charge against them was one of manslaughter in that they had administered chloroform to a woman in such a manner that she died. In his summing up the judge said as follows:—" It is not illegal for these men or either of them to administer chloroform provided they do it with the ordinary care and skill of a qualified practitioner. Before he would let the case go to the jury, the Crown must show some evidence of negligence, and such evidence as would justify the jury in finding them liable. It was alleged that the woman had died of an overdose. Where was the evidence of that? In his opinion there was none. Nothing could be made out of the fact that they were unregistered

[1] *Glasg. Med. Jour.*, May 1898. [2] *B. M. J.*, vol. ii., 1902, p. 1122.

practitioners. Where was the evidence of want of skill ? It was rather the other way. It showed that they had administered chloroform 350 times without an accident. There could be no conviction for manslaughter upon such evidence, and he must direct an acquittal." The jury agreed, and the prisoners were accordingly acquitted and discharged.[1]

5. Actions of damages against medical practitioners for deaths occurring during anæsthesia.

(*a*) In 1903, an action was raised in the Court of Session, Edinburgh—Gillies *v.* Cunningham—in which the pursuer asked that damages of £1000 be cast against the defendant, a medical practitioner, the plea-in-law being that the death of pursuer's husband was due to the culpable negligence or want of reasonable skill of the defender in the administration of chloroform. Along with other medical witnesses, we gave evidence for the defender. The jury gave a unanimous verdict for the defender.

(*b*) Another similar action was raised in the same Court in 1905 against another practitioner in which we were precognosced for the defender. The case did not come to evidence because in the interval the defender became of unsound mind, and had to be confined in an asylum, owing to the mental worry of the possible consequences of the action on his professional reputation.

(*c*) The following case was tried in a foreign Court. A man, who had sustained an injury to his arm, died while under the influence of chloroform administered to enable an operation to be performed. His legal representatives sued the surgeon for 50,000 francs on the ground that the surgeon had not informed the patient of the risk he ran from the use of that anæsthetic. The Court gave judgment against the surgeon, and ordained him to pay damages of 8000 francs. This judgment was appealed. The Court of Appeal reversed the decision, and awarded the surgeon costs on the following grounds—viz. (1) that the medical evidence did not support the view that intemperate alcoholic habits constituted a contraindication to the use of chloroform ; (2) that the use of that anæsthetic should not be restricted to conditions only which threaten life, since such a rule would deprive many patients of the benefits of anæsthesia ; (3) that the failure to impress definitely on a patient the risk of death from any anæsthetic was not a culpable omission, as the risk was a small one (1 in 2000) ; and as the danger of sudden death depends upon the impressionability of a patient, this might be increased by dwelling on the danger to which a patient would be exposed in anæsthesia, the duty of a doctor being rather to reassure a patient and to inspire him with confidence ; and (4) that the patient in this case, like everyone else, must have known, and did in fact know, that a certain risk attended the use of chloroform.[2]

Symptoms.—The effects of chloroform inhalation being familiar to all students of medicine, it is not necessary to deal with these now. The lethal or toxic effects often come on so rapidly and unexpectedly, however, that respiration or circulation has ceased practically without any warning. The danger zone is entered whenever the pupils begin to dilate.

Treatment.—If the drug has been swallowed, the siphon-tube and free lavage of the stomach must be resorted to until the returning fluid ceases to have the odour of chloroform. Should respiration be embarrassed, artificial respiration should be instituted, first by itself, then afterwards with tracheotomy, along with the application of the electric current to the phrenic nerves, inhalations of amyl nitrite, subcutaneous injections of strychnia, rhythmic traction of the tongue, and inversion of the patient. The anæsthetist should provide for possible emergencies by having at hand catch-forceps, hypodermic syringe charged with strychnia solution, etc., and, when possible, the patient should have been suitably prepared for the anæsthetic, and the condition of the principal organs previously ascertained.

Post-Mortem Appearances.—Where the drug has been swallowed, inflammation and erosion of the mucous lining of the stomach, and, perhaps, of bowel also, are likely to be found, along with a distinct, if not, indeed, very marked, odour of chloroform.

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[1] *B. M. J.*, vol. i., 1902.

[2] *Ibid.* vol. i., 1906, p. 282 ; *ibid.* vol. i., 1906, p. 1310.

Where death happens during the administration, our experience is that a definite odour of chloroform is not always perceptible when the body cavities are opened. In some cases we have found a marked odour, and in many a definite odour ; but this obviously depends on the amount of drug which has been used and the length of time of administration. MacWilliam, in his experimental observations on cats put under the influence of this anæsthetic, states that if the thorax of the animal be opened immediately on the occurrence of cardiac collapse, the whole heart will be found largely distended, and will exhibit only feeble and insufficient efforts of contraction ; that some hours after death the left heart will be found rigid and small, while the right heart will still remain distended. In some instances, both ventricles are found rigid and empty after death, and in some others, both ventricles contain a good deal of blood.[1]

During the last ten years, 1899-1909, we have made post-mortem examinations of the bodies of at least 64 persons who have died while under the influence of an anæsthetic. The following table furnishes particulars:—

Anæsthetic used	Number of Deaths
Chloroform	53
A. C. E. Mixture	4
Chloroform-Ether sequence	2
Ethyl Chloride	1
Ether (open method)	1
Ethyl Chloride—Ether sequence	1
Ethyl Chloride—Chl_2-Eth_3-Mixture sequence	1
Stovaine (spinal injection)	1
Total cases = 64	

Of these 64 cases, 21 deaths occurred before the operation for which the anæsthetic was being administered had been commenced, and 43 during the currency of the operation. Nine cases occurred in children under the age of twelve, and 55 in persons above that age. Of the 9 cases under twelve years, the ages were 4 months, 7 months, 13 months, 16 months, 18 months, 29 months; the remaining three cases being over three years and under twelve. Two of the total cases were of women in labour with contracted pelvis. The post-mortem appearances in 46 of the cases were indicative of death by cardiac failure or syncope, and in the remaining 8 cases by asphyxia. It will be observed that the asphyxial state is much less common than the syncopal.

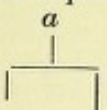
Of late, much has been written respecting *status lymphaticus* as a cause of death from anæsthesia by chloroform, although Paltauf [2] in 1889 and Kundrat [3] in 1895, had already drawn attention to the subject. The former said that such occurrences were likely to happen in those of "lymphatico-chlorotic constitution," as he termed it. By this he meant persons in whom the following conditions prevailed—viz. enlargement of tonsils, enlargement of lymphatic gland system generally, hypertrophy of follicles at base of tongue, enlargement of spleen and thyroid gland and persistent enlargement of thymus gland. Kundrat gave in 1895 accounts of the autopsies of ten cases in which the conditions above named generally prevailed. *Status lymphaticus* may be described shortly as a hyperplasia of the lymphoid tissues of the body shown by enlargement of pharyngeal, thoracic and abdominal glands chiefly, and, less commonly, of the mesenteric glands, as well as the other enlargements already described, associated with flabbiness or flaccidity of myocardium. It has been suggested that its existence may be suspected if there be hypertrophy of superficial glands of neck and axilla, enlarged tonsils and thyroid gland, adenoids, and a large flabby tongue. The immediate causal factor of death seems to us to be the flabby heart muscle in relation to the direct toxic action of chloroform there-

[1] *B. M. J.*, vol. i., 1902, p. 834.
[2] *Wien. klin. Woch.*, 1889.
[3] *Ibid.* Jan. 3-24, 1895.

upon. Ether would seem, therefore, to be a more suitable anæsthetic, but if chloroform is indicated, then after administration of a hypodermic injection of strychnia and atropine has been given.

Cases have been recorded by Hilliard [1] and others in this country. In Hilliard's case there were found on post-mortem examination enlarged thyroid gland, thymus gland weighing 24 grams, greatly enlarged spleen, with a supernumerary spleen, excessively developed Peyer's patches and solitary follicles, and enlarged mesenteric glands.

Dread of anæsthesia must not be kept out of the reckoning of causes of mortality. What is exactly the value of this factor it is impossible to appraise; but sufficient cases have been recorded to entitle one to conclude that in some cases, at least, it plays a not unimportant part. We are acquainted with the facts of a case in which a nurse, about to be submitted to an operation, walked into the operating theatre, was observed to become ghastly pale and to stagger and become unconscious. Closer examination proved that she was dead, all efforts at resuscitation being unavailing. Bodine [2] cites two cases. In the first the patient, who was a very nervous person, became so frightened that his respiratory rhythm was seriously disturbed. The anæsthetist instructed him how to breathe deeply before beginning to administer the chloroform. The cone was then placed over his face. He was told to breathe deeply; but after a few gasps, and before a drop of the anæsthetic had been administered, he ceased to breathe and could not be resuscitated. The second, also a very nervous man and dreading the operation he was about to undergo for hæmorrhoids, was given an enema before the anæsthetic was commenced to be administered. Thinking the operation had commenced, he ceased to breathe, and died. This observer is of opinion that it is largely the absence of fear in children and in women in labour which accounts for the smaller number of mortalities in their cases; and he contends that most deaths by chloroform are due to vasomotor paralysis, and that deaths by fright occur in the same way. Post-mortem examination revealed in the cases narrated tense, full abdominal veins.

Chemical Analysis.—Where poisoning by chloroform is suspected, it is necessary to prove its presence or absence in the body. That is done by finely mincing up parts of the lung, rendering the fluid slightly alkaline by sodium carbonate, placing the material in a suitable flask closed by a stopper containing two openings, through one of which a glass tube is passed right to the bottom of the flask, and through the other, a piece of hard glass tubing about 18 inches in length and tapered to a point at the free extremity, which is bent twice at right angles, 

. Through the former tube, air under pressure is passed into the flask, the flask and its contents being meanwhile gently heated, to assist in the disengagement of the chloroform from the mixture. While this is going on, a small Bunsen flame plays upon the latter tube, midway between the angles of the tube—at *a*—so that the tube is kept red-hot. When the chloroform vapour reaches this point, it is split up into chlorine and hydrochloric acid, which can be tested for in the usual way—the former by holding at the tapered extremity of the tube a piece of starch paper moistened with pure freshly-prepared potassium iodide which it turns blue, and the latter by alkaline litmus paper which it turns red, or by passing the stream of gas into a solution of silver nitrate, which causes a white precipitate of silver chloride to form.

Quantitatively, the chlorofrom may be estimated in terms of the chlorine passed into chloride-free distilled water, by titrating with a standard solution of silver nitrate (8·535 grams per litre of chloride-free water) using neutral potassium chromate solution as indicator.

Waller has suggested in place of the hard glass tube of the apparatus above described a combustion tube filled with chloride-free granulated magnesium oxide kept red-hot, from which, by washing the oxide with chloride-free water

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[1] *B. M. J.*, vol. i., 1908, p. 202.
[2] *Internat. Clinics*, 12th series, vol. iv., 1903, p. 153.

after distillation is finished, the combined chlorides may be titrated either in the manner above described or by Volhardt's method—viz. with standard silver nitrate and ammonium sulphocyanide, using iron alum as an indicator.

Vernon Harcourt decomposes the passing chloroform vapour in a moist atmosphere by an incandescent platinum wire fused into the tube through which the vapour passes. Sketches of each form of apparatus are given.[1]

Nicloux's method is based on a different principle.[2] The process is divided into two parts—viz. (1) separation of the chloroform as such by distillation, and solution of the distilled chloroform in alcohol ; (2) treatment of the separate alcoholic solution of chloroform with alcoholic potash, by which all the chlorine of the chloroform is combined with the KHO to form KCl, which is then estimated volumetrically in terms of chlorine by one of the above-described methods of titration.

Process.—A definite volume of blood or a weighed amount of finely-minced tissue is mixed with five times its volume of about 95% alcohol, and is acidified slightly with tartaric acid. The whole, put into a flask, is connected with a distilling apparatus, and the mixture distilled until about one-third of the entire volume is distilled over. The boiling point of chloroform being lower than that of alcohol, and that of alcohol than that of water, the distillate will contain all the chloroform dissolved in strong alcohol, and the water and excess of alcohol left in the flask containing the distilland.

The distillate is now put into a fresh flask, and about one gramme of chloride-free KHO dissolved in 10 c.c. alcohol added. The flask is now connected with an upright condenser, and the fluid in the flask boiled for at least half-an-hour, the reaction to KCl being then complete—viz.

$$CHCl_3 + 4KHO = 3KCl + KHCO_2 + 2H_2O.$$

The flask and contents, after cooling, are carefully neutralised with pure sulphuric or nitric acid, and the chlorine present estimated by a standard solution of silver nitrate (8·535 grammes to a litre of chlorine-free distilled water) of which 1 c.c. = 2 milligrammes of chlorine. Quantitative estimation may be made from the data taken.

Another test may be employed to the clear fluid obtained from filtration of the contents of stomach, or of lung extract treated as above—viz. the β-Naphthol test. This is employed as follows :—Into a test-tube put some β-naphthol, and add to it a few drops of strong potassium hydrate solution ; then add two or three times the volume of the suspected solution, and gently warm the tube and contents ; if chloroform be present, the mixture will turn blue.

Ether ($C_4H_{10}O$).—In many parts of Europe the use of ether as an intoxicant is common, and, like alcohol, a tolerance to quantity may be established by repeated use. It is much less toxic and much more rapidly stimulant in action than chloroform. Its use as a cheap form of intoxicant is by no means uncommon at country fairs in the North of Ireland, in East Prussia, and in some parts of Russia.[3]

Hart has given a full account of its use in Ireland.[4]

Those who begin the habit take at first doses of from two to four drachms ; when the habit is confirmed, the amount taken may reach to ounces.

Death while under the influence of ether as an inhalation is less frequent than in the case of chloroform, but cases have been recorded. During ten years we have seen only one case.

Christison quotes a case of death from nitrous ether. A druggist's maid-servant was found dead in bed, the air of the room being charged with the vapour of this substance which had been liberated by the breaking of a three-gallon jar of *sp. etheris nitrosi.* Her appearance when found was that of a person in deep natural sleep. Post-mortem examination showed the stomach to be red internally and the lungs to be engorged with blood.[5]

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[1] *B. M. J.*, vol. ii., 1902, p. 116. *Vide* also *ibid.* vol. ii., 1901, p. 1859.
[2] *Ibid.* vol. ii., 1906, p. 1792.
[3] *Ibid.* vol. i., 1903, p. 98.
[4] *Ibid.* vol. ii., 1890.
[5] "A Treatise on Poisons," p. 964 ; *Edin. Med. and Surg. Jour.*, vol. xxxv., p. 452.

Ether when employed as an anæsthetic is used either in a closed apparatus, like that of Clover, or by the open method. The disadvantages of the former method are (1) partial deprivation of air to the patient, and (2) the reinspiration of products of expiration from the bag. The effects of these, coupled with the stimulating action of the drug on the mucous membranes of the air-passages, are (*a*) duskiness of the face, (*b*) laboured breathing with marked abdominal muscular movement, (*c*) considerable secretion of mucus from air-passages, (*d*) after sickness, and (*e*) sequent lung complications.

Armstrong of Montreal [1] has recorded the number of cases of lung complications which followed 2500 ether administrations. Of that total number, 52 developed some form of pulmonary mischief, and 32 of these died, and came to autopsy. Of these 52, 14 had lobar pneumonia (ten being septic cases in some form to begin with), 16 had broncho-pneumonia, 19 bronchitis, 3 plastic pleurisy, 1 pleural effusion, and 2 empyema.

Apart from the effects of the direct stimulating action of ether on the secretion of mucous membranes, there can hardly be any doubt that the deprivation of air and the rebreathing of expiratory products by the closed method must be held to be accountable in some measure for these pulmonary complications, as it is hardly possible to conceive that the rebreathing of air which has passed over the fauces, tonsils, and teeth again and again, could be innocuous, by reason of the micro-organisms present on these parts being taken up in the passing air, and being inhaled into channels the mucous lining of which is practically prepared for their reception and growth.

From this point of view, if from no other, there is advantage and cleanliness in the use of the open method. Besides, the value and usefulness of this method have been proved on the American continent for several years.[2]

Mixtures of Ether and Chloroform, with or without Alcohol, are also employed for anæsthetic purposes. The A. C. E. mixture, which was introduced by Billroth, is believed by some to be more dangerous in action than either pure chloroform or pure ether. We have made autopsies on the bodies of four persons who died while under the influence of this mixture.

Schleich's mixture,[3] which consists of ethyl chloride, 2 parts, chloroform 4 parts, and sulphuric ether 12 parts, is in use in Germany, but we have not found evidence of its use in this country; we have, however, made an autopsy of the body of one person who died while under the influence of ethyl chloride-chloroform (2 parts) -ether (3 parts) -mixture sequence, and one autopsy where the sequence of anæsthesia was ethyl chloride-ether.

Ethyl Chloride.—Is soluble in water to the extent of about 253·5 per cent. by volume, and is freely absorbed by the blood. Like chloroform, it enters into chemical union with the blood. It acts as a stimulant on the central vasomotor system. In 10 per cent. concentration and upwards it produces paralysis of myocardium comparable with that produced by chloroform in one-twentieth that concentration.

It has come to be used as a general anæsthetic for minor operations of short duration, or as the initial anæsthetic in an anæsthesia sequence, as for example, ethyl chloride-ether sequence. From twenty to thirty deaths while under its influence have been recorded in this country. We have examined one only.[4] But others have used it a large number of times without fatal consequences. Daniell, for example, in about 2000 cases had no death, and only one which gave him passing anxiety.[5]

Fairlie-Clarke relates a case in which dangerous symptoms developed in the course of anæsthesia, the dose being 8 c.c., sprayed on an Ormsby's inhaler and partly on the sponge.[6]

Somnoform is largely used in France, and is now being more frequently

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[1] *B. M. J.*, vol. i., 1906, p. 1141.

[2] *Surg. Gynæc. and Obstet.*, vol. iii., No. 6, Dec. 6, 1906, pp. 795-799.

[3] *Münch. med. Woch.*, Jan. 6, 1903.

[4] Luke, *B. M. J.*, vol. i., 1905, p. 1368; Gifford, *ibid.* vol. i., 1905, p. 73; *ibid.* vol. i., 1906, p. 558; p. 616; p. 1058; McCardie, *Lancet*, vol. ii., 1905; *B. M. J.*, vol. i., 1906, p. 616.

[5] *B .M. J.*, vol. ii., 906, p. 1257.

[6] *B. M. J.*, vol. i., 1906, p. 679; Wallace, *ibid.* vol. i., 1906, p. 1339.

employed in this country as a general anæsthetic for operations of short duration. It is composed of ethyl chloride 60 per cent., methyl chloride 30 per cent., and ethyl bromide 5 per cent. Cole,[1] Brown Kelly,[2] Daniell,[3] and others have written of its effects when used experimentally, and as an anæsthetic. From experiments with somnoform, Cole concludes that its chief danger is respiratory paralysis, and that owing to the depression or paralysis of the cardio-inhibitory fibres, and comparatively slight action on the myocardium which it produces, there is no danger of heart failure provided respiration continues or is kept going artificially. He is of opinion that, for prolonged operations, a combination of ethyl bromide with chloroform would be valuable, for ethyl bromide paralyses the vagi. Several deaths have occurred, however, from somnoform.

Nitrous Oxide is the commonest anæsthetic for dental work of short duration, and is perhaps, the safest anæsthetic for short-period anæsthesias. The mortality arising from its use has been reckoned to be about one per million. Deaths are, however, occasionally recorded.[4] In one of the cases under this reference, that of 1904, the body of the patient, a cretin, showed on post-mortem examination a large persistent thymus gland.

Tetrachloride of Carbon has been used largely as a hair-wash, and when so used has exercised its anæsthetic effect. Professor M'Kendrick has drawn attention to its substitution for petrol for this purpose. He narrates the case of a lady, undergoing a " dry " shampoo in a hairdresser's establishment with this substance, who perceived that it was exercising an anæsthetic action on her, and, indeed, she did become partially anæsthetised.[5] In 1909 a question was asked in Parliament on the subject, and the Home Secretary said this carbon compound was not a poison within the meaning of the Pharmacy Acts, and there were not, therefore, any restrictions as to its sale, but the Director of Prosecutions had the question of a prosecution under his consideration.

Stovaine and Other Injection Substances for Spinal Anæsthesia

Stovaine is a chlorhydrate of one of the amino-alcohols. It was discovered by Fourneau. The advantages of a spinal over a general anæsthetic seem to be mainly that with appropriate doses and operations to be performed on the lower part of body or lower limbs, the anæsthesia can be rendered complete below the level of the umbilicus, if the drug be injected into the spinal canal between the third and fourth lumbar vertebræ while the patient is in the sitting posture and the back bent forward. Stovaine-Billon is a sterilised solution of the drug manufactured by F. Billon of Paris, its strength being 10 centigrammes of stovaine per 1 c.c., and its average dose being $\frac{6}{10}$ths of a cubic centimetre or 0·06 of a gramme of the drug. A few deaths have followed the use of such drugs. We have made an autopsy on the body of one adult male who died while under its influence, the operation being amputation of a leg above the knee, and we know of a second death in Glasgow from the same drug. The main features of the post-mortem examination were (*a*) collapsed state of the lungs, and marked œdema on section, (*b*) the presence in both ventricles of the heart, but especially the right, of large, tenacious brown-coloured coagula, and (*c*) similar coagula in the large vessels of the liver and of abdominal veins, the clots almost forming casts of the vessels.

In January 1909, an inquest was held at Battersea concerning the death of a man, aged 72, who died while under the influence of this drug for an operation on the urinary bladder. During the operation the face of the patient became

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[1] *B. M. J.*, vol. i., 1903, p. 1421.
[2] *Ibid.* vol. ii., 1902, p. 588.
[3] *Ibid.* vol. i., 1904, p. 949.
[4] *Lancet*, vol. i., 1896, p. 48; *ibid.* vol. ii., 1889, p. 712; *B. M. J.*, vol. ii., 1904, p. 1635.
[5] *B. M. J.*, vol. ii., 1907, p. 775.

very pallid and he began to yawn, which continued till circulation and respiration ceased. Death was attributed to anæmia of the brain.[1]

Hardouin reports another death, and gives a list of fifteen others collected from French and German sources.[2]

Other spinal anæsthetics which are employed are (1) novococaine or novocaine, with adrenalin, and (*b*) tropococaine, the latter in doses of 1 c.c. of a 5 per cent. solution.[3]

For local anæsthesia, solutions of cocaine, of β-eucaine and of other cocaine derivatives are employed. *Alvatunder*, which is a cocaine preparation, is used in dental work. Deaths have followed the use of these preparations.[4] (*Vide post.*)

Legal Responsibility in Death during Anæsthesia

This question as between anæsthetist and surgical operator will probably have to be decided some day in the law-courts. In the meantime, it is the duty of the authorities who are charged with the investigation of the causes of sudden deaths, to make due inquiry regarding every death which happens during the administration of an anæsthetic. It is most desirable that the public should be assured from such inquiries that due care has been exercised prior to and during the administration of the anæsthetic, and that appropriate measures have been taken to resuscitate the patient. Deaths in Scotland under anæsthetics must be reported to the Procurator-fiscal, and those in England to the Coroner. By each official, an inquiry in accordance with the rights and duties of his office is held, and by each is the inquiry becoming more exacting. With the announcement of the death to the Fiscal in Scotland is furnished a report by the doctor, whose patient the deceased was, on a form supplied from the office of the Fiscal, in which are detailed the circumstances of the death, including the following details—viz. (1) Full name of patient; (2) Age; (3) Address; (4) When admitted to [Hospital or Nursing Home]; (5) Nature of Disease or Ailment; (6) Date of operation and hour of death; (7) When and by whom patient was informed that anæsthetic was necessary; (8) What precautions were used in preparing patient for its administration; (9) When, and by whom, was patient examined as to condition of heart, lungs, and urine, and what were their condition; (10) Anæsthetist, Anæsthetic, Method of Administration. Time during which patient was under the influence of anæsthetic; (11) What physicians were present at operation; (12) Who was Operator. This filled report is sent to the medico-legal examiner, who, from the facts found at the post-mortem examination, and from consideration of the terms of the report, must give his opinion on the following points in his report—viz. (1) The cause of death; (2) Whether the patient was medically examined before it was decided that an anæsthetic should be administered; (3) Whether all due precautions were observed, during the actual administration of the anæsthetic; and (4) Whether there were any symptoms about the patient which might and ought to have been discovered by examination indicating that the administration of an anæsthetic would be attended by special risk to life.

The question of apportionment of responsibility between the surgeon who operates and the anæsthetist who administers the anæsthetic is sure to arise some day in the immediate future. It is difficult, if not, indeed, impossible, to lay down a rule on the point, because there are several conceivable sets of relationships between these persons, even assuming that in all the sets they are both legally qualified practitioners. During an inquest held by the Coroner for the City of London and Southwark on a death from an anæsthetic, this question arose.[5] The Coroner held that the responsibility rested with the operating surgeon who controls the operation, and in a case of mala-praxis, or verdict of culpable neglect, by a jury, it might be the duty of the coroner to commit the surgeon and not the anæsthetist for manslaughter. *The Law Journal*, commenting on this, said "the necessity for operation is usually, but not always, decided on by the operating surgeon. When it takes place, the

[1] *B. M. J.*, vol. i., 1909, p. 376. [2] *Arch. Gen. de Chir.*, No. 8, 1908.
[3] *B. M. J.*, vol. ii., 1907, p. 869. [4] *B. M. J.*, vol. i., 1908, p. 120.
[5] *Ibid.* vol. i., 1908, p. 45; p. 119.

control of the operation must be in the operator's hands, but with a skilled anæsthetist, the fitness of the patient to take the anæsthetic must, as a matter of medical judgment and skill, be largely with the administrator." We doubt whether the rule, as stated by the coroner, could be applied in all cases ; for the circumstances of each individual case, assuming *culpa*, must determine the issue.

Chloral Hydrate, Bromoform, Iodoform

Chloral Hydrate ($C_2H_3Cl_3O_2$).—This substance is not infrequently used for suicidal purposes, and has been employed criminally by mixing it with beer or stout, with the object of stupefying persons for purposes of robbery. It is believed to act by being changed in the body into chloroform ; but this view has been challenged by some observers. In one case of suicide by an intemperate man seen by us, the quantity taken to produce death was 220 grains. We have also been engaged in a case where a prisoner was convicted of drugging the liquor of his victims by putting syrup of chloral hydrate therein, so that he might the more easily rob them. On the person of the prisoner four half-ounce phials (nearly empty) were found, the dregs of which proved to be chloral. He was sentenced to a term of penal servitude.

Occasionally this drug has caused death by having been taken or given accidentally. In one case half-an-ounce of the drug was taken in gin in mistake for salts [1] ; and the late Professor Tyndal met his death by accidental administration of an overdose of the drug. A woman suffering from bronchitis who was ordered one drachm of the syrup of chloral, but to whom, instead, was given one drachm of chloral itself, died within one hour.[2] The only fatal case in our knowledge resulting from the criminal administration of chloral was tried at the Liverpool Assizes, in March 1889, when a man named Parton was charged with the crime of wilful murder of John Fletcher in Manchester. The prisoner was seen to empty the contents of a small bottle into a glass of beer. The prisoner and deceased thereafter entered a cab, but later, while the cab was proceeding at a walking pace, the prisoner decamped. Fletcher when found in the cab looked insensible, but was able to direct that he should be taken to the Royal Infirmary, where he died just as that institution was reached. It was proved that the prisoner tried to purchase of a Liverpool chemist forty grains of chloral, but failed to get that amount without a prescription. While the chemist, however, was weighing out ten grains for him, the prisoner snatched up the chloral bottle and ran off. Chemical analysis revealed indications of chloral in the stomach and intestines, but not in the blood of deceased. The prisoner was sentenced to death, but was afterwards reprieved.

Symptoms.—Drowsiness, going on to unconsciousness ; slow, laboured respiration, with cyanosis of lips, and gradually weakening pulse ; contraction of pupils, almost to pin-head ; blanched or cyanosed condition of face ; subnormal temperature ; failure of heart's action. Paralysis of the heart is the cause of fatal issues.

Treatment.—Use of siphon-tube with free lavage ; restoration of body heat ; subcutaneous injection of strychnia ; administration of ether hypodermically, or of stimulants *per rectum*.

Post-Mortem Appearances.—These are practically *nil*.

Fatal Dose.—Very uncertain. While so small a quantity as twenty grains has killed an adult, a boy of sixteen has recovered from the effects of swallowing one ounce.[3]

Fatal Period.—Is variable. It may be comparatively short, or it may be prolonged for several hours, depending upon the onset of paralysis of heart.

Chemical Analysis.—As chloral hydrate is soluble in ethylic ether, the contents of the stomach, after having been freely washed with petroleum ether to get rid of fatty matters, are treated with ethylic ether in a separator, the ether is then separated and allowed to evaporate, when the chloral will be deposited. The urine may be treated in a like manner, in which chloral may be found along with urochloral acid.

Bromidia is a proprietary medicinal mixture sold for the purpose of sooth-

[1] *B. M. J.*, vol. ii., 1900, p. 468. [2] *Ibid.* vol. i., 1884, p. 475.
[3] Plummer, *The Lancet*, vol. i., 1894, p. 21.

ing the nervous system, and procuring sleep. Several fatal cases have occurred from the use of over-doses, its toxic effect being chiefly due to the chloral hydrate which it contains. The composition of bromidia is as follows :—Each fluid drachm contains 15 grains each of chloral hydrate and potassium bromide, and $\frac{1}{8}$ grain each of ext. cannab. indica and ext. hyoscyamus. It is recommended to be taken in half-drachm doses in water or syrup every hour till sleep is produced.

A fatal case from an overdose is reported of a London barrister, the verdict of a coroner's jury being that death was due to syncope from an overdose of bromidia taken for sleeplessness.

Bromoform ($CHBr_3$).—This liquid drug, which bears a close resemblance both in taste and colour to chloroform, has been much used of late years in the treatment of convulsive affections, and especially in whooping-cough. Its administration must be used with caution, chiefly by reason of its comparative insolubility in water, and its higher specific gravity (2·13) which is more than twice that of water. Burton-Fanning [1] recommended its use in whooping-cough, and that it should be prescribed in suspension with pulv. tragacanth co. and water, but owing to the high spec. gravity of the substance, in spite of this form of excipient, he found that it was liable to fall to the bottom of the bottle. He therefore advised that the last dose should be thrown away. From the difficulties of its equal admixture, cases of poisoning, fortunately as yet unattended by fatal results so far as we know, have occurred.[2]

Symptoms.—Unconsciousness, which supervenes rapidly ; feeble, or stertorous respiration ; weak, irregular, feeble pulse ; marked contraction of pupils ; and threatened collapse and death.

Treatment.—Use of siphon-tube and free lavage with warm water containing sodium carbonate or Condy's fluid, and, latterly, with coffee. Stimulants —as sal volatile, or alcohol—*per rectum*. Artificial respiration if necessary.

Toxic Dose in Children.—In a child of two, three or four minims have produced poisonous effects ; and in one of six years, a drachm and a half imperilled life.

Iodoform.—Iodoform is in common use as a surgical dressing, and causes toxic symptoms occasionally when absorbed from a large, raw surface. It has caused death when dissolved in ether and injected to render aseptic the interior of large, chronic, or cold abscesses. It has not yet been used with suicidal or homicidal intent. Eustace records a case in which a partically demented woman chewed an iodoform dressing, and thereafter betrayed toxic symptoms, the chief of which were cold extremities and delirium. She recovered. Oberlander records two cases, in which from its internal administration (·8 gramme daily in a pill) toxic effects were evinced when, in the one case, 42 grammes in all had been taken, and in the other, 5 grammes covering a period of seven days.

Koriander of St Petersburg, by experimental poisoning of dogs with iodoform, has shown that the chief post-mortem appearances found were (*a*) nephritic, affecting the renal glomeruli, and (*b*) fatty infiltration of liver by minute fat granules. In these experiments the iodoform was introduced into the peritoneal cavity of the animal.[3]

Symptoms.—When absorbed into the body from surgical dressings, it causes gastro-intestinal irritation, rise of temperature, and skin-eruptions. After injection, it has produced unconsciousness, with delirium, coma, and death. The symptoms were giddiness, vomiting, deep sleep, delirium. diplopia, and Cheyne-Stokes' respiration.

Sulphonal, or Disulphonethyl-dimethylmethane.—This is one of the comparatively new drugs for inducing sleep, and is used by patients just as opium or morphia, by repeating prescriptions without further medical advice. It is a crystalline substance, sparingly soluble in water but more freely in alcohol. Many cases of poisoning have already been recorded from its use in overdose. Waldo [4] records a case of a man of thirty-three years who had been in the habit

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[1] *Practitioner*, Feb. 1893.

[2] *B. M. J.*, vol. i., 1900, p. 1283 ; *ibid.* vol. i., 1900, p. 1340 ; *ibid.* vol. i., 1901, p. 1202.

[3] *Lancet*, vol. i., 1889, p. 140.

[4] *B. M. J.*, vol. i., 1901, p. 1473.

of taking hypnotics, and chiefly sulphonal, for several years. He developed pain and tenderness over the stomach, attended with nausea, vomiting, and delirium at nights. He gradually passed into a state resembling delirium tremens. His urine had a port-wine appearance, and smelt like chlorodyne or celery on different occasions. Four days before death, general convulsions set in. No urine was passed for forty-eight hours. The urine being submitted to spectroscopic examination showed the presence of hæmatoporphyrin—an iron-free pigment—which exhibits two spectra depending upon whether the urine be acid or alkaline ; in the former, there is a narrow band between C and D close to the D line, and a second much broader band between D and E ; in the latter, there is one band between C and D, two bands (distinct) between D and E, and a fourth broad band between E and F. Calvert relates a case in which a servant-maid had this condition of hæmatoporphyrinuria without having taken sulphonal.[1] Keith Campbell [2] records a fatal case with this urinary condition following the use of 30 grains of the drug in two doses. Knaggs [3] narrates the case of fatal poisoning in a man who took over an ounce of the drug, and died at the end of three days. Several other cases are recorded in Continental medical journals.

Some writers are of opinion that sulphonal as well as trional and veronal has a cumulative toxic effect.[4] This, however, is still doubtful, although there is not a little evidence in favour of that view. Percy Smith [5] records the case of a woman suffering from melancholia who took 300 grains of sulphonal within two days, from which she recovered after prompt treatment and without any apparent ill effects. Other cases of the toxic effects will be found in the under-noted references, but in no case with fatal result,[6] although in one case the patient had swallowed with suicidal intent about 245 grains, and continued somnolent for five days.

The remarkable colour appearances of the urine in cases of sulphonal poisoning, colours varying from port-wine to reddish-black in tint, have commonly been attributed to the presence of hæmatoporphyrin, but it has been found that if that blood pigment be entirely removed the urine remains of its original colour. In the case quoted, in which the patient took at one dose 235 grains of the drug, however, the urine at no time contained hæmatoporphyrin.

At an inquest held in Manchester in November 1909, it was shown in evidence that the man had swallowed two handfuls of sulphonal tablets, after taking a considerable amount of whisky, with the intention of committing suicide. On becoming unconscious he was sent to the Infirmary, where he died. On post-mortem examination the stomach was found to contain a considerable number of undissolved tablets of the drug. The verdict of the jury was suicidal poisoning by sulphonal.[7]

Fatal Dose.—Thirty grains have killed ; on the other hand, recovery has followed the ingestion of three ounces.[8]

Treatment.—Evacuation of contents of stomach. This appears to be a form of poisoning in which saline injections and bleeding and transfusion of live human blood ought to be tried.

Chemical Analysis.—There does not appear to be any method yet devised for its detection in the body, owing to its being decomposed. The spectroscopic detection of hæmatoporphyrinuria would afford strong suspicion of its use.

Trional, or Diethylsulphonmethylethylmethane.—This synthetic drug has been recommended as a safer substitute for sulphonal, but from recorded cases of its toxic effects, it ought to be used, if at all, with great caution. Mosso in 1894 demonstrated that it was cumulative in its action, and from the symptoms produced, there is suggested an affinity for groups of nerve cells in the anterior cornua of the spinal cord, in this being not unlike the action of some metallic poisons. Hart [9] records the case of a woman who had taken during two months about thirty 15-grain doses of the drug, and at the end of the time was seized

[1] *B. M. J.*, vol. ii., 1900, p. 1784. [2] *Jour. of Ment. Sci.*, Ap. 1898.
[3] *B. M. J.*, 1890, vol. ii., p. 955. [4] Bampton, *B. M. J.*, Nov. 4, 1899.
[5] *Ibid.* vol. i., 1900, p. 136.
[6] *Ibid.* vol. ii., 1898, p. 807 ; p. 1337 ; *ibid.* vol. i., 1899, p. 209 ; *ibid.* vol. i., 1909, p. 1235.
[7] *B. M. J.*, vol. ii., 1909, p. 1431. [8] *Deutsche med. Wochenschr*, 1891.
[9] *Amer. Journ. of the Med. Sci.*, Ap. 1901 ; *B. M. J.*, vol. i., 1901, *sup.* p. 97.

with acute gastro-intestinal inflammation. The urine became black in colour five days after, and contained hæmatoporphyrinuria. A few days later tingling of arms and legs, with diminished sensibility, loss of power, and decreased reflexes, followed. Three weeks after the onset there was well-marked double wrist-drop and foot-drop, loss of weight, delirium, and hallucinations. She recovered over a year after. Other cases, fatal and non-fatal, are recorded in Continental medical journals.

Fatal Dose.—Not well ascertained.

Treatment.—This must have special reference to the profound changes in the blood, whence arise the symptoms referred to. Whether repeated bleedings and transfusions of blood are likely to act beneficially remains yet to be tried; but they are undoubtedly indicated.

VERONAL OR DIETHYLMALONYL-UREA occurs in colourless and odourless crystals, which liquefy at 191° C. One part of the drug is soluble in 12 parts of boiling water, and in 145 parts of water at 20° C., and is freely soluble in alkaline solutions. If one may judge from the relatively larger number of deaths which have been recorded after its use, it would seem to be more toxic than sulphonal or trional. Most of the fatal cases have been recorded in foreign medical literature. We have had on one occasion to make a post-mortem examination of the body of a female lunatic who died after this drug had been administered.

Lyons [1] records the case of a lady who betrayed serious toxic symptoms after taking two powders, each of which contained 10 grains of this drug, and one quarter grain of codeia.

Death has followed doses of 170 and 232 grains respectively,[2] and Davies records a case where death followed a dose of 90-105 grains.[3]

Symptoms.—Profound sleep; respiratory enfeeblement tending toward respiratory paralysis; cyanosis; feeble pulse; and variable pupillary conditions.[4]

PARALDEHYDE ($C_2H_4O_3$).—This fluid hypnotic drug possesses an extremely unpleasant taste and a very penetrating odour, but while it might be supposed that such properties would be against the acquisition of a habit, habituated use is by no means uncommon. It seems, like other alcohols, to lose its effect in uniformity of dose, and hence the dose has to be increased. We have had personal experience of one such case in an elderly man, the victim of diabetes and insomnia, who acquired an inordinate craving for the drug and took daily large doses of it.

Death from an overdose is comparatively rare, but cases have been recorded.

1. A patient in a fever ward of Cork Workhouse was given by mistake six to seven teaspoonfuls of the drug. In about five minutes afterwards he became unconscious, and, despite medical treatment, died four hours later.[5]

2. Behr records the case of a neurasthenic lady to whom paraldehyde was given for insomnia in place of sulphonal, which had not acted successfully. The prescribed dose of a teaspoonful daily was soon increased to a dessertspoonful, and by the end of six weeks had reached 15 grammes daily. This last amount was taken daily from the middle of January till the end of May, when she was found to be extremely anæmic, her face of a corpse-like colour, and her eyes fixed and expressionless. She had tremors of hands and tongue. All drugs were discontinued. Great restlessness thereupon developed, and the tremors increased. She took alternate fits of screaming, and laughter, and had hallucinations of sight, hearing, and smell, exactly like those of delirium tremens. She recovered after some weeks.

The same writer states that a dose of 50 grammes was inadvertently given to two lunatics, both of whom recovered.[6]

We have examined the body of an insane woman in an asylum who died after

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[1] *B. M. J.*, vol. i., 1907, p. 259.
[2] *Ehrlich. Münch. med. Woch.*, 1906.
[3] *B. M. J.*, vol. ii., 1909, p. 1154; *ibid.* vol. ii., 1909, p. 1387.
[4] *B. M. J.*, vol. ii., 1904, p. 1679; *Lilienfeld. Berl. klin. Woch.*, May 25, 1903.
[5] *Lancet*, vol. ii., 1890, p. 423.
[6] *St Petersburg, med. Woch.*, No. 14, 1902.

a dose of this drug. The only post-mortem appearances worthy of note were hyperæmia of the gastric mucous membrane, and a very marked odour of the drug when the body cavities were opened.

Hydrocyanic or Prussic Acid (HCN)

Hydrocyanic acid, when pure, is a colourless, volatile liquid, evolving a strong odour of peach-blossom, laurel-water, or of bitter almonds. It is but feebly acid, reddening litmus paper but slightly. The Pharmacopœial preparation contains about 2 per cent. of the anhydrous acid, and that of Scheele, which is the only other preparation, sometimes used in this country, about 5 per cent. The former preparation, however, has been found to contain as little of the acid as 0·6 per cent., and as much as 3·2 per cent., while the latter has been found to vary between 2 and 8 per cent. When inhaled, its odour causes a feeling of chokiness or constriction in the throat. It has a pungent, acrid, or bitter taste. It has never been found as a natural constituent of the body, although traces of sulpho-cyanides are found in the saliva. It is not a product of putrefaction so far as is known, but it may be formed by burning organic matter with alkalies at a red heat, the carbon and nitrogen of the former uniting with the latter to form cyanides. It is not found in nature as such, but in the kernels of various fruits, as of hawthorn, peach, plum, bitter almond, apple pips, and others, amygdaline and emulsine exist which react upon one another in presence of water and form the acid ; in like manner may it be said to exist in the leaves of cherry-laurel, a preparation of which is used in medicine, and which contains about 0·08 to 0·1 per cent. In oil of bitter almonds it exists in much larger percentage than in preparations from other fruits, the quantity of acid varying from 8 to 15 per cent. " Essence of almonds," which is the oil dissolved in spirit, is very poisonous. The eating of bitter almonds has produced toxic effects on more than one occasion.[1] A clergyman at West Malling, Kent, prescribed for a young girl, a parishioner, and administered to her some oil of bitter almonds, from which she died. The coroner's jury returned a verdict of manslaughter.

Hydrocyanic acid combines with bases of several metals to form cyanides, those of the alkalies and alkaline earths being soluble in water, alkaline in reaction, and therefore give off HCN in presence of even the feeblest acid ; those of the heavy metals, as mercury, zinc, lead, copper, and others possess no odour, are insoluble in water, but give off HCN in presence of mineral acids. In addition, it combines with metals to form double cyanides, such as the ferro- and ferri-cyanide of potassium ; and in combination with sulphur, forms sulphocyanides or thiocyanates with alkalies and alkaline earths, iron, mercury, etc. All of the sulphocyanides, however, possess no odour, are poisonous, and give off HCN when distilled with acids.

Of these preparations the most likely to cause poisoning are (1) oil of bitter almonds, (2) cyanide of potassium,[2] which is used in photography, electro-plating, and gold-recovery, and (3) hydrocyanic acid itself. Laurel-water, however, has also caused poisoning.

[1] *South Australian Register*, Aug. 6, 1879 ; *B. M. J.*, vol. ii., 1881, p. 12 (Baker).

[2] *B. M. J.*, vol. i., 1884, p. 228.

Cases.—1. Harpy records the case of a boy, aged 9, who retired to bed in good health save a little toothache. Soon after, the attention of a younger brother, who slept with him, was attracted to him owing to vomiting and his peculiar breathing. His mother being called found him unable to speak. His eyes were wide open, bright and staring, his lips and fingers of a violet colour, his jaws clenched, his limbs in a state of clonic spasm, and his breathing coming in gasps. A strong odour of prussic acid was perceived from his breath. After treatment, he recovered consciousness about three hours later, and got well. It appears that his mother soaked a piece of cotton-wool with what she thought to be almond oil, and put it in the hollow tooth. The oil, however, proved to be oil of bitter almonds, containing 15 to 20 per cent. of prussic acid. It was thought that the boy had swallowed the piece of wool in his sleep, as it was not found.[1]

2. Norman Moore narrates the case of a man who was found dead in bed in a hotel. He had taken half-a-tumblerful of a saturated solution of potassium cyanide. Post-mortem examination of the stomach and gullet showed that their mucous surfaces were of a peculiar reddish-brown colour and very much wrinkled, but there was no evidence of hæmorrhage and no detachment of the mucous membrane.[2]

3. Dobson tells of a young woman, aged 20, a worker in photography, who was found lying at the foot of a staircase in an unconscious condition, breathing stertorously, with widely dilated pupils and no pulse at the wrist, and cold. She had vomited, and the vomited matter smelled of bitter almonds, as did also her breath. She recovered after treatment. It appeared that she had been scraping a lump of potassium cyanide with a knife, and it is believed had put the blade into her mouth.[3]

4. Hislop reports the case of a photographer who took an overdose of the cyanide. He died. Post-mortem examination gave the following results :— skin of body pale, except of sides and back, which were livid ; much frothy mucus escaping from mouth ; lower lip red and corroded ; mucous membrane white in colour and easily stripped ; hands clenched, and finger nails deep blue in colour ; toe nails of a like colour ; meninges of brain and brain-substance deeply congested ; right heart engorged with dark blue clotted blood, left side contracted and empty ; lungs dark and engorged ; mucous membrane of stomach and intestines congested in patches. Cyanide found in stomach washings.[4]

5. Wigglesworth narrates the case of a man, aged 25, who at 4.30 P.M. was seen by a child to drink something from a bottle, throw the bottle away, and then to fall down. The child ran and told her mother. The man was found on the ground in convulsions and foaming at the mouth. When seen by the narrator, the man was insensible, his face greyish-blue in colour, mouth covered with foam, jaws tightly clenched, so much so that one of the teeth was broken in forcing open the mouth to introduce the stomach-tube, eyes were intensely injected and fixed, pupils largely dilated, but conjunctival reflexes present ; breathing was pectoral, inspirations jerky and sounded like a faint hiccough, pulse small and rapid, arms slightly flexed at elbows, fingers tightly contracted, thumbs firmly pressed into palms of hands, and abdominal muscles rigid. The bottle from which he drank smelled of potassium cyanide. By vigorous treatment he improved, and by 8.15 P.M. had regained consciousness. It was thought he had taken about 20 grains of the poison.[5]

6. A man in Halle took suicidally a "considerable quantity" of potassium cyanide in solution, and also a solution of atropine. Attacked by fainting fits he was taken to hospital and treated. Although no antidote was used, by next day he was quite well. It was thought that the atropine had counteracted the action of the cyanide. Atropine had before this been recommended as an antidote in poisoning by this salt.[6]

The sensational and somewhat dramatic suicide by this substance of

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[1] *B. M. J.*, vol. i., 1905, p. 941.
[2] *Ibid.* vol. i., 1882, p. 740.
[3] *Ibid.* vol. i., 1896, p. 17.
[4] *Lancet*, vol. ii., 1890, p. 1266.
[5] *B. M. J.*, vol. i., 1897, p. 1093.
[6] *Lancet*, vol. ii., 1890, p. 542.

Whitaker Wright after receiving sentence in a London law-court will be in the recollection of readers.

7. In Feb. 1906, two men, employed in a chemical work near Glasgow, were engaged in cleaning out sodium cyanide tanks after removal of the liquor. The tanks, which are 10 ft. deep by 7 ft. 2 in. in diameter, were used for absorbing HCN gas in the NaHO liquor which they held. On the top of the tank is a manhole 15 in. in diameter. After the process of absorption has been in operation for a length of time, the muddy material which deposits at the bottom of the tank has to be removed by hand, after the caustic NaHO liquor has been drawn off. The men, one inside the tank to fill the buckets with the deposit and the other outside to empty them, were so engaged when they were overcome by the hydrocyanic fumes, but although they were promptly rescued and resuscitative measures were employed, they quickly died. A third man, one of the rescuers, was also affected but recovered.

8. A junior house surgeon in a hospital committed suicide in 1905 by taking prussic acid. An empty bottle smelling strongly of that poison was found lying beside his dead body.

In Dec. 1909, at Verdun, France, a number of men belonging to a squadron of soldiers refused to eat the soup offered to them for dinner because of the unpleasant smell it emitted. They complained to the colonel, who caused inquiry to be made. On analysis the soup was found to contain much potassium cyanide. Suspicion fell upon a non-commissioned officer, who was arrested and, later, confessed his guilt.

Symptoms.—These to some extent depend on the preparation which is swallowed, and its quantity. In large doses, the acid produces death almost instantaneously, with lightning-like action; but during the act of swallowing, a hot, bitter taste is said to be experienced in the mouth. Whether this be so or not, after a convulsive cry, complete loss of consciousness and muscular power almost immediately supervene, with hurried respiration, sometimes convulsive, sometimes stertorous, imperceptible pulse, coldness of extremities, prominent, glistening, staring eyes with dilated pupils, which are non-reactive to light; then follow convulsive seizures, and death. If death be not so rapid, froth may appear at the mouth, and relaxation of sphincters of bowel and bladder may take place with voidance of contents.

In poisoning by potassium cyanide the rush of symptoms is not so rapid. These symptoms are as follows:—convulsive seizures, insensibility; odour of prussic acid in breath, and in vomited matter, should there be vomiting; face somewhat cyanosed; foam or froth at mouth; jaws tightly clenched; respirations jerky, hiccoughy; pulse small and rapid; eyes staring and fixed, with marked dilatation of pupils; and convulsive position of fingers in hand. Cases of poisoning by this salt may be consulted in the following references.[1]

The proximate cause of death is through the nervous system; but whether this is effected by the direct operation of the poison upon the central nervous system as is held by Preyer or others, or upon the vasomotor centre or the respiratory centre as is held by other observers, is not yet quite clear. But it must be remembered that hydrocyanic acid acts upon hæmoglobin, forming a compound which has been called cyanmethæmoglobin, which cripples the oxygen-carrying function of the red corpuscles. There is nothing, therefore, to interfere with the hypothesis that the effect of the acid upon the blood is

[1] *B. M. J.*, vol. i., 1896, p. 17; *ibid.* vol. i., 1897, p. 1039; *The Lancet*, vol. ii., 1889, p. 42; *Chem. News*, 1861, p. 261.

to produce convulsive seizures and early insensibility, as the result of the conveyance of imperfectly-oxygenated blood to the nerve-centres.

Post-Mortem Appearances.—Externally these are: open, fixed, staring eyes with dilated pupils, froth at the mouth, fixation of jaws, and convulsive attitude of hands. In addition to these, the colour of p.-m. lividity is sometimes pinkish or rosy, although not so pronounced as in CO poisoning. Internally, the signs are remarkably negative, except that the lungs are engorged and the right heart also engorged, the left heart being usually empty. The tell-tale odour of prussic acid will most likely be present on opening the chest cavity, and in the contents of stomach. Owing, however, to the red colour of cyanmethæmoglobin which is formed, the mucous membrane of the stomach may be of a reddish hue. The blood is usually dark in colour; it is never bright red as in CO poisoning. Moore gives an account of the appearances found in the internal organs of a man of 28 who died from the effects of swallowing about half-a-tumbler of a saturated solution of the cyanide. He had not vomited, and lay as if asleep. The stomach and gullet were of a peculiar reddish-brown colour, and were very much wrinkled; but there was no hæmorrhage, nor was the mucous membrane detached at any point. All the cavities of the heart contained imperfectly clotted blood; the lungs were engorged; the brain was normal, as were also the small intestines.[1] Spectroscopic examination of the blood ought to be made in such cases, for the compound of HCN and hæmoglobin is fairly stable, and its presence is betrayed by the following spectrum—viz. bands resembling those of reduced hæmoglobin, and which are not affected by NH_4HS.

Death most usually happens from asphyxia, hence the signs of this form of death are present.

Fatal Dose.—The smallest dose which has been shown to be fatal was half-a-drachm of the B.P. acid, which if reckoned to contain 2 per cent. of the anhydrous acid, is equal to 0·6 grain of anhydrous hydrocyanic acid.[2] Probably the next smallest was 20 grains of Scheele's acid, equivalent to 50 grains of the B.P. acid, and to one grain of the anhydrous acid.[3] On the other hand, recovery has followed the use of much larger doses, as 1·3, 2·3, and 4·8 grains of anhydrous acid respectively.[4] The vapour of the acid has caused the onset of dangerous symptoms, and, according to Christison, the application of the acid to a wound upon the hand caused death one hour afterwards. From the foregoing it may be taken that one drachm of the B.P. acid will kill. Two drachms of the oil of bitter almonds killed a man in seventeen minutes.[5] Five grains of the cyanide of potassium has produced death, but recovery has followed larger doses.

Fatal Period.—This usually falls within five minutes; but cases have been recorded where persons have survived its use for twenty minutes and longer. In a case of suicide, in which a woman swallowed a weak preparation of the acid, death did not ensue for forty minutes.[6]

[1] *B. M. J.*, vol. i., 1882, p. 740.
[2] Garstang, *The Lancet*, vol. ii., 1888, p. 15. [3] *Med. Gaz.*, vol. xxxv., p. 896.
[4] Shively, *Internat. Jour. Med. Sciences*, vol. 100, 1890, p. 47; *B. M. J.*, vol. ii., 1890, p. 1120.
[5] *The Lancet*, 1863, vol. ii., p. 447. [6] *Ibid.* vol. ii., 1889, p. 864.

In another suicidal case of a young woman in Belfast, life was prolonged for 3½ hours after taking the poison, which she had taken in milk.[1]

Cases of homicidal administration are fortunately few. In March 1845, at the Spring Assizes, Aylesbury, John Tawell was tried and convicted of poisoning a woman with prussic acid given in porter. The poison was discovered on chemical analysis in the contents of the stomach of the victim, and purchase of prussic acid by the prisoner was proved in evidence. In July 1860, at Lewes, a medical practitioner—George Ball—was tried for administering prussic acid to his mother, from the effects of which she died. This was really a case of poisoning by misadventure, and the jury returned a verdict of "Not guilty." At the Circuit Court, Glasgow, in Dec. 1857, Peter Walker was convicted of feloniously administering the acid to a woman, Agnes Montgomery. The poison was found in the stomach on post-mortem examination of the exhumed body. The prisoner confessed his guilt after sentence of death had been passed. Oil of bitter almonds was the form of poison administered by the prisoner Timmins who was tried at the Maidstone Assizes in 1883.

Treatment.—Immediate use of siphon-tube, and free lavage with warm water either alone or containing a 5 to 10 per cent. solution of sodium thiosulphate, or a mixture of the sulphates (ferrous and ferric) of iron followed by a solution of potassium carbonate, to form Prussian blue, which is inert; emetics, if tube be not available; stimulants, as ether subcutaneously, or brandy *per rectum*; cold affusions; artificial respiration; electricity to phrenic nerves and chest. Atropine hypodermically ought to be tried.

Chemical Analysis.—As hydrocyanic acid and its soluble compounds are rapidly decomposed in the body, examination for the poison should be made as soon after death as possible; and the same is true of any suspected articles of drink or medicine.

I. The first thing to note of the contents of the stomach, or articles of drink, is the presence or absence of the tell-tale odour; at the same time, the absence of the characteristic odour does not prove the absence of the poison.

Advantage should next be taken of the *volatile nature* of the poison for its detection. To test this, place a portion of the stomach contents, or other substance, into a wide-necked glass jar, covered with an inverted shallow glass or porcelain capsule. On the concave side of the glass capsule put a drop of silver nitrate solution; place the jar, etc., into a vessel of warm water; and note whether or not the silver solution becomes turbid. If it do so, owing to the formation of a new salt of silver, the new compound may consist of the chloride, carbonate, bromide, iodide, or cyanide. To distinguish between these—the mouth of the jar being meanwhile carefully stoppered—the precipitate should be examined microscopically for the presence of crystals, in the form of granules, prisms, and needles; it should next be noted whether or not the white precipitate darkens on exposure to light, for if it does, it is likely to be chloride of silver; if it do not, add a tiny drop of NH_4HS and evaporate to dryness, then dissolve the residue in water, add a drop of a *per*-salt of iron, and if HCN be present, a

[1] *B. M. J.*, vol. i., 1883, p. 131.

brilliant red colour of the sulphocyanide of iron will form, thus distinguishing it from the other salts of silver.

II. If a white porcelain capsule be now inverted over the mouth of the jar, having upon its concave side a mixed drop of solution of caustic potash and of solutions of a *per-* and *proto*-salt of iron, the presence of HCN is indicated by the drop assuming a bright blue colour, which becomes still more marked by the addition of a drop of hydrochloric acid, owing to the formation of Prussian blue ($Fe_4 3FeCy_3$).

III. Another white porcelain capsule having on its concave side a drop of NH_4HS should now be placed over the mouth of the jar. Even in the presence of HCN no visible change takes place in the drop, owing to the fact that the sulphocyanide of ammonium is colourless, but if a drop of perchloride of iron be added, a beautiful red colour will at once be struck. Stewart has suggested a very ingenious apparatus for carrying out the vapour tests. It consists of a shallow glass jar, closed by an india-rubber stopper carrying at right angles two glass rods ending in glass spoon bowls, into which the silver and potash solutions respectively are put. The prepared apparatus is then placed in a warm position for six or eight hours, the two rods removed, and a third, containing NH_4HS, substituted.[1] To the contents of the spoon bowls the above liquid tests are applied.

Quantitative Estimation.—An aliquot portion, previously estimated, of contents of stomach is placed in a retort, connected with a well-fitting condenser, and distilled, the distillate being collected in an ordinary receiver. Thereafter the contents of the receiver are acidulated with dilute nitric acid and excess of silver nitrate is added. The precipitate being washed and dried, is then weighed, 100 parts of the precipitate being equivalent to 20·15 of anhydrous prussic acid.

If prussic acid be thus obtained, and if the contents of the stomach were not found markedly acid in preliminary testing, then there can be little doubt that the HCN existed in the free state. In order, then, to distinguish between poisoning by free HCN and by an alkaline cyanide, a portion of the reserved fluid may be directly tested with a mixture of the *per-* and *proto*-salts of iron, and if Prussian blue be formed, it may be concluded that the HCN existed in the form of an alkaline cyanide.

Should the HCN not come over by simple distillation, it will be necessary before redistilling to acidulate the mixture with sulphuric acid; or should it be apparent that the poison existed initially as an alkaline cyanide, the acid should be added before the mixture is first distilled. By this method, however, it must be remembered that HCN may be evolved from the ferro- or ferri-cyanide of potassium.

The blood and bodily tissues may also be tested in the foregoing manner.

Failure to detect the poison in the body may result from undue delay, but notwithstanding its volatility and liability to decomposition, it has been detected weeks and months after death; for example, Reichardt [2] found it in a body two months after death. That it is liable to rapid decomposition in the body under certain circumstances

[1] "Trials for Murder by Poisoning," p. 72.
[2] *Archives Pharmac.*, iii. 19, 204.

is apparent from the fact that, as Casper states, Schauenstein, one of the Prussian official chemists, failed to find it 26 hours after death, but found *formic acid*, the main product of the metamorphosis of the poison in the body. It is important, therefore, that the presence of formic acid should be sought for, and its amount estimated in those cases in which poisoning by HCN is suspected, but where the poison as such cannot be found on analysis of the bodily organs.

Opium

Nat. Ord. = Papaveraceæ.—Opium consists of the inspissated juice of *Papaver somniferum*, and contains a large number of alkaloids, as morphin, narcotin, codein, narcein, thebain, apomorphin, anarcotin, and others, several of which are highly poisonous; the neutral substance called meconin or opianyl; and meconic acid. The principal alkaloids in use in medicine which are obtained from opium are morphia or morphin, codeia, and apomorphin, of which the first two act as narcotics or sedatives, the last chiefly as an emetic. Opium and morphia enter into the composition of a number of official preparations as well as of patent medicines, as for example, chlorodyne, nepenthe, Godfrey's cordial, Dalby's carminative, Winslow's soothing syrup, Battley's solution, Locock's pulmonic wafers, and others.

Cases of poisoning may arise from any of the preparations which contain opium, but the commonest forms are laudanum, chlorodyne, and of the preparations of morphia, any soluble salt of the Pharmacopœia.

Symptoms.—These appear earlier from the use of morphia than from crude opium or its preparations, and they may be divided into two groups—viz. those indicative of excitation of the higher nerve-centres, and those indicative of narcosis. When a case calling for treatment usually comes under notice, the former symptoms will have passed away, and the latter are fully developed. The latter symptoms especially, therefore, demand consideration, and consist of the following—viz. an overpowering condition of drowsiness, which gradually becomes deeper until it ends in profound insensibility so that no stimulus can arouse; although in the earlier stages, however, the person may be partially roused to consciousness. In the later stages, the muscles become relaxed, the pulse small and weak, and the breathing laboured, noisy, and it may be, irregular, while at a later stage, it becomes shallow and slow; the face is pale, cold, and sometimes bedewed with clammy perspiration; and the pupils are strongly contracted, almost to pinhead in size. Death may succeed the deepening of the narcosis, or it may be preceded, especially in children, by convulsive seizures.

It occasionally happens that there may be a remission of the symptoms for a short period of time, but they return in all their original severity from which the person may die. The reader is referred to a case of this kind recorded in a previous chapter (p. 472).

The symptoms of opium poisoning may be complicated or masked by its having been taken with other drugs. Dr Gregory reports a case of a lady who at 9.30 A.M. took for toothache 17 drachms of laudanum,

and at 10.30 P.M. 60–70 grains of antipyrin. At 5 A.M., when the doctor saw her, she was in an excited condition, but answered questions readily and distinctly. Her temperature was 99° F., the pulse 100, and the pupils normal and responsive to light. When the stomach was washed out 19½ hours after the taking of the laudanum, the returning fluid smelled most strongly of that drug. She made a good recovery.

Infants and young children are most susceptible to the influence of opium and morphia. One drop of laudanum has many times proved fatal. For this reason, therefore, the administration of the drug to children should be avoided, and the use of patent medicines which contain them strongly denounced. While death from an overdose is the rule, astonishing recoveries are sometimes experienced. Fotheringham states the facts of a case in which an infant 3 months old recovered after the administration of a teaspoonful of liq. morphinæ in mistake for fluid magnesia. The tea-spoon, on measurement, was found to hold 75 minims, and allowing for a little to be lost while being given, it may be reckoned that the infant swallowed 60 minims of that preparation of morphia.[1] Doernberger[2] narrates another case in which an infant recovered from the effects of "sedative tea" prepared from the green capsules of the poppy.

Self-administered injections of morphia in overdoses may also produce poisoning. One must therefore be alive to this form of administration, and examine for evidence of needle-pricks on those parts of the body available for self-administration. (*Vide* Fig. 24, p. 83.)

Cases.—1. Smith records a case of a man who took ℥iii of laudanum, and who after prompt and active measures recovered.[3]

2. Rossiter mentions the case of a man who swallowed ℥ii of liniment of opium, who died.[4]

3. At an inquiry held at Brighouse regarding the death of a man who had died from an overdose of morphia, it was brought out in evidence that deceased had acquired the morphia habit while a resident in China. He used to take as much as 60 grains of hydrochlorate of morphia daily. By means of a telegram and by prefixing the title "Doctor" to his name therein, he obtained two gross of pills each containing 2 grains of that salt of morphia, equivalent in all to 576 grains of the drug. He took the whole of this quantity within twenty-four hours, of which he swallowed, two hours before his death, 200 grains in the form of 100 pills. His symptoms were a short period of excitement of a tetanic character and paralysis of the respiration, followed by death. There was an absence of the usual prolonged comatose state. This is believed to be the largest dose of morphia that has been taken.

4. Willoughby records the case of a woman who in three hypodermic injections injected into her body eight grains of sulphate of morphia in solution. She had only on one occasion previously had morphia injected. She was vigorously treated by injections of atropia, the interrupted electric current applied to the soles of feet, and by injection of about 30 ounces of warm normal saline solution subcutaneously. The most marked improvement followed the use of the saline solution. She regained consciousness. Thereafter, so long as contraction of the pupils continued, she was given small amounts to swallow of a dilute solution of potassium permanganate.[5]

5. In another case, in which 4 grains were injected and vigorous treatment was employed, the man recovered.[6]

6. In early October 1903, Miss Hickman, M.D., who was at the time junior resident physician at the Royal Free Hospital, London, disappeared. Two

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[1] *B. M. J.*, vol. ii., 1898, p. 1251.
[2] *Münch. med. Woch.*, Ap. 13, 1897.
[3] *B. M. J.*, vol. ii., 1899, p. 1674.
[4] *B. M. J.*, vol. ii., 1899, p. 1194.
[5] *Lancet*, vol. i., 1902, p. 1316.
[6] *B. M. J.*, vol. ii., 1905, p. 1040.

months later, some boys who were bird-nesting came across the dead body of a woman in a plantation in one of the parks in the neighbourhood of London. When examined by the police, there was found lying beside the body an empty medicine bottle, unlabelled and uncorked. The body was much decomposed, and the features could not be distinguished. The body was identified as that of the missing lady by friends from the clothes, a watch and chain, and two bronze medals which were known to belong to her. It was proved at the inquest that the deceased had purchased morphia sulphate tabloids and had obtained on August 12, a hypodermic syringe, which she had left at a place to be repaired. The late Sir Thomas Stevenson from analysis found morphia present in the viscera. The verdict of the jury was that on October 8, 1903, deceased was found dead in the Sidmouth Plantation, and that she died from morphia sulphate, self-administered at a time when she was temporarily insane.[1]

7. At Derby Assizes, 1889, before Mr Justice Hawkins, Ann Whitfield was charged with the wilful murder of her son at Hasland, Derbyshire, on June 27, 1888. There were four children of the family. They were all in apparent good health till June 5 of that year, when one was taken ill. The doctors in attendance treated the case as one of nephritis. He had sickness, some unconsciousness, but no contraction of pupils, up till his death on June 18. The medical certificate of death bore that death was due to nephritis and uræmia. On June 26, another child was taken ill. He had dilated pupils with unconsciousness and roughness of breathing and dulness of lungs. He died on the 27th. His death was certified as due to congestion of lungs. Both of these children were insured.

The prisoner's husband was also subsequently ill on two occasions when he was at home. (His duties as an engine-driver took him away from home frequently.) His symptoms were : loss of use of legs, sickness, and a lethargic state similar to that shown by the children who had died. On Feb. 4, 1889, prisoner herself was found in the attic of the house in an unconscious condition, a doctor, who was called, declaring it to be due to narcotic poisoning. She was arrested on a charge of attempting *felo de se*. Suspicion then arose as to the causes of death of the children. Their bodies were exhumed on Feb. 20, and the viscera were sent to Mr Allen, county analyst, for analysis. No trace of poison was found in the body of the first boy, but in the viscera of the second boy meconic acid in small amount was found. It was proved in evidence that prisoner had sent her boy Henry to buy laudanum and that she had laudanum in the house. Many other suspicious facts were brought out. The judge summed up against the prisoner, but the jury returned a verdict of not guilty. She was sentenced to a term of imprisonment with hard labour for the attempt on her own life.[2]

8. At the High Court of Justiciary, Glasgow, in 1899, a nurse-girl, aged 15, was tried on the charge of having administered laudanum to a child of 17 months under her care, with intent to murder or disable him. The child's life was in danger for some hours. The purchase of the laudanum was proved. The accused ran away from the house on the day in question, leaving behind her a written confession that she had poisoned the child. She gave evidence on her own behalf, acknowledged that she had given him the drug, but not with the intention to hurt him. The jury found her not guilty.

9. In the Devereux case, 1905, in which the prisoner, a druggist's assistant, poisoned his wife and children with morphia, the late Sir Thomas Stevenson found in the viscera of the former 1·12 grains of the alkaloid which were equivalent to 1·4 grains of a soluble salt of the alkaloid, and in those of the latter, a poisonous amount of the same poison. It will be remembered that the bodies of the victims were discovered in a large tin trunk, which the accused carted about with him from place to place as part of his belongings.

Post-Mortem Appearances.—As death is from coma, the p.-m. signs will be found of this kind of death, or of comato-asphyxia. If the case has been untreated, and if opium itself or laudanum has been

[1] *B. M. J.*, vol. ii., 1903, pp. 1105, 1356, 1381.
[2] *Lancet*, vol. ii., 1889, p. 392.

taken, the odour of the drug may be perceived in the stomach. If the stomach has been washed out, the odour should be perceived during the operation. It may very well happen, if morphia has been taken, that nothing may be found in the stomach indicative of the fact. Moreover, the examiner has to bear in mind that opium may be introduced into the body by other channels than the stomach, as, for instance, by the rectum. The late Sir P. Heron Watson informed us of a case where the poisoning was due to a piece of opium introduced by the person into the rectum to allay the pain of hæmorrhoids.

Treatment.—This must be regulated by the condition of each individual case, with respect to the time of swallowing the poison, if it has entered the body by the mouth, or of injection where it has been used hypodermically. In the former case, the siphon-tube must be used with free lavage of the stomach, first with simple warm water, and then with warm water in which 10 to 15 grains of potassium permanganate to the pint of water are dissolved. This line of treatment by permanganate was first suggested by Dr Barber Smith in 1884 (Maynard). There can be little doubt from the experiments of Moor upon himself with this salt, having taken on two occasions three and five grains of sulphate of morphia respectively, followed thereafter by four and eight grains of permanganate within a few seconds after the morphia, and no harmful results succeeding, and from his observations on the result of this treatment of 35 cases of opium poisoning with success, that permanganate of potash oxidises the alkaloids of opium into harmless compounds.[1] Raw's six cases corroborate the value of the treatment.[2] Luff subjected this treatment to chemical experiment *in vitro*, by mixing vomited matter with known quantities of morphia, and then with known quantities of permanganate. After agitating the mixture at intervals of half-an-hour, it was then mixed with alcohol acidulated with acetic acid, filtered through linen, and the filtrate evaporated to a syrupy consistence at 35° C. This was extracted with successive drenchings of absolute alcohol, which were filtered, and the alcohol evaporated. The residue was then treated with water acidulated with acetic acid to dissolve any morphin unacted upon in the vomit, and the fluid was then filtered; the filtrate was then made alkaline by ammonia, shaken up with double the volume of hot amylic alcohol, which, on separation of the fluids, was removed, and this operation was repeated two more times; after which the amylic alcohol extracts were united, filtered, and evaporated to dryness over a water-bath. The residue which remained was then dissolved in a little water acidified with acetic acid, the solution filtered and concentrated, and then a little ammonia was added. This was then allowed to evaporate spontaneously, and the residue examined for morphia. Where 5 grains of morphia were added to the vomit, and subsequently 7 or 8 grains of permanganate dissolved in eight ounces of water, no morphia could be extracted as above; and the same result happened in other experiments with 3 grains of the one and 4 grains of the other.[3] Maynard records the results of 19 cases of poisoning treated by this method

[1] *B. M. J.*, vol. i., June 22, 1895.
[2] *Ibid.* vol. ii., 1895, p. 76; *ibid.* vol. i., 1896, p. 82.
[3] *Ibid.* vol. i., 1896, p. 1193.

at the Medical College Hospital, Calcutta, at varying intervals after the poison had been taken, and from varying doses—from 360 grains downwards—of the poison. Of the 19 cases 13 recovered, and 6 died.[1] Luff, in the paper quoted, makes the further suggestion, that even in those cases in which the morphia has been administered hypodermically the permanganate treatment ought to be adopted because morphia is excreted by the stomach. Maynard suggests also the use of permanganate solution acidulated with sulphuric acid, because of the comparatively greater insolubility of the sulphate than the acetate of morphia in water. In the presence of an acid, too, permanganate has greater oxidising power. Gowring has also recorded a case of recovery by this treatment [2]; and Walker, of one from morphia poisoning [3] by 16 grains of the sulphate. It is important to remember that permanganate must not be used in too strong solution as it is slightly corrosive in its effects; indeed, one case has been recorded of this kind where such effects were produced.[4]

While permanganate of potassium may, therefore, be expected to neutralise any opium or morphia upon which it can act in the stomach, it will be necessary to combat the toxic effects of that portion which has been absorbed, and from which the symptoms present arise. The physiological antidote is atropia. For this purpose $\frac{1}{20}$th to $\frac{1}{12}$th of a grain of atropin sulphate may be injected hypodermically in an adult, and from the $\frac{1}{300}$ to $\frac{1}{150}$ of a grain in infants, with a gradual increase in dose in children and young persons up to the amount first named.

Ernest Bashford [5] has made an exhaustive investigation on the subject of the antagonism of atropia and morphia by experiments on white rats. From these experiments he concludes that in morphin poisoning not more than 1·5 mg. (about $\frac{1}{12}$ grain) of atropin should be injected, and that the dose should not be repeated. He further affirms that it is uncertain whether the antagonism between these toxic agents is mutual—that is, whether morphia would act as an antidote to atropia as the latter does to the former—which is the view of some observers.

In all cases of poisoning, the bodily heat must be restored by suitable restorative measures, and it is not wise practice to subject a patient to too vigorous or prolonged muscular exercise. In the immediate absence of a siphon-tube, emesis should be promoted and encouraged by the readiest emetic, and stimulation by the use of strong coffee. Where the heart's action appears to be failing, injection of ether under the skin, or alcohol *per rectum* is called for. In infants, a soft rubber catheter with enlarged eyes may be utilised as a siphon-tube with any kind of funnel which is convenient.

Fatal Dose: Infants.—One drop of laudanum has killed on more than one occasion, and an amount of compound tincture of camphor containing the $\frac{1}{19}$th of a grain of opium has produced the same result. Children have, however, recovered from large doses; from $7\frac{1}{2}$ grains of opium,[6] from one and two teaspoonfuls of laudanum, and from 60

[1] *B. M. J.*, vol. i., 1896, p. 1194.
[2] *Ibid.* 1896, vol. i., p. 785.
[3] *Ibid.* 1896, vol. i., p. 82.
[4] *Petersburg, med. Woch.*, 1895.
[5] *Arch. Internat. de Pharmacodyn, et de Thérap.*, vol. viii., fasc. 3 and 4, 1901.
[6] *Med. Gaz.*, May 1859, p. 505.

minims of liq. morphinæ.[1] We have seen recovery in a child of nine months after 15 drops of laudanum, and that without recourse to any special treatment.

Adults.—Four grains of opium and one grain of morphia respectively may be deemed as likely fatal doses, as they have produced such results. Recovery has, however, followed treatment where 360 grains of opium have been taken [2]; from 55 grains of morphia acetate [3]; and in a case which we treated, from one and a half bottles of chlorodyne.

Fatal Period.—As early as forty-five minutes [4] (Lyman) in a female aged 52, from one ounce of laudanum. The usual period is from 9 to 12 hours. It may, however, cover days; in one case where 10 grammes of a liquid preparation of opium was injected in an adult instead of 10 drops, death did not happen till 2 days [5]; and in a child of three months not until after 56 hours.[6]

Chemical Analysis.—In conducting an inquiry on a death from presumed opium poisoning, it is essential in the examination of the stomach washings, vomit, and contents of the stomach, to carefully note any odour of opium or its preparations, both in the cold and when gently heated, and also whether there are small pieces of opium in the contents, lest the crude drug has been swallowed. The absence of odour, however, is no index to the absence of the poison, since it may be masked by other odorant materials, or it may be absent owing to a preparation of morphia having been taken. In the analysis for opium, the presence of meconic acid and morphia are sought for; indeed, the discovery of the former alone is sufficient to establish the presence of the drug, but it is better if possible to demonstrate also the presence of morphia. If the liquid to be examined consists of comparatively clear stomach washings, acidulate it with acetic acid, evaporate at low temperature to a small volume on a water-bath, and filter. To the clear filtrate, add slight excess of acetate of lead, which will precipitate the meconic acid as meconate of lead, along with albuminous matter. After the precipitate has settled, filter through a small moistened filter, and wash the residue in the filter with distilled water. Both the filtrate and residue must next be carefully examined; the former for morphia, the latter for meconic acid.

I. *Examination of Residue in Filter.*—The filter-paper being still moist, perforate its apex, and carefully wash its contents by a wash-bottle into a long test-tube; allow the precipitate to settle, and decant some of the supernatant clear fluid. Shake up the precipitate in the remaining fluid, and pass H_2S for some time through it to ensure complete precipitation of lead sulphide. The meconic acid will now be in solution. Filter the whole; and concentrate filtrate on water-bath to dissipate excess of H_2S. Allow concentrated solution to cool. Transfer a drop of it to a watch-glass, and touch the drop with a glass rod dipped in a solution of a *per* salt of iron; if meconic acid be present, a colour ranging from red to blood-red will develop, which is not affected by the presence of a free mineral acid, but which is discharged on adding a drop of a solution of protochloride of tin, but is not discharged by mercuric chloride,

[1] *Vide ante*; and *The Lancet*, vol. ii., 1889, p. 1113. [2] Maynard, *vide ante.*
[3] Bonjean, *Annal. d'Hygiène*, 1845.
[4] *Amer. Jour. Med. Science*, October 1854.
[5] *The Lancet*, Ap. 1851, p. 435. [6] *Med. Gaz.*, March 1858, p. 292.

as is the red sulphocyanide of iron. Should this reaction be absent or only show a faint response, concentrate the residual liquid still further, and again test. Should even this fail, gently evaporate the residual liquid to dryness, extract it with a small quantity of strong alcohol, filter, and evaporate to dryness; then dissolve dry residue in a few drops of warm water, and test as before. If no reaction appear, meconic acid is not present, since by the above method, carefully conducted, $\frac{1}{100}$ of a grain of the acid may be detected.

II. *Examination of the Filtrate.*—If morphia has been initially present, the filtrate ought to contain it in the form of acetate, along with any excess of lead acetate which may not have been precipitated by inefficient use of H_2S. It is better, therefore, first to pass H_2S through the filtrate to test this, and if a precipitate forms, after thorough settling, the liquid is filtered, and evaporated to dryness on the water-bath; the residue is then dissolved with a little distilled water, and again filtered. A drop of the filtrate may then be tested by nitric acid, when the presence of morphia will be indicated by the development of a lemon-yellow to orange-red colour; and another drop, by the solution of iron, when, if no free acid be present, a blue colour will be struck. The remaining fluid, after being slightly diluted with water, is alkalinised by a strong solution of potassium carbonate, and after standing for some time is shaken up with *absolute* ether. This ether extracts some colouring matter and derivatives of opium, but the morphia remains dissolved in the aqueous alkaline fluid. The ether being separated and set aside for further use, the alkaline liquid is now examined for morphia. This may be done in different ways. (1) Shake up the liquid for some time with five times its volume of a mixture of two parts of absolute ether and one part pure alcohol. After separation of the liquids, decant, or pipette off the alcohol-ether solution, allow it to evaporate spontaneously in a watch-glass, when, if morphia be present, it will be deposited as crystals. These crystals or some of them may be dissolved in a drop or two of distilled water, and tested with nitric acid and iron, to demonstrate the presence of morphia.

(2) By extraction of the alkaline solution with hot amylic alcohol.[1] This process is carried out by shaking up the aqueous alkaline solution with two or three times its volume of the hot alcohol, allowing the liquids to separate, pipetting off the alcoholic layer into a watch-glass, evaporating it at gentle heat on a water-bath to dryness, when the crystals will separate out. If, however, there be only an amorphous residue, it should be redissolved in ordinary dilute alcohol, and evaporated spontaneously. Tests for morphia may then be applied. Certain objections have, at the same time, been offered to this method; for example, that the amylic alcohol may contain coloured and resinous substances due to furfural; again, it dissolves urea and extractives, which prevent the ultimate purification of the morphia.

III. *Extraction of the Alkaline Solution by Acetic Ether.*[2]—The manipulation of the process is practically identical with the foregoing. It is objected to this process that morphia is much less soluble

[1] Uslar and Erdmann (*Liebig's Annalen*, 1861, vol. 120).

[2] Valser, *Chem. News*, 1864, vol. ix., p. 289; *Jour. Pharm. et Chimie*, xlii. 49, 63.

in pure acetic ether than in either of the solvents of the other methods. It has, however, this advantage, that after evaporation it is more likely than the amylic alcohol process to leave the alkaloid in the crystalline form.

IV. *Extraction by Mixture of equal parts of Acetic and Ethylic Ethers.*—In using this process the alkali should be added to the residual fluid in presence of this solvent, and after due agitation the separation should be effected at once.

V. *Gérard's Method.*[1]—Reduce organs to pulp ; add weight of water and hydrochloric acid equal to one-tenth the weight of the mixture ; digest whole mixture on water-bath for two hours ; afterwards supersaturate mixture with ammonia ; then agitate mixture with two or three successive portions of amylic alcohol ; separate after each washing the amylic alcohol, and set aside. Evaporate the aqueous mixture to dryness. Grind up residue with clean, sharp sand. Extract same with ammoniacal amylic alcohol. Mix combined amylic alcohol solutions, shake with hydrochloric acid, and thereafter agitate mixture with fresh portions of amylic alcohol and ammonia. Distil off the amylic alcohol, and examine residue left in porcelain dish for morphine and oxymorphine by the Marquis reagent,[2] which is composed of a mixture of 30 c.c. of strong sulphuric acid and 20 drops of formaldehyde. This reagent gives with morphine a deep violet-red colour, and with oxymorphine, a beautiful bright green colour. Should the residue be sufficient in amount, the alkaloids may be converted into sulphates, when the sulphate of oxymorphine may be separated from the sulphate of morphine owing to the fact that the former is almost insoluble in cold water. This method is applicable also in the examination of urine for morphine.

Liquid Tests for Morphia and Meconic Acid.

1. Nitric Acid gives with concentrated solution of Morphia a rich orange colour ; better, if it be added to the crystalline alkaloid.

2. Ferric Chloride solution gives with Morphia in neutral solution a deep blue colour, which on the addition of nitric acid acquires an orange-red colour. With meconic acid ferric chloride gives a deep blood-red colour which is not discharged by mercuric chloride as is the red sulphocyanide of iron, nor by hydrochloric acid as is the red ferric acetate.

Atropa Belladonna, or Deadly Nightshade

Nat. Ord. = Solanaceæ.—This plant is a native of Great Britain. It has pointed, entire, smooth, unequal leaves in pairs, and its flowers are bell-shaped, hanging, and of a dull reddish colour. It flowers in July, and fruits in September, its fruit being a jet-black, or deep violet berry about three-fourths of an inch in diameter, which on expression gives a violet-coloured juice. The root is cylindrical in shape, varies in length from several inches to two feet, appears reddish-brown or brownish-white in colour externally, is branched and tapering, and possesses a sweetish, or sweetish-bitter taste. All parts of the plant are poisonous to man ; but rabbits may be fed exclusively on the leaves for days together without inconvenience (Ogle), although it produces dilatation of

[1] *Jour. de Pharm. et de Chem.*, July, 16, 1905.
[2] *Pharmaceutische Centralb. band*, 37, 1896, p. 844.

their pupils as in man ; pigeons seem to be able to take 3 grains of the alkaloid without harm, and without pupillary dilatation.[1] The root and leaves are used in medicine. From the root the alkaloid *atropia* is obtained. Atropia or Atropine ($C_7H_{23}NO_3$), which was discovered by Mein in 1831, occurs as silky, prismatic, and needle-like crystals often aggregated together, and has a bitter, burning taste.

Preparations of the leaves and the root of the plant and of the alkaloid form some of the officinal drugs of the Pharmacopœia. The eating of the berries has given rise to poisonous and fatal effects on several occasions. A man and a child who partook of a pie made with them and apples both died.[2] At an inquest held at Morecambe, September 1889, on the cause of death of a boy, it was shown in evidence that he had eaten black berries by the roadside, and the jury returned a verdict of atropine poisoning.[3] A similar case occurred at Birkenhead in Sept. 1909. This case is, to our mind, not clearly proved. Medicinal preparations occasion toxic symptoms. Scott records an interesting case of five boys who, finding some sweet "stuff" tasting of liquorice, swallowed varying amounts of it, and thereafter developed the toxic effects of belladonna. The stuff consisted of an electuary of belladonna and liquorice, and contained ʒii of belladonna extract to the ounce, and the quantities taken by the boys varied from half-a-teaspoonful upwards. They all recovered.[4] A tablespoonful of the liniment produced toxic symptoms in a lady, from the effects of which however she recovered.[5]

Cases of poisoning by the liniment, taken accidentally or suicidally, are also recorded. In one, a wineglassful was taken,[6] and chloroform had to be administered to allay the great excitement of the patient ; in a second, two ounces and two drachms were swallowed. Pilocarpin, hypodermically, acted very beneficially in this case.[7] In a third case, a boy of two and a half years drank a quantity equal to about four drachms of the extract. They all recovered.

From its use as an external application in the form of liniment and of plaster, and as an enema, serious and fatal results have also happened. We have seen toxic symptoms after the use of a 2-grain pessary.

Cases of accidental and suicidal poisoning by the alkaloid are comparatively rare, and criminal poisonings still rarer. Dr Oliver[8] has reported a very interesting case of suicidal poisoning by the alkaloid, a summary of the facts of which is as follows. A young woman of twenty-one was admitted to the Newcastle Royal Infirmary, having taken nearly one ounce of "eye-drops" (four grains of atropine sulphate to the ounce) twelve hours before, while she was drunk. Attempts had previous to hospital treatment been made to induce vomiting, but without success. Her condition on admission was as follows : her face was flushed, the lips dry and blistered, tongue and mouth dry, eyes prominent, conjunctivæ injected, pupils widely dilated and immobile ; there were twitchings of fingers and toes, with tremors. She was delirious, constantly moving about the bed, picking the bedclothes, muttering and pointing to imaginary objects. The temperature was

[1] Wood's "Therapeut," p. 233.
[2] *New York Jour. of Med.*, vol. viii., p. 284.
[3] *The Lancet*, vol. ii., 1889, p. 706.
[4] *B. M. J.*, vol. i., 1900, p. 632.
[5] *B. M. J.*, vol. i., 1897, p. 1219.
[6] *B. M. J.*, vol. i., 1881, p. 639.
[7] *B. M. J.*, vol. i., 1881, p. 594.
[8] *The Lancet*, vol. ii., 1889, p. 1003.

101° F., pulse 135, respirations 32, but irregular. There was no vomiting. There was retention of urine. Three minims of the hypodermic solution of morphia were injected, and two hours later, a similar dose. Next day she was conscious, complained of thirst, took milk, but her pupils were still dilated, and her mouth was dry. Her temperature was 103° F. Three days later her temperature became normal. Her pupils, however, were still dilated a week after her admission to the hospital, and she was discharged well on the twelfth day. Purjesz relates a similar attempt at suicide by "eye-drops," but the quantity taken was only nine-tenths of a grain. Pilocarpin hypodermically was the antidote used.[1] In 1872, at the Manchester Assizes, an inquiry was held before the Grand Jury as to a charge against a nurse named Steele for having maliciously put atropia into milk, from drinking which the resident surgeon of the workhouse died and two other persons were poisonously affected. Madame Bianchini was tried and convicted by the Seine Assizes, held at Paris in March 1899, of having attempted the life of her husband by administering to him atropia. From the evidence it appeared that she obtained the drug by means of forged prescriptions.

Symptoms.—These are giddiness, drowsiness, confusion of thought, great thirst and dryness of mouth and throat; indistinct articulation and difficulty of swallowing, for the same reason; talkative, chattering, active, semi-wakeful delirium, in which the patient seems to live in a world by himself; sometimes the delirium is turbulent and the patient violent; the face is rosy and flushed; *the pupils are widely dilated and immobile*; and the temperature of the body is above normal. In cases which end fatally, the drowsiness lapses into deep sleep, then stupor, during which the face takes on a livid appearance; finally there are convulsions, and death.

Post-Mortem Appearances.—Careful watch should be paid to the contents of stomach for portions of berries or seeds. The post-mortem signs are generally those of asphyxia.

Fatal Dose.—An injection *per rectum* of a decoction of 80 grains of the root, one of a drachm of the extract, and of an internal dose of a like quantity of the liniment have proved fatal. Death has occurred from the external application of a belladonna plaster to a sensitive surface.[2] Two grains of atropia have killed. Recoveries have followed, however, after half-an-ounce of the liniment (*vide ante*), after 8 to 12 grains of extract in a child of 2 to 3 years[3]; and from doses of 3½, 4, and 5½ grains of atropia respectively. An ointment containing 0·21 grammes of atropine applied to the abraded skin caused death.[4]

Treatment.—Use of siphon-tube with free lavage of stomach; emetics, if tube not convenient; tea, coffee, or infusion of tannin, or solutions of tannic acid; hypodermic injections of pilocarpine hydrochlorate—⅓ of a grain—or of morphia.

Chemical Analysis.—It is necessary to separate out the alkaloid by Stas' or Dragendorff's process (*q.v.*). But before this, a drop of

[1] Pester, *Med. Chir. Presse*, 1880; and *B. M. J.*, vol. i., 1881, p. 300.
[2] Woodman and Tidy, "Med. Jurisp.," p. 410.
[3] *New York Journal of Med.*, Sept. 1845, page 182.
[4] Ploss, *Zeits. f. Chir.*, 1863.

the filtered vomit or stomach contents may be instilled into the eye of an animal, to see if pupillary dilatation is produced. Chemical tests of themselves are not reliable.

Belonging to the same natural order are other poisonous plants —viz. *Datura stramonium* (or Thorn-Apple), and other Daturas; *Hyoscyamus niger* (or Henbane); *Solanum tuberosum* or the common potato, and other Solanums. The *Datura alba* and *D. fastuosa* are common toxic agents in Indian criminal jurisprudence, for a full account of which the reader is referred to Chevers' "Medical Jurisprudence for India." On general lines, the symptoms of the above are identical with those of Atropia. Sharp, indeed, declares that the mydriatic alkaloids, hyoscyamine, hyoscyine, daturine, duboisine, scopolamine, atropine, and others, which in common possess the power of dilating the pupil, are practically identical.[1] An interesting case occurring in this country is recorded by Taylor[2] in which three persons suffered from the toxic effects of Stramonium which was accidentally present in a mixture of dried herbs which had been put into broth. Taylor found two unmistakable portions of the leaf, two buds, and the corolla of the Stramonium plant in some of the remaining dried herbs, and from an infusion of these in warm water he obtained a solution which, on application to his own eye, rapidly and fully dilated the pupil. The persons recovered.

Aconite

(*Aconitum Napellus*, or Monkshood, *Aconitum ferox*, and others.) Nat. Ord. = Ranunculaceæ. *Aconitum napellus*—monkshood—which is indigenous in this country in gardens, grows from a height of two feet upwards, with spikes of blue flowers, each flower being not unlike the cowl of a monk; hence its name. The *A. ferox* grows in the Himalayas, and is even more deadly in its effects than the former. All parts of these plants are poisonous—root, stem, leaves, flowers, and seeds. The root is the part which has most commonly given rise to poisoning, being accidentally mistaken for the root of the horse-radish. It is short and clumpy, not unlike a carrot in shape, or conical in form, throwing off a number of curly fibres, and is nut-brown in colour.

The comparative differences between these roots are presented in tabular form.

Characteristics of

Aconite Root	*Horse-Radish Root*
1. Short, carrot-like, tapering.	1. Long and cylindrical, not tapering.
2. Gives off curly fibres.	2. Gives off straight fibres.
3. White when cut, it slowly reddens.	3. White when cut, and remains so for an indefinite period.
4. When tasted, it produces tingling and numbness of tongue, mouth, and lips.	4. When tasted, is hot, pungent, and bitter, but does not produce numbness.
5. Scrapings of root are friable and succulent.	5. Scrapings are tough and stringy.

From the fresh leaves and flowering tops an extract is made, and

[1] *B. M. J.*, vol. ii., 1895, p. 1547.
[2] *Ibid.* vol. i., 1882, p. 538.

from the root a tincture and liniment, as well as the alkaloid Aconitia or Aconitin are obtained.

Aconitin, isolated by Geiger and Hesse in 1833, is usually a white amorphous powder, but in Morson's preparation—pseudaconitin or Nepalin—it is crystalline. It is not altered on exposure to air, melts in about 150 parts of cold water, about 50 of boiling water, and in about 750–800 of ether. It is freely soluble in alcohol, chloroform, or benzole. Its salts are also freely soluble in water and alcohol, but not in ether. When the alkaloid is heated on a porcelain spatula, it melts at 140° F. into a yellow liquid, then gives off light fumes or vapour, becomes carbonaceous, and ultimately disappears leaving no residue. Other alkaloid derivatives have been obtained from the aconite class. Cash and Dunstan are of opinion that any differences between aconitin, japaconitin, and pseudaconitin are differences of degree and not of kind. Methylbenzaconin, obtained by boiling aconitin with methyl alcohol in a closed tube, has a feeble toxicity.[1]

Commercial aconitia varies in strength, and according to Murrel [2] is probably constituted of a mixture of alkaloids. English aconitia is much stronger than the German, the French kind being intermediate in strength. By reason of this variability in strength accidental toxic effects have been produced. Plügge and Huisinga record a case in which a patient was killed by a chemist substituting Petit's nitrate for Friedlander's preparation.[3] Busscher and Desnos record other cases.

Symptoms.—After a poisonous dose, the first notable symptom is the tingling and numbness of mouth and throat; then follows pain in stomach, nausea, vomiting; the numbness extends over the body and limbs; the patient complains of the skin of his face feeling as if drawn; of a feeling of constriction in throat and of inability to swallow; there are great restlessness and prostration, and feebleness of muscular power; symptoms of shock supervene, with delirium and unconsciousness; convulsions usually precede death. In the Poplar cases, the pupils were dilated. Springmühl gives a very graphic account of a case of suicidal poisoning by an analytical chemist at Breslau who took 8 grains of Merck's aconitin.[4] Baker narrates the symptoms in four boys and a girl which followed the eating of a piece of aconite root, but all of whom recovered.[5] The matron of a workhouse died in four hours from the effects of three teaspoonfuls of Fleming's tincture. Her pupils were much dilated. Digitalis hypodermically, inhalations of ammonia, injections of brandy, and artificial respiration for two hours failed to avert the fatal issue. Another lady, who took some of the medicine for a headache, was very ill, but she recovered.[6] Reichert gives an analysis of the treatment of forty-one cases of poisoning by this drug, and after discussing the various antidotal remedies which had been used speaks favourably of the use of amyl nitrite and strychnia, the former by inhalation, the latter subcutaneously.[7]

The symptoms may be stated chronologically as follows. Their onset appears from a few minutes to an hour after taking the poison:

[1] *Proc. Roy. Soc.*, 1901.
[2] *B. M. J.*, vol. i., 1882, p. 555.
[3] *Berl. klin. Woch.*, 1882; *Arch. der Pharm.*, 1882.
[4] *B. M. J.*, vol. i., 1882, p. 803.
[5] *Ibid.* vol. ii., 1882, p. 1039.
[6] *Ibid.* vol. i., 1881, p. 64.
[7] *Phil. Med. Times*, Nov. 19, 1881.

(1) numbness, burning, and tingling of mouth and throat; (2) feeling of constriction and burning in throat; (3) severe pain and tenderness in stomach; (4) nausea and vomiting; (5) numbness, loss of power, and pain in the limbs; (6) giddiness, singing in the ears, deafness, loss of vision; (7) indistinct articulation, and ultimate loss of power of speech; (8) unconsciousness, convulsive gasps, or convulsions; (9) dilatation or contraction of pupils.

The only case on record of trial for homicidal poisoning by the alkaloid is that of R. *v.* Lamson which was tried before Mr Justice Hawkins and a jury at the Central Criminal Court on March 16 and 17, 1882. The prisoner—a medical practitioner—while visiting his brother-in-law, a boy at Blenheim House School, Wimbledon, administered the poison to him in a gelatine capsule, into which he ostensibly put some sugar. The prisoner left the house within five minutes after. The boy took ill within half-an-hour after swallowing the capsule, and died in about 3½ hours after the onset of the symptoms. Stevenson and Dupré isolated the alkaloid from the viscera, as proved by physiological tests performed by Stevenson upon himself and upon animals. Purchase of the alkaloid by the prisoner was proved in evidence. He was condemned to death. Poisoning is relatively more common from accident than from suicide or homicide. M'Whannell [1] records a case of fatal result from one ounce of the liniment. We are acquainted with the facts of a case where a man swallowed shortly after a hearty mid-day meal half-an-ounce of A.B.C. liniment, and although the symptoms of poisoning did not actively supervene for about one hour after and he eventually recovered, his life was in great danger for some hours. Treatment had, however, been promptly and energetically applied.[2]

This case arose out of an accident in dispensing. A man left a prescription at a chemist's shop to be filled, and an address to which the bottle was to be sent. By mistake, a bottle containing A.B.C. liniment, which was lying also to be packed for sending out, was addressed to this person. The medicine arrived shortly before he left his office to catch his suburban train, and, without unwrapping the bottle from the paper which enveloped it and reading the directions on the label, he merely snipped off the neck piece of the paper, and having been told the dose he was to take, measured out a tablespoonful, mixed some water with it, drank it off and walked leisurely to the railway station near by, and got into the train. He managed just to get home before the toxic effects of the drug overcame him. For some hours his life was in jeopardy. But he recovered. He raised an action of damages against the chemists in the Court of Session in 1901, and was awarded £700.

Post-Mortem Appearances.—Those found in the case narrated by Springmühl, already described, may be taken as fairly typical. They were as follows:—mucous membrane of mouth pale; congestion or engorgement of brain, and lungs; inflammation of stomach and congestion of mucous membrane; and congestion of liver and kidneys. These, it will be noted, are not different from those of other irritant poisons of a similar kind.

Treatment.—Use of siphon-tube and free lavage of stomach with

[1] *B. M. J.*, vol. ii., 1890, p. 791.
[2] *Ibid.* vol. ii., 1880, p. 488.

animal charcoal suspended in water; or emetics; administration of stimulants, hypodermically or *per rectum*, and restoration and maintenance of animal heat. Some have recommended hypodermic injection of strychnia and inhalations of amyl nitrite.

Fatal Doses.—About one drachm of the root, four grains of the extract, and 25 drops of Fleming's tincture.[1] Of the alkaloid $\frac{1}{16}$ of a grain killed a medical man in Holland (Desnos). Recovery, however, has followed two teaspoonful and tablespoonful doses respectively of the tincture, and over two ounces of the liniment.

Fatal Period.—The shortest is three-quarters of an hour (case of Hunt from about one ounce of tincture)[2]; the longest, 20 hours; the average, about 8 hours.

Chemical Analysis.—The alkaloid is separated from the stomach washings or stomach contents by the process for extraction of alkaloids, and after isolation is tested by its effect upon the tongue, and upon mice by injection. According to Stevenson $\frac{1}{2000}$ of a grain of English aconitin may be so detected.

Strychnia ($C_{21}H_{22}N_2O_2$)

(*Strychnos nux vomica, Strychnos Ignatii.*) Nat. Ord. = Loganiaceæ.—From the seeds of *S. nux vomica* an officinal tincture and extract are prepared for medicinal purposes. The seeds are flattish, nearly round, less than an inch in diameter, slightly convex on one side and concave on the other, and are covered by fine short, silky, yellowish-grey hairs. They are very hard, and when a small portion is chewed an intensely bitter taste is experienced in the mouth. From this seed the alkaloids strychnia, brucia, and igasuria are obtained, as also from the *S. Ignatii*. The alkaloid strychnia, first isolated by Pelletier and Caventou in 1818, is found in commerce in the crystalline form as pearly scales, octohedra with rhomic bases, or more commonly as four-sided prisms. It has an intensely bitter taste—one grain will impart to a gallon of water (1 in 70,000) a perceptible bitterness. It forms salts with the acids, sulphuric, hydochloric, acetic, and others, the acetate being the salt most commonly used, probably by reason of its greater solubility in water and alcohol. One grain of the alkaloid itself dissolves in 7000 parts of cold water at 16° C., and in 2500 of water at 100° C. The salts of the alkaloid are used in different vermin-killers mixed with colouring materials as Prussian blue, indigo, or soot. These are called Battle's, Butler's, Gibson's, Marsden's and Barber's Vermin Killers and Miller's Rat Powder, and all contain varying percentages of the poison, from 23 per cent. downwards. By the sale of these, strychnia is put within reach of the public.[3]

Brucine differs in action from strychnine. It produces at first slight convulsive seizures, but these pass off quickly, the chief action being paralysis of the motor nerves and narcotism, thus resembling the action

[1] *Amer. Med. Monthly*, Mar. 1854, p. 223.
[2] Taylor, "Med. Jurisp.," vol. i., p. 427.
[3] *Lancet*, vol. ii., 1889, p. 643.

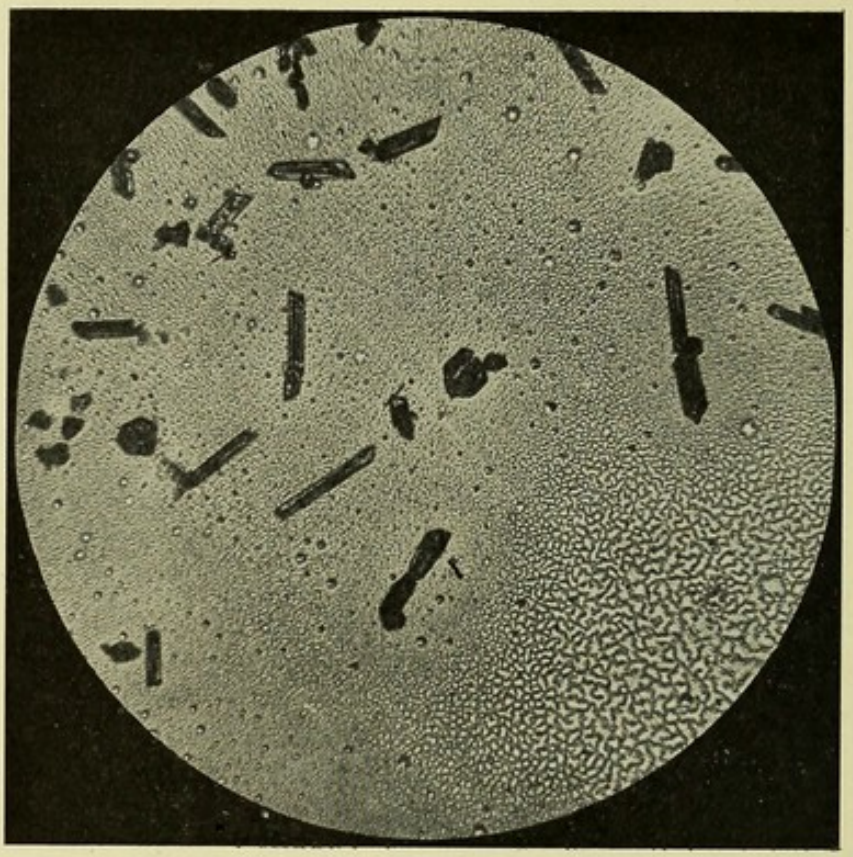

FIG. 128.—Photo-micrograph of crystals of Strychnia obtained from Nux Vomica. × 50 diameters. (Author.)

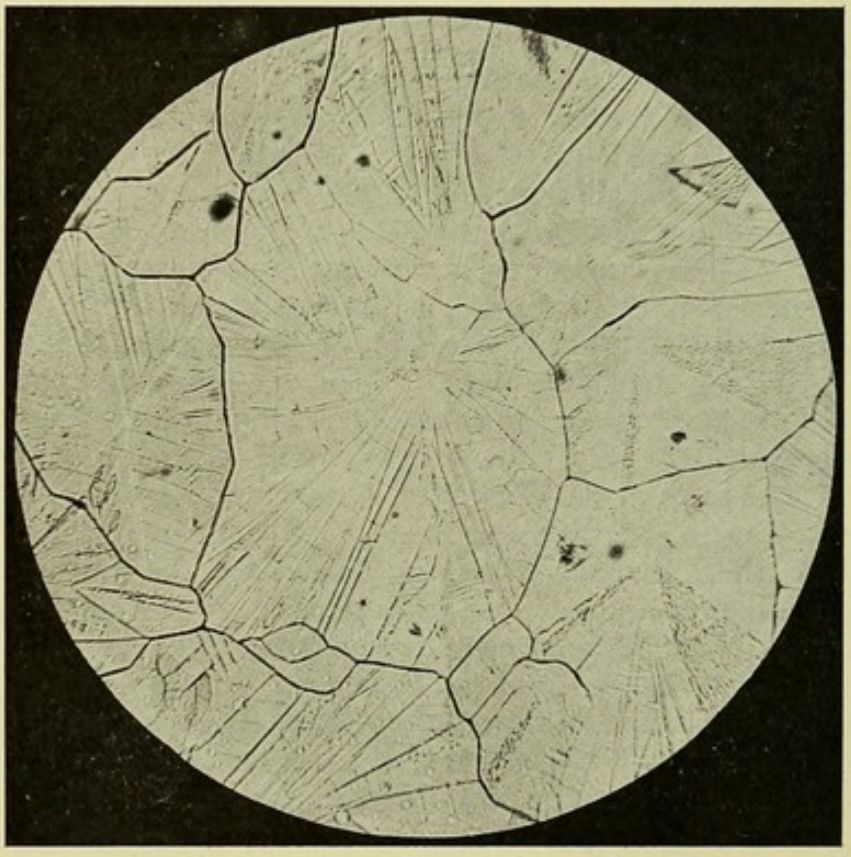

FIG. 129.—Photo-micrograph of feathery crystals of Strychnia. ×500 diameters. (Author.)

of curare or conium. It possesses only about one-eighth the toxic effect of strychnine.[1]

Symptoms.—When a poisonous dose has been swallowed, the following symptoms appear after an interval which may vary from a few minutes up to one hour. An intensely bitter taste is perceived in the mouth ; soon thereafter comes on a sensation of suffocation, accompanied by jerking or twitching of the muscles of the neck, body, and limbs, followed by severe tetanic convulsion of all the muscles of the body. During this state the muscles become stiff and rigid, so that the body is thrown into the form of an arch, only the back of the head and the heels touching the bed or ground—the condition known as opisthotonos. In some cases the body-curve is in the opposite direction, called prosthotonos, or it may be laterally curved, pleurosthotonos. Owing to the tetanic contraction of the thoracic muscles breathing becomes difficult and imperfect, and the face in consequence becomes more or less cyanosed. Owing to the contraction of the muscles at the angles of the mouth *risus sardonicus* is produced, the lower jaw becomes firmly shut or fixed by the contracted condition of the masseters, the fingers are clenched in the palms of the hand, the feet arched inwards, and the eyes staring and wild-looking. This so-called spasm or fit lasts from half-a-minute to two minutes, and then there is a remission of the symptoms. During all the time of the spasm the sufferer is in complete possession of his senses, and he is apt to complain bitterly of the insufferable pain. During the remission he lies in a calm but weakened condition, and he may fall asleep. During the convulsive seizure the pupils become dilated, and during the period of remission they resume their normal condition, which, relative to the former state, appears to be one of contraction. After a variable interval, depending upon the severity of the toxic effects and often as the result of a very trivial cause—such as a person walking across the floor, a touch, or even a draught of cold air—another attack similar to the first comes on ; and feeling it impending, the person may ask to be firmly held or rubbed. In cases going on to a fatal issue the intervals of remission are short, in less severe cases they may be longer. Death usually happens either during a spasm from asphyxia induced by the fixation of the chest walls, or from exhaustion from the repetition of the attacks. It may follow, therefore, very shortly after the spasms appear—almost at once—or it may be delayed for some hours. In the trial of Palmer for the poisoning of John Parsons Cooke, the question arose as to the possibility of idiopathic tetanus being mistaken for strychnia poisoning. In tetanus or lockjaw, fixation of the lower jaw is one of the earliest and most prominent symptoms—hence its name—but in strychnia poisoning it is only a part of the general tetanic contraction of the bodily muscles, and passes off with the muscular relaxation during the period of remission. Indeed there is no other set of phenomena, from disease or poison, which is exactly comparable to that which follows the absorption of strychnia in the body. The symptoms appear even if the poison is applied externally and is absorbed. But certain cases very closely simulate poisoning by strychnia.

[1] Dixon and Harvey, Brit. Pharmaceut. Conference, 1908.

Dixon has reported a case of intermeningeal spinal hæmorrhage—ascertained on post-mortem examination—which by reason of the similarity of the symptoms to strychnia poisoning compelled him to decline to grant a certificate of death without a post-mortem examination. The patient, a tall and very powerful man of forty-nine years of age, who had previously enjoyed uniformly good health but who was somewhat intemperate, was suddenly seized with violent tetanoid convulsions about half-an-hour after taking tea in the evening. These convulsive seizures continued to recur at short intervals. During each paroxysm the body became completely extended and remained so for a short time; this was followed by comparative relaxation, which, however, was again succeeded by another spasm. The man was never unconscious; he screamed with the pain caused by the great contraction of the muscles; when anything was put in his mouth the jaw contracted forcibly upon it, and when swallowing was successful, it happened in spasmodic gulps. During a spasm the pupils were dilated, but not insensible to stimulus. He died in less than two hours from the onset of his illness. On post-mortem examination the arachnoid cavity of the spinal canal was found filled with black coagulated blood, and this was believed to be sufficient to account for the symptoms and the death. The stomach and portions of viscera were removed, but nothing is said in the report respecting whether or not they were subjected to analysis.[1]

In one case [2] the application of $\frac{1}{12}$ of a grain of strychnia to the eye produced toxic effects in less than three or four minutes. Gorochofzeff of Orenburg states that the toxic effects of strychnia are more marked when it is introduced into the mouth only than when into the stomach; for example, a dog whose œsophagus was ligatured, and into whose mouth half-a-grain of the sulphate was put, died in four minutes; while another, which was made to swallow a similar dose, did not die till the end of fifty minutes. He asserts further that he does not think that this rapidly fatal result is brought about by absorption of the poison from the mouth, as in such cases the poison could not be detected in the blood. This latter view, however, does not meet with general acceptance.

The period of onset of the symptoms varies, as has been said, in different cases, depending upon the quantity and form of the poison exhibited, and to some extent, also, upon the condition of the individual. In the case of Madame Merghelynk in 1870, they came on *almost immediately*.[3] In a case where a man on the hunt for pheasants' eggs picked up a hen's egg which he sucked, symptoms of strychnia poisoning [4] showed in *four or five minutes* after. In the victim of Dove they developed in *fifteen minutes*; in Cooke, the victim of Palmer, in about *one hour*; in another case, in a like period; [5] and in another, in *two and a half hours*.[6] In a case of poisoning by 6 drachms of tincture of nux vomica, the symptoms "quickly developed." [7] Strychnia poisoning may arise from mistakes in prescriptions by chemists.[8] In this case, two persons died from strychnia having in some way got into phenacetin. In Partick, near

[1] *The Lancet*, vol. i., 1879, p. 333.
[2] *Amer. Jour. Med. Science*, Oct. 1861, p. 573.
[3] Taylor, "Med. Jurisp." [4] *The Lancet*, vol. ii., 1889, p. 951.
[5] *B. M. J.*, vol. ii., 1900, p. 1312. [6] *Amer. Jour. Med. Sci.*, Ap. 1848, p. 592.
[7] *B. M. J.*, vol. ii., 1899, p. 10. [8] *The Lancet*, vol. i., 1896, p. 135.

Glasgow, a similar mishap occurred owing to strychnia having been given in mistake for another medicine. Ogilvie narrates a case of accidental poisoning in which an old man and his wife, after each had taken a powder administered by their daughter, developed symptoms of strychnia poisoning. The man died, but the woman recovered. After a post-mortem examination of the body of the man, a "large quantity" of strychnia was found by chemical analysis in the stomach.[1] At the inquest, the chemist gave evidence that the powders he supplied contained calomel and nothing else. It appears, however, that the daughter had been housekeeper to a man who was in the habit of getting calomel powders from this chemist, that on the day she left for home he had given her what he believed to be one of the calomel powders, but had by accident given her instead a paper containing the remains of a small quantity of strychnia, which he had bought four years before from a chemist for the purpose of killing a dog. Just a day or two before his housekeeper left his house he had put this packet into his vest pocket, and it was this packet which he had unfortunately given to his housekeeper—the daughter of these old people—in mistake for a calomel powder. The jury returned a verdict in accordance with the evidence.[2]

Strychnia in solution may be accidentally taken, as in the case above narrated of nux vomica poisoning. It is usually taken suicidally in the form of vermin-killers.[3] Homicidal administration has given rise to some well-known cases. Among the chief are those of William Palmer, a medical practitioner, who was tried at the Central Criminal Court, London, May 1856; of William Dove, for the murder of his wife, tried at Leeds, July 1856; of Silas Barlow, for the murder of his mistress, tried at the Central Criminal Court, London, November 1876. In later years, George Horton was tried at the Derby Assizes, May 1889, for the murder of his daughter by strychnia, the poison having been given in the form of vermin-killer; $\frac{8}{10}$ of a grain of the poison being found in the body of the victim; and Walter Horsford, for the murder by strychnia of Mrs Holmes, at the Huntingdon County Assizes, June 1858, the poison given being a salt of strychnia in the form of a powder. The quantity of the poison found in the body of deceased by the analysts Knight and Stevenson amounted in all to 6·54 grains. To these must be added the case of Thomas Neill Cream, a medical man, for the murder of four women and the attempted murder of a fifth by strychnia, which was tried at the Central Criminal Court, London.

Of the most recent cases of homicidal administration one was tried in March 1905, at the Armagh Assizes, in which Agnes Black and Sarah Anne Pearson were tried for the murder of Alice Pearson, who was mother-in-law and mother respectively to the prisoners, by poisoning her with metallic mercury and strychnine. It was proved in evidence that Black had purchased the mercury and ten grains of strychnine two days before the deceased died. Strychnine was found in the stomach of deceased to the amount of one-seventh grain, and 286 grains of metallic mercury. Both prisoners were found guilty and were sentenced to death.

In another, a man was charged before the High Court of Justiciary at Edinburgh in March 1907, with having on Nov. 19, 1906, sent by post to W. L., in Old Cumnock, Ayrshire, a cake of shortbread having a covering or layer of

[1] *B. M. J.*, vol. i., 1884, p. 1251. [2] *Ibid.* pp. 1010 and 1011.
[3] *The Lancet*, vol. ii., 1889, p. 166; *ibid.* vol. ii., 1889, p. 643.

icing adherent thereto, with which he had previously mixed a quantity of strychnine, his intention in so sending the cake being to poison the said W. L., and said cake having been delivered to the said W. L., a portion of cake and icing was eaten on Nov. 23 by the housekeeper to the said W. L., in consequence of which she died, and that he did thus poison her and murder her. Two other persons who had also partaken of small portions of the cake and icing were similarly but less severely seized, but they recovered. Analysis showed that the strychnine was only present in the icing and not in the cake itself. The evidence at the trial did not, in our view, bring home the crime to the prisoner. In any case, the jury, instead of deciding on the evidence, were advised that they might return a verdict that accused was now insane. (*Vide* also p. 527.)[1]

In July 1908, a young man, living with his mother in Glasgow, handed her on leaving the house in the morning half-a-cake of iced chocolate, telling her as the piece was so small she should eat it all herself. She shared it, however, with two other woman, and all three were soon afterwards seized with the symptoms of strychnine poisoning, the mother so seriously that she was removed to a hospital, where, later, she died. The two other women recovered after treatment. The same day it was reported to the police that a young man had died suddenly in a room of one of the railway stations in the city. This proved to be the son. Post-mortem examination showed that he had died from asphyxia, believed to be due to convulsive contraction of the thoracic muscles from strychnine poisoning. It was believed that he had impregnated the iced chocolate with the poison, had given his mother one half, and retained the other for his own use.

Post-Mortem Appearances.—In several cases, prolongation of cadaveric rigidity has been a noteworthy appearance. The body of John Parsons Cooke—Palmer's victim—was "much stiffer than bodies usually are five or six days after death—the muscles being strongly contracted and marked, and the hands stiff and firmly closed" according to the evidence of Dr Harland, who made the post-mortem examination of the body. Dr Stevenson, in the trial of Walter Horsford, stated that the legs and fingers of the deceased woman were rigid at the time of exhumation of the body twelve days after death, and that he had seen the same rigidity in the body of Matilda Clover—one of Cream's victims. Hollis records[2] the post-mortem appearances found on the body of a child of four years who had died from the accidental administration of liquor strychniæ instead of cough mixture. The body on being exhumed twenty-three days after burial and twenty-seven days after death, showed the fingers of the hands to be tightly clenched over the thumbs, the feet to be inverted and arched, and rigidity generally to be well marked. Strychnia was found in the viscera on analysis. But in other cases, such abnormal duration of rigidity is not found. The reason for these different appearances is probably to be found, at least partly, in the period of time which elapses between the onset of the convulsive seizures and death. If it be short—and assuming that the individual has before the administration of poison been in good health—the muscular irritability will not have been exhausted, and thus the period of *rigor mortis* will be longer than if the time be long and the muscular irritability exhausted by the violent tetanic contractions which the muscles have undergone. But it would appear from certain indications as if the phenomenon was also in part due to the specific action of this particular poison.

The most constant appearances of the internal organs are as follow :—

[1] Glaister, *Lancet*, vol. ii., 1909, p. 1431.
[2] *B. M. J.*, vol. ii., 1901, p. 618.

engorgement of lungs; fluidity and dark colour of the blood; engorgement of blood-vessels of brain and spinal cord; the condition of the right heart with respect to large amounts of blood in its respective cavities. These appearances indicate death by comato-asphyxia. The stomach but rarely presents any unusual appearance. Some observers, however, have stated that congestion of the mucous membrane is present.

The experiments of Meltzar and Salant on nephrectomised rabbits indicate that, while strychnine is eliminated in normal animals by the kidneys, removal of these organs causes cumulation of the poison in the body.[1]

Treatment.—Chloroform ought to be administered as soon as possible in view of the fact that the convulsive seizures are induced by almost any treatment of the patient, such as hypodermic injection or the administration of an enema. As soon as the person is under its influence, the siphon-tube ought to be passed into the stomach and that organ freely washed out, either with water simply, or with water in which animal charcoal or tannin is suspended, until bitter taste has disappeared in washings. The administration of chloroform, moreover, ought to be continued for hours if need be, so long as the seizures threaten to return.

The following case exhibits the valuable effects of chloroform:—A soldier took suicidally one ounce of liq. strych. P. B., having just before eaten a hearty dinner. An hour later the symptoms of poisoning appeared. Calling for help, he was given an emetic of mustard and water. Muscular spasmodic seizures became very severe, and he was put under chloroform. Asphyxia, threatening, tracheotomy was performed. Chloroform was continued, and stomach was washed out with a 1 in 1000 solution of potassium permanganate. Convulsive spasms reappeared whenever the chloroform was intermitted, consequently it was renewed, and he was kept under its influence continuously for fifteen hours, about eight ounces of chloroform being used during that period. He recovered. The man's weight was 118 lbs. The amount of strychnine salt which he swallowed was $4\frac{3}{8}$ grains.[2]

In the unavoidable absence of chloroform, a handy emetic ought to be given, either preceded or followed (perferably the former) by the administration of chloral hypodermically, *per rectum*, or by the mouth. Where death is threatened from arrest of respiration, artificial respiration may be tried, but this, if chloroform is not used, will be a difficult if not ineffective operation, because of the fixed and rigid condition of the muscles of arms and chest. Other symptoms must be treated as they arise.

Fatal Dose.—Although alarming symptoms have on more than one occasion been occasioned by $\frac{1}{12}$ of a grain, a *quarter of a grain* is the smallest fatal dose which has been recorded.[3] This was in the case of Agnes Sennett or French, a patient in the Glasgow Royal Infirmary, who in Sept. 1845 swallowed a pill which contained by prescription that amount of the drug and which had been prepared for a paralytic patient. The symptoms came on in three-quarters of an hour after, and she died

[1] *Jour. Exper. Med.*, vol. vi. 2.
[2] Dick, *B. M. J.*, vol. ii., 1900, p. 1312.
[3] Evidence of Dr Corbett, in trial of Palmer.

in 1¼ hours. Half-a-grain has also produced fatal results.[1] Recoveries after prompt treatment have, however, followed large doses; for example, one in which 20 grains were taken,[2] and another, in which 40 grains were swallowed.[3] Other cases of recovery from large doses are also recorded.

Fatal Period.—Death may happen almost immediately. This result happened in the case of a druggist who took 1⅔ grains, along with nux vomica powder in addition. Life may, however, be prolonged for hours after the onset of symptoms. Paley records a case in which death did not follow until 5 hours[4]; and in at least other four recorded cases it did not happen till 6 hours after.

Chemical Analysis.—Of all the alkaloids, strychnia is perhaps the most easily detected, because of its less liability to decomposition in the animal tissues, of its markedly bitter taste, and of its chemical reactions. It has been discovered in the bodies of those poisoned months after interment, but not constantly. The stomach washings, vomited matters, contents of stomach, or finely pulped bodily organs are treated by strong alcohol and acetic acid, the latter in sufficient amount to give the whole a distinct acid reaction. The mixture is kept hot for two or three hours, then strained through a fine cloth, the alcohol nearly all distilled from the filtrate, and the remainder evaporated on a water-bath at about 70° C., to nearly dryness. The residue now consists of the acetate of strychnia and organic matter. This is then stirred with a little distilled water acidified by acetic acid, filtered, the filter washed with a little water, and the filtrate put into a test-tube, bottle, or small separator; slight excess of solution of caustic potash or soda is now added, which throws the alkaloid out of solution, and pure chloroform or a mixture of chloroform and ether, in volume larger than that of the solution, is at once added, and the whole vigorously shaken for some minutes. When the fluids have separated and if a separator has been used, the chloroform layer which is lowermost is run off, or if a test-tube or bottle has been used, the upper aqueous layer is pipetted off; in either case, the chloroform fluid is transferred into a watch-glass. The aqueous alkaline fluid is again treated as before with fresh chloroform, and, after separation, the chloroform is added to the first chloroform. The chloroform extract, which contains the strychnia, is now permitted to evaporate spontaneously to dryness under cover. A portion of the dried residue may now be transferred to a clean porcelain slab and tested by the colour and other reactions. The remainder, if impure, must be re-treated with distilled water and acetic acid, with potash, and with the chloroform solvent as before, in order to rid it of organic matter. If the quantity obtained be ponderable, it should then be carefully weighed. The strychnia found after this treatment is composed of varied crystalline forms.

Liquid Tests.—

1. The Colour Test.—If to the crystals be added two drops of strong H_2SO_4,

[1] Warner, "Poisoning by Strychnia," p. 138.

[2] *Buff. Med. and Surg. Jour.*, Nov. 1866, p. 135 (quoted by Wormley, *op. cit.* p. 543).

[3] *Med. Gaz.*, Sept. 21, 1865, p. 267.

[4] *Brit. and For. Med.-Chir. Rev.*, Oct. 1860, p. 382.

no reaction will happen ; but if the edge of the solution be touched with a tiny portion of manganese peroxide or potassium bichromate in the solid form, or with a drop of a strong solution of the latter, a beautiful deep blue colour will form at the point of contact which will rapidly change into purple, crimson, and red, and then slowly fade away. This play of colours is characteristic of strychnia, and can be perceived with the 1-10,000th of a grain of the poison.

2. The Physiological Test.—This was originated by Marshall Hall, and was based on the sensitiveness of frogs to the action of strychnia. He advised that a fresh frog be immersed in the solution suspected to contain strychnia, the presence of the strychnia in the fluid being shown by the development, sooner or later, of tetanic convulsions in the animal. Harley proposed a modification of the test by injecting some of the solution into the thoracic or abdominal cavity of the animal. Hall claimed that by his method the 1-5000th of a grain could be detected, and Harley, by his method the 1-16,000th part of a grain.

3. Taste Test.—This should be performed with great caution on the residue obtained from the foregoing process. It is of value in demonstrating the presence or absence of a markedly bitter taste.

Digitalis Purpurea (Foxglove)

Nat. Ord. = Scrophulariaceæ.—This plant, which is familiar in the woods, by the roadsides, and in gardens owing to its beautiful spike of purple, dark red, or white bells, is poisonous. Its leaves, root, and seeds contain the following toxic glucosides — viz. digitalin ($C_{54}H_{84}O_{27}$), digitoxin, digitalein, and digitonin, and other principles. The leaf is large, ovate, crenate in shape, narrowed at its base and downy, especially on its under surface. It is of a dull green colour. The root is composed of many long slender rootlets. From the leaves, especially, is obtained the glucoside digitalin, which, when pure, consists of fine white acicular crystals, has no odour, and possesses a bitter taste. It and digitoxin are the principal poisonous constituents. Digitalin is a cumulative poison. Many cases of poisoning have resulted from the leaves having been eaten in mistake for borage or other plant, and it has been used homicidally at least upon one occasion—viz. in the notorious case of the widow De Pauw, who was poisoned by the homœopath, Conty de la Pommerais, as recorded by Tardieu.

Radcliffe narrates the case of a boy, two years of age, who was found playing with a box of Nativelle's digitalin granules which had been supplied to his aunt. He was well until evening, when he became unusually cross. Early next morning he vomited, and about noon became semi-unconscious, pale, with somewhat dilated pupils, and continuation of the vomiting. By 3.30 P.M. he was worse ; his respirations having become shallow, the pupils more dilated, and the pulse, as before, being exceedingly irregular and intermittent. He was quite comatose. After treatment he got better. On inquiry it appeared that he had swallowed five granules, containing in all $1\frac{1}{4}$ milligrams of digitalin.[1] Schofield refers to untoward effects which arose in a case of administration of digitalis.[2]

Symptoms.—These are nausea, vomiting, which may not however come on for two or three hours after the taking of the poison, followed by abdominal pains, and, perhaps, diarrhœa. The pulse becomes

[1] *B. M. J.*, vol. i., 1901, p. 338.
[2] *Ibid.* vol. i., 1902, p. 1068.

remarkably slowed; in one recorded case it fell to 25 beats per minute. Consequent upon this condition of the heart, there is a feeling of faintness and præcordial oppression, the respiration becomes slow and sighing, the patient becomes drowsy, which last state may gradually deepen into coma; convulsions may precede death.

Fatal Dose.—Is very uncertain. Mawer[1] states that a woman who took 56 granules of Homolle's preparation of digitalin, equivalent to a dose of 84 grains of dried leaf, recovered. Nine drachms of the tincture has killed in one case, and thirty-eight grains of the powdered leaves in another.

Post-Mortem Appearances.—Are not characteristic. Where the leaves have been eaten, or the powdered leaves taken in infusion, search should be made for fragments.

Chemical Analysis.—For the discovery of the glucosides, the Stas-Otto, or Dragendorff process of separation is necessary. An alcoholic extract is made of the material to be examined, the alcohol having been acidulated with acetic acid. This is then dissolved, after concentration into a syrupy consistence, with water rendered feebly acid by acetic acid, then shaken up with petroleum ether to remove impurities, then with benzene, which will dissolve out digitalein, and next with chloroform, which dissolves the digitalin and digitoxin. To identify these is next necessary. The only fairly reliable way is by physiologically testing the residues by injecting minute portions into a frog. The method adopted by Tardieu in the Pommerais case, where it was suspected that digitalin was the poison used, was to expose the hearts of three frogs by opening the thoracic cavities. No. 1 was left alone, except that the heart was kept moist; into the pleura of No. 2 a definite known amount of digitalin (6 drops of a solution containing 1 of digitalin in 500) was injected; and into the pleura of No. 3 some of the suspected solution of the extract from the body. The number of contractions of the heart was then counted in each. In the above case, the heart of No. 1 beat 42 times per minute at the end of six minutes, and 36 at the end of 31 minutes; that of No. 2, 20 and 0 at the same respective periods of time; and that of No. 3, 26 and 0 respectively at the like periods; the last two had obviously died before the end of the second period. From this comparative method of examination, it was demonstrated that the suspected material contained a cardiac poison. Brouardel thinks that doubt exists as to whether the poison was digitalin. At the time of the trial of Pommerais, Dr Hébert, pharmacien of the Hôtel Dieu, showed that in decomposing organic substances toxic principles existed which produce effects upon the heart identical to those from digitalis.[2]

[1] *The Lancet*, vol. i., 1880, p. 166.
[2] *Ibid.* vol. i., 1889, p. 763.

CHAPTER XX

VEGETABLE POISONS AND SEPARATION OF ALKALOIDS

THE method first proposed for separating alkaloids of vegetable poisons from mixtures containing organic matter, such as vomited material, the contents of the stomach, or from the organs of the body was that by Stas.[1] This consisted in extracting them by strong alcohol acidulated with tartaric acid, filtering and concentrating the alcohol extract, neutralising it with soda, shaking up the mixture with ether, pipetting off the ethereal extract, allowing it thereafter to evaporate spontaneously, and thus obtaining the alkaloid in the residue. To this original process various additions in respect of solvents and chemical reagents have been made from time to time by different chemists as Selmi, Prollin, Thomas, Erdmann and von Uslar, and others, until Dragendorff published in 1876 his elaborate system of separating by different solvents [2] alkaloids and glucosides, and other active animal and vegetable principles. In this system, however, are utilised the principles of processes formerly proposed. The main principles of this system are the uses of different solvents in acid and alkaline media.

The organic substance to be examined—vomited material or bodily organs—must undergo certain preliminary treatment—viz. (1) it must be as finely divided as possible; (2) digested for some hours in water at a temperature of 40–50° C., and the whole made distinctly acid with sulphuric acid; (3) filtered; (4) the extraction and filtration repeated two or three times; (5) the filtrates united. The combined extract is next evaporated to a syrupy consistence on the water-bath, is then mixed with two or three times its bulk of alcohol, is allowed to macerate for 24–36 hours at about 34° C., is then permitted to cool, and last of all is filtered, the residue on the filter being washed with 70 per cent. alcohol. The alcohol is then distilled from the filtrate, and the aqueous residue which remains is diluted with water and filtered. The material is now ready for the use of the solvents which ought to be used in the following order. When, however, from the symptoms exhibited during life a particular poison is suspected, the operation may be abbreviated by the use of the most suitable solvent of the alkaloid suspected.

The solvents are as follow :—*first*, in the *acid aqueous fluid*.

(*a*) *Petroleum ether*.

This dissolves out *picric acid, camphor and other ethereal oils*, carbolic acid, etc.

[1] *Annal. d. Chem. and Pharm.*, vol. 84, p. 379.

[2] *Gerichtlich-chemische Ermittelung von Giften.*

(*b*) *Benzene.*

This dissolves out *thein*, *digitalin*, *cantharidin*, *colchicin*, etc.

(*c*) *Chloroform.*

This dissolves out narcein, papaverin, cinchonin, etc.

Then the same solvents are used after the aqueous solution has been made *alkaline* with a solution of caustic potash or soda, or with ammonia.

(*a*) *Petroleum ether* (cold).

This dissolves out volatile alkaloids and small amounts of fixed alkaloids. A preliminary test of the residue from a small portion of the solvent will make it clear whether volatile alkaloids are present or not. If not, then the solvent and the aqueous solution may be raised to 40° C., and vigorously shaken.

This dissolves out strychnin, brucin, quinin, coniin, anilin, etc.

(*b*) *Benzene.*

This dissolves out strychnin, brucin, aconitin, the opium alkaloids—codein, narcotin, thebain, atropin, physostigmin, etc.

(*c*) *Chloroform.*

This dissolves out morphin, papaverin, narcein, etc.

Then the aqueous alkaline solution is shaken up with—

Amylic Alcohol.

This dissolves out morphin, solanin, salicin, etc.

Last of all the aqueous solution is evaporated to dryness after addition of powdered glass, and mixed with—

Chloroform.

This dissolves out Curarin.

The foregoing, which is but an outline sketch of Dragendorff's method, will give the student who is familiar with chemical manipulation some conception of the mode by which alkaloids are separated.

The Stas-Otto process is based upon the following main principles—viz. (1) that the acid salts of the alkaloids are soluble in water and alcohol; (2) that these and the neutral salts are for the most part insoluble in ether; and (3) that the alkaloids, when precipitated from an acid solution by an alkali or alkaline carbonate, are soluble in ether or amyl alcohol. The technique of the process is as follows:—the suspected substance, having been prepared by being divided finely or mashed into a pulp, is heated to 90° C., and mixed with alcohol, with sufficient tartaric acid added to make the mixture distinctly acid. The whole is then allowed to macerate for a length of time in a closed or nearly closed vessel at a temperature of 70°-75° C. After cooling the liquid is filtered, and the residue on the filter well pressed out, the fluid therefrom being mixed with the filtrate. The residue is again treated with alcohol, and the whole process repeated at least three or four times. The various filtrates are mixed together, filtered, and evaporated *in vacuo* at 35° C. The residual liquid is again filtered through a water-moistened filter to arrest fat, which may further and more completely be removed by shaking up the residual liquid in a separator. The aqueous acid layer being run off, powdered glass is added, and the fluid is evaporated almost to dryness *in vacuo* over sulphuric acid. The residue is then mixed with absolute alcohol and allowed to macerate for at least 24 hours, and, then, is again evaporated as before *in vacuo* at 35° C. This residue is thereafter mixed with water, and an alkaline carbonate is added till the mixture is alkaline. This throws any alkaloid present out of solution. The aqueous alkaline fluid is now shaken up with four times its volume of pure ether, the ethereal layer separated, and allowed to evaporate spontaneously at the ordinary tempera-

ture. If any alkaloid be present, it is left on the evaporating watch-glass as a residue, which may, thereafter, be tested for identification of the alkaloid.

In dealing with certain alkaloids in previous pages, we have sketched in some detail the process to be followed for their isolation, but no one should attempt to detect these, or indeed any poisons in the organs of the body, or in substances which have come from the body, unless they are sufficiently expert in chemical manipulation and technique.

Associated with alkaloids of vegetable origin are certain alkaloidal bodies which are found in the living as well as in the dead body and in decomposing animal matter. These are more commonly called *ptomaines*, as they were named by Selmi, but, chemically, they are identical in many particulars with the alkaloids which have been discussed. For example, like vegetable alkaloids, ptomaines contain nitrogen; they exist in solid and liquid, volatile and non-volatile forms; they are alkaline, unstable bases, and unite with acids to form salts; they each produce definite physiological results when injected into the body of a healthy animal, corresponding in some particulars to those produced by the vegetable alkaloids, and, generally, are precipitated by the same group reagents. To those alkaloidal substances which are produced in the living body by the operations of the organs as the effect of tissue-metabolism, the name "*leucomaines*" was applied by Gautier. In addition to these alkaloidal bodies, moreover, there are found certain nitrogenous substances, not alkaloids, which have received the name of tox-albumins, or albumoses.

Several ptomaines have already been isolated, as Putrescin ($C_4H_{12}N_2$), Cadaverin ($C_6H_{14}N_2$), Saprin ($C_5H_{16}N_2$), Neuridin ($C_5H_{14}N_2$), Hydrocollin ($C_{11}H_{13}N$), Collidin ($C_8H_{11}N$), Parvolin ($C_8H_{11}N$), and others, which, because of the absence of oxygen in their composition have been separated into a non-oxygenated group. The first four named have but little toxic effect, whereas hydrocollin or hydrocollidin, which was isolated by Gautier and Etard from decomposing mackerel and horse-flesh, and others as peptotoxin, and mydein of the same group, possess highly toxic properties. Of the oxygenated group may be mentioned Cholin ($C_5H_{15}NO_2$), Neurin ($C_5H_{13}NO$), Muscarin ($C_5H_{10}NO_3$)—which is found not only in *Agaricus muscarius* but also in human flesh—Gadinin ($C_7H_{16}NO_2$), Mytilotoxin ($C_6H_{15}NO_2$)—obtained from poisonous mussels—and others—all of which are extremely poisonous.

Certain of them cause dilatation of the pupil and coma; others, convulsive effects; and others paralyse the action of the heart. It will be thus apparent that, without the exercise of the greatest care, ptomaines might be mistaken for vegetable alkaloids in the examination of the body after it has undergone putrefaction. Indeed this question arose in the Lamson case, and appeared to constitute the theory of the defence to account for the cause of death of Percy Malcolm John. It was for some time held to be a differentiating feature between ptomaines and vegetable alkaloids that the former reduced *ferri*-cyanide of potassium to the state of *ferro*-cyanide in the presence of a ferric salt, but Brieger traverses that view, and states that where the reaction does happen, it is only because of impurities present in the ptomaines.[1]

[1] *Weitere Untersuchungen über Ptomaine*, Berlin, 1885.

Moreover, when one remembers that to obtain a ponderable amount of ptomaine from decomposing animal material it is necessary to operate upon large amounts—often one or two hundredweights—it will be seen how the finding of an alkaloid from a small quantity of stomach contents or small bulk of bodily organs by the Stas-Otto process is little likely to be confounded with ptomaines.[1]

Calabar or Ordeal Bean (*Physostigma Venenosum*)

Nat. Ord. = Leguminosæ.—As the name implies, this bean was used as an ordeal for various purposes among primitive peoples. It is thicker than our own garden bean, measures from one to one and a half inches in length and a half to three-quarters of an inch in width, and weighs from 1½ to 2 drachms. It consists of a shell and kernel, the former hard, brittle, and dull claret-coloured, the latter being white in colour, but without smell or taste. From the kernel the alkaloid—Physostigmin or Eserin—is obtained, which is now mainly used in ophthalmic practice, but was at one time much used by some in the treatment of tetanus. The alkaloid is either colourless or slightly yellow in colour, has a bitter taste, is slightly soluble in water, but is freely soluble in alcohol, ether, chloroform, or benzol. Physiologically, it contracts the pupil; in a poisonous dose, it causes giddiness, paralysis of voluntary muscles, and muscular twitchings. Death happens from asphyxia, due to paralysis of respiratory muscles.

There is no recorded case of criminal poisoning, but there are several which have arisen from accident. In 1864, about seventy children in Liverpool were seized at the same time with toxic symptoms due to eating the beans which had been thrown out with some rubbish. Only one boy who had eaten six beans died. Of thirteen of the children examined, only one had contracted pupils.[2] In another instance, two children aged three and six respectively, who each ate the kernel of one nut, recovered.[3]

Cases of poisoning may arise in shipping ports owing to occasional cargoes of beans being imported as ballast. Recently, our attention was drawn to this in the case of one seaport.

Treatment.—Use of siphon-tube; hypodermic injection of atropin, or injection of chloral *per rectum*.

Cannabis Indica or Indian Hemp

This is used by natives of the Malay peninsula and of parts of the East Indies in the form of haschish, just as opium is among the Chinese, for the purpose of obtaining intoxication of a sensuous character. It is sold in native Indian bazaars under different names; as *gunjah*, the dried flowering tops, *churrus*, the resinous exudation, *bang* or *sulzea*, the larger leaves and capsules, or *majoon*, a mixture of bang, butter, and

[1] Stevenson, *B. M. J.*, vol. i., 1884, p. 1136.
[2] Cameron, *Med. Gaz.*, Oct. 1864, p. 406.
[3] *Edin. Month. Jour.*, 1864, p. 193.

flour. The drug itself and its preparations are apt to vary in strength.[1] Cases of accidental or suicidal poisoning have been recorded.[2]

Symptoms.—Giddiness; drowsiness; numbness and sense of loss of power of limbs; anxiety; a sensation as if of going mad, or of impending death; feeble but quiet respiration; weak and irregular pulse and faint heart action; dilatation of pupils; deep unconsciousness. In Minter's case, where the dose of the tincture was 10 minims three times daily, the toxic symptoms only appeared after the drug had been taken regularly for twenty-four days. This patient said he felt he was mad, that he could see and hear one minute but could not the next; he was very restless and had a distressing sense of impending death. The latter-narrated symptoms of the above group were present in the case observed by Saxby, whose patient had taken about two teaspoonfuls of the B.P. tincture. The main indications of the action of the drug are (1) temporary intoxication, (2) delirium, (3) acute mania, (4) chronic mania, (5) chronic dementia, (6) cannabinomania.[3]

Treatment.—Injection, hypodermically, of strychnia sulphate, where the patient is deeply unconscious; stimulants *per rectum*, or by mouth if patient is able to swallow; otherwise, the general line of treatment ought to be like that for other narcotics.

Gelsemium

Gelsemium sempervirens or *Yellow Jessamine.*—This plant contains a poisonous alkaloid called *gelsemine*, which was discovered by Wormley and first described by him in 1870.[4]

According to Gerrard, it has the formula $C_{12}H_{14}NO_2$, and its hydrochloride, $2C_{12}H_{14}NO_2HCl$.

Symptoms.—In poisonous doses it produces impairment of sight, double vision, sometimes total blindness, with ptosis. The pupils are dilated and usually insensible to light. Speech is impaired or nearly lost. The gait is staggering, due to muscular inco-ordination. The skin is warm and moist, although the extremities may be cold. There is great muscular relaxation of the body, but the muscles of the face and throat in some cases seem to be in a state of tetanic spasm. There is general prostration. The mind remains for some time clear, but unconsciousness sooner or later supervenes.

Few cases of poisoning by the drug have been recorded in this country, and such as have occurred have been chiefly the result of errors in dispensing. The following cases may be cited :—

1. Myrtle narrates a case, in which he had prescribed pills each containing $\frac{1}{10}$th grain of *gelsemin*, but instead of which the dispenser substituted *gelsemine hydrochloride*, the medicinal dose of which is from $\frac{1}{16}$th to $\frac{1}{20}$th of a grain. After taking a pill, the patient suffered from giddiness and sickness, and lost the power of speech. There was muscular inco-ordination of limbs, and quivering of muscles of right side of face. These symptoms were followed by trismus, clonic convulsions, and exhaustion, unconsciousness being present for about two hours. The patient recovered.[5]

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[1] Walker, *B. M. J.*, 1896, vol. ii., p. 1382.
[2] Minter, *B. M. J.*, vol. ii., 1896, p. 1772; *ibid.* (Saxby), vol. ii., 1896, p. 1160.
[3] *B. M. J.*, vol. i., 1903, p. 207.
[4] *Amer. Jour. Pharm.*, xlii. i.; *Micro-Chemistry of Poisons*, 2nd edit., p. 683.
[5] *B. M. J.*, vol. i., 1889.

2. A young man, aged 24, who, for neuralgia, took a teaspoonful of the fluid extract, and repeated the dose fifteen minutes later, soon afterwards complained of a choking sensation and pushed his fingers into his throat as if trying to open it for more breath, staggered about his room as if intoxicated, and then became unconscious. He died about four hours after taking the drug.[1]

3. In another case a young, healthy, married woman, several weeks pregnant, took three teaspoonfuls of the fluid extract, and died seven and a half hours later.[2]

4. A grocer was tried at the West Riding Assizes for the manslaughter of a girl. It appeared in evidence that having been asked to supply her with witch hazel he inadvertently gave her gelsemium. The jury returned a verdict of not guilty.[3]

5. Amyot tells of a case which he believed exhibited an idiosyncrasy toward this drug.[4]

Treatment.—Emptying and washing out of stomach. Hypodermic injection of strychnine and atropine. Faradisation of spinal cord. Warmth. Stimulants. Artificial respiration.

Chemical Analysis.—The alkaloid may be separated from contents of stomach by acidulating contents with acetic or hydrochloric acid, digesting at moderate heat for over an hour on a water-bath, cooling the liquid, straining through a fine muslin cloth, washing solids with absolute alcohol, concentrating acid-alcoholic mixture, rendering same slightly alkaline by addition of sodium carbonate, washing with ether, and evaporating extract. Acidulate extract with weak hydrochloric acid, and filter; shake with ether, and evaporate ethereal extract. To crystalline residue, add a drop or two strong sulphuric acid, and then a drop of solution of potassium dichromate, when, if alkaloid be present, a reddish-purple or cherry-red colour will develop, changing quickly to a bluish-green or blue colour. This test will react satisfactorily with $\frac{1}{10000}$th of a grain of alkaloid.

Cocaine, Benzoyle Methyl-ecgonine ($C_{17}H_{21}NO_4$)

Cocaine is the alkaloid of *Erythroxylon coca*, and is a crystalline substance, without colour, having a bitter taste, which leaves behind it a numbness of the tongue and mucous membrane of the mouth. It is but slightly soluble in water. It has the property of de-sensitising the terminal nerves of the part into which it is injected or absorbed, and in a large dose produces paralysing effects upon the central nervous system. When injected for minor operations, such as extractions of teeth, it has produced toxic effects. In some persons the injection hypodermically of the drug has become a confirmed habit. From both of these causes fatal poisonings have resulted.

Symptoms.—Pallor of face; dilatation and immobility of pupils; rapid unconsciousness; convulsions; pulse abnormally rapid at first, rapidly slows down and becomes intermittent and feeble.

Barratt[5] records a case where a medical man injected hypodermically into his own body, in two doses at an interval of five minutes,

[1] Boutelle, *Boston Med. and Surg. Jour.*, Oct. 27, 1874, p. 321.
[2] *Amer. Jour. of Pharm.*, Jan. 1870, p. 14.
[3] *Jour. of State Med.*, vol. xiii., No. 1.
[4] *B. M. J.*, vol. i., 1901, p. 640.
Ibid. vol. i., 1896, p. 1032.

40 minims of a 35 per cent. solution, equal to about 14 grains of cocaine hydrochlorate. Eight minutes after he felt very weak, but was conscious. On examination he was found to be almost pulseless. Ether was injected hypodermically and brandy administered by the mouth on several occasions at short intervals for three hours, on account of the threatened failure of the heart. He never lost consciousness. During these three hours he perspired freely because of the copious draughts of hot weak tea which he drank to allay his great thirst, and he passed about 80 ounces of urine. There was no tendency to convulsions, which is a common feature in such cases. In a few days he was quite well. Vinogradoff[1] gives an account of the post-mortem examination of the body of a young woman who died from the effects of twenty-two grains of cocaine which were administered as rectal injections to produce anæsthesia for a surgical operation in that region. Within a quarter of an hour after the injection she began to suffer from clonic spasms in the limbs and opisthotonos, and became cyanosed. Examination of the body revealed fluidity and dark brown colour of the blood, like that found in potassium chlorate poisoning. The signs of death by asphyxia were also present. This death caused the surgeon who made the mistake in the amount of cocaine injected to commit suicide. Golovkoff[2] relates another case where toxic effects followed the injection for toothache of fifteen minims of a 2 per cent. solution of the hydrochlorate, a similar dose having been injected between three and four hours before. The symptoms were : restlessness, dilatation of pupils, pallor of skin, rapidity of pulse and respiration, shivering, dread of death, and convulsive movements of the limbs. The respirations rose to 200 per minute, and the heart sounds were audible at a distance of two paces from the patient. Ammonia administered internally and by inhalation had a remarkable restorative effect. In a couple of hours the patient had recovered. Zantchevsky's experiments show that a nearly identical train of symptoms is produced on dogs by this drug, and calculated according to body weight, that the lethal dose for man should be between 20 and 40 grains ; and that to produce chronic poisoning a daily injection of four grains should be required.[3]

A fatal case is recorded in which, for temporary relief of a urethral stricture to enable a catheter to be passed, half-a-drachm of a 10 per cent. solution of cocaine hydrochloride was injected into the urethra, the point of the penis being held to prevent regurgitation of the fluid. In a few minutes the patient, a man of 56 years, was in a state of clonic convulsion, with back arched and jumping off the bed. His jaws were moving spasmodically, and he had bitten his tongue. The face was somewhat cyanosed, the breathing very spasmodic and slightly stertorous, the eyeballs fixed, lids being half closed. No pulse could be felt at wrist, but the heart was beating. In about a minute later, respiration ceased, the cyanosis increasing. Artificial respiration was at once commenced, and other measures used, but all to no effect, as he was dead in about three minutes from the time of injection. Post-mortem examination revealed nothing markedly abnormal. An inquest

[1] *The Lancet*, vol. ii., 1889, p. 656.
[2] *Ibid.* vol. ii., 1889, p. 1126.
[3] Barratt, *vide supra.*

was held, and a verdict of death from cocaine poisoning was returned by the jury.

Another fatal case of a similar nature has been recorded in which 2½ grains of cocaine had been injected into the urethra and was followed by a fatal result.[1]

In chronic poisoning exhibited by habitual users of the drug, in addition to the signs of physical degeneration which are apparent, psychical degeneration, as indicated by moral debasement, is also present. In those persons, complaint is often made of the sensation in the skin as if grains of sand or other particulate bodies were lying in or under it,—a symptom which was first pointed out by Magnan.

Post-Mortem Appearances.—These are negative as indicating the character of the poison. Death being due to asphyxia, the signs of that form of death are likely to be found. Vinogradoff has pointed out (*vide supra*) the fluid character and dark brown colour of the blood, showing that the poison acts upon that fluid, and that hyperæmia of brain and lungs, and albuminoid degeneration of nerve cells of cerebrum, of the muscular fibre of the heart, of the liver cells, and of the epithelium of the urinary tubules, were also present in the case narrated.

Treatment.—After evacuation of contents of stomach, attention must quickly be paid to the action of the drug upon the heart. Judging from Golovkoff's experience and that of others, ammonia ought to be freely administered in the form of inhalation and also internally. Gooding [2] and Mowat [3] have both reported favourably of its effects. Ether should be injected hypodermically, and brandy may also be freely administered by the mouth if the patient be conscious, and the thirst should be satisfied by copious draughts of hot weak tea. Chloroform ought to be used to overcome convulsions, and artificial respiration, threatened asphyxia.

Fatal Dose.—Two-thirds of a grain killed a woman of seventy-one years of age, and twenty minims of a 4 per cent. solution injected into the urethra has produced the like result.[4] Recovery has followed, however, the use of larger doses, as in the cases reported by Barratt and others.

Chemical Analysis.—Is not very satisfactory.

Laburnum (*Cytisus Laburnum*)

This gives rise to toxic symptoms when the seeds, bark, or flowers are eaten, as sometimes happens, inadvertently by children. The tree is a common one in gardens, shrubberies, and woods, and may be recognised by its greenish bark, its drooping tassels of yellow flowers, which afterwards develop into bunches of pods. The toxic principle of the bark and pods—Cytisin—belongs to the narcotico-acrid class. Death has resulted in animals and human beings from eating the bark,[5] and in children, the seeds.[6] Two fatal cases in children,

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[1] *B. M. J.*, vol. ii., 1906, p. 868; *vide* also *Lancet*, vol. i., 1899, pp. 273, 292; *B. M. J.*, vol. i., 1902, p. 1020; *Lancet*, vol. i., 1889, p. 614.

[2] *The Lancet*, vol. i., 1888, p. 394.

[3] *Ibid.* vol. ii., 1888, p. 715.

[4] Mathieson, *Dub. Jour. Med. Sc.*, 1895.

[5] *Veterinarian*, vol. lv., p. 92; *The Lancet*, vol. i., 1868, pp. 58, 86.

[6] *B. M. J.*, vol. i., 1870, p. 79 (Wheelhouse).

aged three and eight years respectively, occurred at Shigsby, Yorkshire, after eating the pods or seeds. The elder child was attacked by vomiting and diarrhœa, pains in the head, and complete prostration, and died fourteen hours after. The younger child vomited, complained also of pain in the head, and became unconscious ; for two and a half hours before her death she had convulsions. She died eight hours after beginning of attack. Cytisin was found in the stomach contents of each child.[1] A boy of four years suffered severely from eating some of the flowers. He came home stating that he could not walk, and was sick. He was drowsy, and became cold, his temperature falling later to 93·6° F. His pupils were dilated, but they contracted under a bright light. He recovered.[2]

At Partick, near Glasgow, in Aug. 1909, seven boys, whose ages ranged from six to eleven years, ate pods from this tree. All suffered from sickness, vomiting, and other symptom, but after treatment in hospital, recovered.

Symptoms.—Vomiting, purging, great restlessness, then drowsiness, coma, with convulsive twitches, and convulsions ; subnormal temperature.

Post-Mortem Appearances.—Dilatation of pupils ; clenched jaws ; intense inflammation in intestinal tract from lower third of duodenum to lower end of ileum.

Treatment.—Evacuation of stomach contents ; purgatives ; stimulants.

Fatal Period.—Eight hours ; six days in a child of 5½ years, from seeds ; thirteen hours, from bark.

Fatal Dose.—Not well ascertained.

Darnel Grass (*Lolium temulentum*)

Nat. Ord. = Graminaceæ.—Toxic effects have been produced from this plant where persons have partaken of bread baked with wheat the flour of which contained ground darnel seeds. In 1850, it was recorded that thirty persons were seized with symptoms of poisoning after eating such bread, but all recovered.[3] Christison records that eighty person in Sheffield were similarly attacked, but they also recovered ; and he gives another instance, in which a farmer, his wife, and a servant partook of bread made up of flour composed of one part wheat and five parts darnel, from the effects of which the farmer and the servant died.

Symptoms.—Headache ; giddiness ; vomiting and purging ; symptoms not unlike delirium tremens ; impaired vision ; paralysis ; convulsions.

Treatment.—As for any other narcotico-irritant poison.

Colchicum Autumnale or Meadow Saffron

This plant and the medicinal preparations made therefrom are poisonous. From the seed, bulb, and plant generally, the alkaloids colchicin and colchicein are obtained. The plant is equally fatal to cattle as to human beings. In 1862 Margaret Wilson was convicted of the murder of Mrs Somers by administering this drug. From the evidence, it would appear as if the prisoner had in the same way caused the death of other three persons. As the active principle of the drug is a common constituent of proprietary preparations for gout, accidental poisonings have frequently occurred.[4]

Symptoms.—Incontrollable vomiting, with nausea and retching ; violent diarrhœa with stools of a serous character, afterwards bloody ; violent, griping, abdominal pains ; gastric burning ; spasms ; convulsions ; great muscular weakness ; paralysis ; collapse ; but consciousness is preserved to the end.

Post-Mortem Appearances.—Are those of an irritant poison.

Fatal Dose.—℥iij of the *Vinum* has killed.[5] Recovery, however, has followed half-an-ounce.

Treatment.—As for irritant poisoning.

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[1] *B. M. J.*, vol. i., 1882, p. 199.
[2] *Ibid.* vol. i., 1883, p. 1117.
[3] *Edin. Month. Jour.*, Aug. 1850, p. 180.
[4] *The Lancet*, vol. i., 1881, p. 368.
[5] Wood, *U. S. Dispens.*, 13th edit., p. 1504.

Privet (*Ligustrum vulgare*)

This shrub, which grows in our gardens, hedges, and shrubberies is poisonous. Its berries, which in autumn are purplish-black in colour, are sometimes partaken of by children as edible fruit, with development of symptoms of poisoning from which death has happened.[1] Broadbent[2] records a case of poisoning of two children, aged three and five years respectively, who suffered severely after eating freely of the ripe berries, but who both recovered.

Symptoms.—Violent vomiting and purging; weak, thready pulse, subnormal temperature, and coldness of body to the touch; convulsive twitchings or convulsions.

Treatment.—As for irritant poisoning.

Yew (*Taxus baccata*)

This shrub or tree is poisonous, because of the presence of a toxic alkaloid, called by Marmé, taxine, the chemical formula of which as given by Hilgar and Brande and verified by Thorpe, is $C_{37}H_{52}NO_{10}$. The alkaloid is to be found in every part of the shrub, but mainly in the leaves and berries. Children are liable to be attracted by the beautiful scarlet berries and to eat them. The leaves are popularly believed to be emmenagogic in their action, and for that reason are very occasionally used as an abortifacient; but they have no specific action upon the uterus. The plant is poisonous to animals as well as man. We once made a post-mortem examination of the body of a pet stag, the cause of whose death was likely to be the subject of legal proceedings, as its death was supposed to be due to a mineral poison laid down for the purpose, but we found that the cause was the eating of the leaves of a yew-tree which grew on the lawn of the party supposed to have poisoned it. A horse, too, died from the same cause. In *The Times*, Nov. 1899, an interesting correspondence on the lethal effects of yew upon animals took place. One person wrote that a herd of cows strayed during the night into a field where there was a large yew-tree. In the morning five of the cows lay dead.[3]

Carter states a case where a young woman, suspected to have taken a decoction of yew leaves to procure abortion, was found dead in bed. Death followed in nine hours after taking the decoction, and on post-mortem examination parts of the leaves were found in the stomach.[4]

The seeds are poisonous, but the pulp, if at all poisonous, is much less so, as we have personally eaten of the pulp of several berries more than once without any apparent effect. The alkaloid has been investigated by Thorpe.[5]

Symptoms.—Vomiting; gastro-intestinal pain; weak, irregular action of heart; muscular weakness; collapse; delirium.

Treatment.—As for irritant poisoning.

Post-Mortem Appearances.—Carefully examine stomach contents for portions of leaves and seeds; and the stomach and intestines for signs of irritant poisoning.

Conium Maculatum or Spotted Hemlock

This is a very common plant in our hedgerows, waste heaps, and wild places generally. If the leaves are bruised between the fingers a mouse-like odour is produced from the alkaloid conia or coniin. The leaves are deep green in colour, tripinnate, not unlike parsley leaves; the stem is tall, round, smooth, green in colour, spotted; the root tapering, not unlike a parsnip. The alkaloid, which is most abundant in the fruit, is fluid at ordinary temperature, has an acrid, bitter taste, and possesses an exceedingly pungent, mousey, or urinous odour. A Pharmacopœial tincture and succus are made from the plant. The plant, or

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[1] Taylor, *op. cit.* p. 844.
[2] *B. M. J.*, vol. i., 1884, p. 267.
[3] *B. M. J.*, vol. ii., 1899, p. 1377.
[4] *Ibid.* vol. i., 1884, p. 818.
[5] *Proc. Chem. Soc.*, vol. xviii., No. 253, p. 123.

preparations from it, has given rise to accidental, suicidal, and homicidal poisonings. Falck[1] records seventeen cases of death from it, two of them homicidal, one suicidal, twelve accidental, and two from popular medicinal use. On August 4, 1901, a number of boys from an Industrial School were camping out on the Island of Cumbræ in the Firth of Clyde. During their afternoon walk, they chanced to rest where there was a quantity of hemlock growing. Mistaking this for an edible herb, a number of them partook of varying proportions of it. Almost immediately twenty-four of them were seized with violent pains. Emetics were freely administered shortly thereafter, and with the exception of a boy of nine they all recovered. The deceased was very ill from the very outset and never regained consciousness. In March 1884, several boys belonging to the training-ship *Cumberland* on the Clyde partook of the roots of hemlock. Ten of them became seriously ill, the prominent symptoms being deep stupor and loss of power of limbs. They, however, all recovered, although in five of the cases the unconsciousness lasted for some hours.[2] Other cases have been reported. Two children, aged four and six years respectively, died from eating the leaves and seeds, death occurring in a few hours.[3] A boy died at Annan, and another at the Island of Sanda from eating the root, which each had picked up in his rambles.[4]

From examination of the plant in the Millport case, it appears that the plant, the root of which was eaten, was *Cicuta virosa*. The symptoms appeared within half-an-hour, the most prominent being headache, giddiness, burning pain in stomach, and sickness. In the fatal case, convulsions came on followed by unconsciousness, and they continued almost without intermission for five and a half hours until death supervened. The spasms or convulsions were very severe, the whole body being perfectly rigid and the spine arched. The boys believed the root to be parsnip. It was of this poison that Socrates drank when he ended his life as the sentence of his countrymen. After calmly partaking of the contents of the cup he walked up and down his apartment conversing with his friends till, being no longer able to walk, he had to lay himself down upon a couch, where he lay calmly awaiting death.

Symptoms.—The symptoms at first are those of an ordinary irritant poison, but later they exhibit themselves in the form of muscular weakness and gradually deepening paralysis, during which the breathing becomes difficult and slower, delirium, coma, or convulsions supervene, and the patient dies of asphyxia.

Post-Mortem Appearances.—Are those of asphyxia. Look for remains of leaves or root in stomach.

Treatment.—Use of siphon-tube and free lavage of stomach with water containing tannic acid; artificial respiration sustained for a length of time; stimulants hypodermically or *per rectum*; sustain bodily heat.

Fatal Dose.—Not known.

Chemical Analysis.—Separation of the alkaloid by Dragendorff's process.

Œnanthe Crocata, Water-Hemlock, or Five-Finger Root

Nat. Ord. = Umbelliferæ.—This is one of our most actively poisonous plants, and is usually found growing near water to the height of from 4 to 5 feet. Its stem is round and smooth, its fruit oblong and black, its leaves when bruised impart a yellow stain to the fingers, and its root resembles a bunch of small parsnips, consisting of from 2 to 10 tubers with rootlets. It has been eaten in mistake for an edible vegetable. One of the most recent cases of poisoning from it is recorded by Griffin.[5] Two men had eaten of what they thought was a piece of carrot; one died, the other recovered. The symptoms come on within 2 hours after eating it.

Symptoms.—In the fatal case, the man fell down in a fit, but soon after regained consciousness. Another fit came on, with vomiting; his face was

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[1] *Prakt. Toxicologie*, p. 273. [2] *B. M. J.*, vol. i., 1884, p. 576.
[3] *B. M. J.*, vol. i., 1881, p. 896. [4] *Ibid.* vol. i., 1881, Ap. 30, and p. 822.
[5] *Ibid.* vol. i., 1900, p. 509.

livid, his pupils dilated and fixed; there was a bloody foam about mouth and nostrils; the breathing was stertorous; and there was complete insensibility. He had six fits or convulsions in all before he died. Death was due to asphyxia. In the case that recovered vomiting was the first symptom; there was no insensibility, but he was delirious, drowsy, and talked incessantly to himself; his face was pale, his pupils dilated, and the pulse weak and slower than normal. On recovering, he stated that the man who had died had given him the piece of carrot, of which, however, he took only two bites, and then threw away the remainder. This piece was found. It had a strong disagreeable smell, and an acrid taste. The bitten surface was dotted over with reddish-brown, pin-head spots—an appearance which the cut root assumes after exposure for some time to the air. Other cases are recorded, but not of recent years.

Post-Mortem Appearances.—These are indicative of gastric irritation, and of asphyxia.

Treatment.—Use of siphon-tube with free lavage of stomach; artificial respiration; stimulants.

Veratria, Sabadilla cevadilla or officinalis

(*Veratrum album* = White Hellebore; *Veratrum viride* = Green Hellebore.)—Nat. ord. = Melanthaceæ.—Veratria is usually met with as a white amorphous powder, although in Merck's preparation it is composed of rhombic prismatic crystals. Some of the preparations of this plant are officinal. The plants contain several alkaloids.[1]

In 1903, a number of cases occurred in Maryborough Prison owing to this poison having inadvertently been placed in food. No permanently ill effects followed.[2]

Symptoms.—Are those of a narcotico-irritant poison—viz. pain and burning in throat, gullet, and stomach; vomiting; diarrhœa; signs of collapse; coma. Esche [3] experimented upon himself with the drug, and after taking ½ grain of the acetate, his symptoms were as follow:—pale, cold, clammy skin, pinched features; rapid, thready, irregular pulse, violent vomiting, marked muscular tremblings, and convulsive movements of limbs. Cases exhibiting toxic effects may be studied under the following references.[4] In the first of these a woman became insensible after taking the sixteenth of a grain; in the second, an adult man took 30 grains of crude veratria made from *Veratrum viride*; in the third, a person swallowed a quantity of liniment supposed to contain 3 grains of the alkaloid. All these cases recovered.

Treatment.—Use of siphon-tube; maintenance of bodily heat; administration of stimulants; artificial respiration, if necessary.

Fatal Dose.—Death has followed the taking of 18 grains of powdered root of *V. viride.*

Chemical Analysis.—Separation of the alkaloids by Dragendorff's process. The alkaloid—veratria or veratrin—is taken up by benzene or chloroform in alkaline aqueous solution.

Nicotiana Tabacum

Tobacco is not now used as a therapeutic agent as it once was, but its popular use is perhaps greater than ever it has been. The plant contains a very poisonous alkaloid—nicotin—to which its toxic effects even by smoking must be attributed. The alkaloid is a colourless, transparent, volatile liquid, but develops on exposure to air an amber tint, and latterly becomes a resinous substance. It has a pungent, acrid taste, and produces a greasy-looking green stain on white filtering-paper—conia causing a *pink* stain. The question

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[1] *Vide* Wright and Luff, *Jour. Chem. Soc.*, July 1879.

[2] *B. M. J.*, vol. ii., 1903, p. 432.

[3] Wood, *op. cit.* p. 159.

[4] Taylor, "Med. Jurisp.," vol. i., p. 332; Percy, "Prize Essay," 1864, p. 76; *St Geo. Hosp. Rep.*, 1870, vol. v.; *Med. Gaz.*, vol. i., 1863, p. 5.

whether the alkaloid exists in tobacco smoke has been much debated. Some observers [1] affirm that it is absent, and that the derivatives which take its place are mainly pyridin, collodin, and others ; others, as Binz,[2] that in addition to pyridin, nicotin is also present as well as CO gas. Cases of acute poisoning are now comparatively rare, but sub-acute and chronic cases are common by reason of the immoderate use of tobacco among boys. An unusual case is recorded by Gill. A convict admitted to Liverpool prison was examined on entrance by the medical officer in the usual way, by whom he was certified to be in fairly good health. Four hours later the convict was found in a state of collapse, with nausea, vomiting, and paralysis of both legs. It seems that he had secreted an ounce of cut Cavendish tobacco in his rectum, in order to convey it past the searchers, and that on being put into his cell he tried but failed to remove it, with the above consequences. The tobacco was found by the officials in its unusual position. The man recovered.[3] To a child, aged 18 months, suffering from oxyurides, was given an injection consisting of a decoction of two cigars. The child thereafter began to vomit and to be convulsed ; it then lapsed into a state of coma, with frequent, feeble pulse, cold extremities, irregular respiration, and contracted pupils. It recovered. Both cigars contained about 2½ drachms of tobacco.[4] O'Neill records an interesting case where toxic effects followed the external application of the leaf. A woman suffering from varicose veins accidentally wounded herself ; to staunch the blood a handful of chopped tobacco was applied to the wounded surface and kept in position by a bandage. The patient became extremely prostrated, almost pulseless, her skin pale and cold, her pupils dilated, and she suffered from much pain in abdomen, with nausea and vomiting. She got better after a lapse of several days.[5]

Bleasdale [6] records the case of a boy of two years, thought to be affected with thread worms, who was given by a midwife an enema of about half-a-gill of a decoction made by cutting up black twist tobacco and pouring boiling water over it. Soon afterwards, the child became comatose ; there was hardly any pulse, the breathing had almost ceased, and the pupils were widely dilated and insensitive. Artificial respiration was started and other restorative measures used, and at the end of forty minutes' use of the artificial respiration he vomited and began to improve.

Stillingfleet Johnson narrates the case of a man, aged 75, who was found on a doorstep with his throat bleeding, a bottle lying not far from him, and a greenish-coloured vomit on the ground near him. A paper found in his hand bore the writing, "I did this myself." A knife was also found near him. The external jugular vein was found to be severed in the throat wound. He died suddenly. An analysis was made of the contents of stomach and nicotin was isolated. Some of the purified isolated alkaloid on being injected into a rabbit caused the animal to be thrown into violent convulsions, and to be followed by muscular paralysis, respiration ceasing within three minutes after injection of poison.[7]

In April 1904, a young married woman died from the effects of drinking a fluid out of a bottle labelled "dandelion beer," but which was found to be pure nicotin intended as an insecticide for garden use.

Symptoms.—When the leaves are swallowed—as in a quid—or where immoderate smoking has been indulged in by one unaccustomed to smoke, the principal symptoms found are : giddiness, depression, sickness, vomiting, muscular tremors, feeble, rapid, and, it may be, irregular pulse. Morrow [8] has drawn attention to a peculiarity in the breathing of persons suffering from nicotin poisoning by smoking—viz. a form of Cheyne-Stokes' respiration in which there is a deep inspiration followed by absence of rhythmic respiration for a considerable interval, then succeeded by another deep inspiration. He adduces three cases in which this phenomenon was seen. He made a series of experiments on rabbits to discover its physiological basis, and by tracings shows

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[1] Vohl and Eulenberg, *Arch. f. Pharm.* 2, cxlvi. p. 130.
[2] Dent, *Aertze-Zeitung*, Jan. 1, 1900.
[3] *B. M. J.*, vol. i., 1901, p. 1544.
[4] *The Lancet*, vol. i., 1879, p. 206.
[5] *The Lancet*, vol. i., 1879, p. 296.
[6] *B. M. J.*, vol. i., 1906, p. 1155.
[7] *Lancet*, vol. ii., 1890, p. 337.
[8] *B. M. J.*, vol. i., 1898, p. 1406.

that the poison of tobacco seems to act chiefly on the respiratory centre, paralysing the expiratory division of it. The symptoms after taking the alkaloid are more acute than those described. These are a burning, acrid taste in mouth and throat, followed by nausea, vomiting, rapid unconsciousness, symptoms of shock, gasping or sighing and irregular respiration, with delirium, and, possibly, convulsions. In the early stage of acute, and in all stages of sub-acute poisoning, the pupil is contracted, but in the later stage of acute poisoning it becomes dilated.

There is reason to believe that in the form of snuff, powdered tobacco, it is sometimes feloniously put in liquor for the purpose of enabling the easier commission of such crimes as theft. The only homicidal case on record is that recorded by Tardieu,[1] in which Count Bocarmé and his wife were convicted of murdering their victim—Fougnies—by administering forcibly the alkaloid which Bocarmé himself had made.

Chronic Poisoning.—There can be little doubt that the use of tobacco in the form of cigarettes by boys of immature age is productive of considerable constitutional mischief, especially if the smoke is inhaled. This is indeed true of all who inhale the smoke. Not to speak of the dyspepsia, anæmia, and stunted growth which are produced, it gives rise to nervous troubles and to tumultuous, and sometimes irregular, action of the heart; indeed, "tobacco heart" is a well-known condition in present-day medical practice.

Post-Mortem Appearances.—These are very indefinite. Death would seem to be due to asphyxia, and therefore the post-mortem signs of that form of death are likely to be found. In all cases, the contents of the stomach should be examined for remanent parts of the leaf, leaf-stem, or mid-rib. In odd cases where the leaf has been swallowed, the odour of tobacco may be perceived in the stomach; in other cases, the odour cannot be counted upon.

Fatal Dose.—An enema of half-a-drachm, and one of a drachm of the leaves have caused death, but recovery has followed the use of an enema in which half-an-ounce of snuff and five leaves were mixed. Of the alkaloid probably 10 to 20 milligrams would cause death.

Fatal Period.—In fifteen minutes, after enema.[2] In three to five minutes from nicotin.[3]

Chemical Analysis.—Examine contents of stomach for fragments of leaves, which may be recognised microscopically by the small glandular hairs which they possess. The contents may then be treated by the Stas-Otto or Dragendorff process for the alkaloid, which consists of oily-looking drops.

Lobelia

(*Lobelia Inflata*, or Indian Tobacco.)—This plant possesses toxic properties by reason of the active principle Lobeliin or Lobelin which it contains. This has an action somewhat akin to tobacco. It is a favourite remedy of the "Thomsonian" or "Coffinite" school of practitioners, who assert that it is not a poison. It is commonly used in America as a drug, and has very often given rise to fatal effects. In 1884, a herbalist in England was charged with having caused the death of a woman by administering lobelia in an acetic-acid solution. The woman only survived its administration some forty minutes, previous to which she had been profusely purged. It was shown in evidence that the woman had taken of the solution prescribed an equivalent of 28 grains of the drug. At the trial [4] several witnesses were called for the defence—all of them herbalists—by whom it was asserted that the drug was not a poison, that the Committee of the House of Lords in 1857 struck it out of the proposed list of poisons; and one of the witnesses testified that he himself had taken 960 minims of lobelia without being poisoned. The jury, owing to the summing-up of Mr Justice Watkin Williams, returned a verdict of not guilty.

Symptoms.—The main symptoms are those of a depressant nature; vomit-

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[1] *Vide L'Étude Méd.-Leg. sur. l'Empoisonnement.*
[2] Beck, "Med. Jurisp.," vol. ii., p. 878.
[3] Taylor, *op. cit.* vol. i., p. 393.
[4] *B. M. J.*, vol. i., 1884, p. 343.

ing is usually an early symptom ; the pulse becomes weak ; the pupils dilated ; the patient becomes insensible and collapsed prior to death.

Treatment.—Evacuation of contents of stomach by tube and free lavage with water ; stimulation hypodermically by ether, or *per rectum* by alcohol ; restoration and maintenance of bodily heat.

Fatal Dose and *Fatal Period* are both uncertain.

Chemical Analysis.—In Dragendorff's process lobelin is extracted from an alkaline aqueous solution by petroleum ether, and gives with Fröhde's reagent (1 part of sodic molybdate dissolved in 10 parts of strong sulphuric acid) a deep violet solution which gradually fades.

Alcohol (C_2H_6O)

Having already considered the toxic appearances from alcohol (p. 468), it is only necessary to describe now the salient characteristics of alcoholic intoxication, and their modifications by the use of different forms of alcohol. The chief signs of alcoholic poisoning are these : deep unconsciousness ; face pale, with occasionally some degree of cyanosis of lips ; subnormal bodily temperature ; regular, deep, but not stertorous breathing ; pupils are contracted if the person is allowed to remain undisturbed for fifteen minutes, but become dilated on the application of any stimulation. We consider such pupillary conditions to be pathognomonic of the alcoholic state.

In poisoning by methyl alcohol, we are of opinion from our experience that the unconsciousness is more profound, and that the person recovers less rapidly.

Methyl Alcohol.—During a long experience as police surgeon, we had to deal with not a few cases of alcoholic coma from this form of alcohol, among persons who were furniture polishers, or dispensing chemists of degenerate habits. They were not, however, common. But in America and Canada the toxic effects have been observed more frequently. In these countries a cheap deodorised methyl alcohol has been placed on the market which is called by names such as " Columbian spirits," " Cologne spirits," " Eagle spirits." Buller and Wood [1] state that of 275 cases of overdoses, 122 deaths resulted. The symptoms of poisoning were : gastro-intestinal irritation, accompanied by abdominal pain and vomiting, vertigo, headache, and dilatation of pupils. In fatal cases, there were marked cardiac depression, sighing respiration, cold sweats, delirium and unconsciousness, followed by coma and death. Blindness was not an infrequent accompaniment of the cases which did not die. It was at first complete and bilateral, then it slightly improved, only, however, later to relapse to total blindness. Buller [2] has noted that blindness may result from relatively small doses of this form of alcohol. In two cases a single dose of about two ounces produced complete blindness within 24 hours which lasted about twelve days, followed by but slight improvement; and in a third case the person took a wineglassful on three successive days before the onset of blindness, which followed the same course as the others. Wood [3] has recorded 23 cases of fatal methyl-alcohol poisoning. In one branch of the hat-making industry, the air of the working-room becomes saturated with

[1] *B. M. J.*, vol. i., 1905, p. 262.
[2] *Ibid.* vol. i., 1904, p. 151.
[3] *Ibid.* vol. ii., 1006, p. 1855.

the fumes of methyl alcohol, and similar effects to those described are sometimes produced.

Amylic Alcohol.—Cases of poisoning from amylic alcohol ($C_5H_{12}O$) are comparatively rare. The case recorded by Ord is full of interest.[1] A coal-porter drank about half-a-pint of fousel oil at 5.30 A.M., went to his work, and at 10 A.M. become unconscious. When brought to St Thomas's Hospital at 12.30 P.M. he was still unconscious, the muscles of his arms and legs were rigidly extended, as were also those of the neck and back; his teeth were tightly clenched; his face bluish; the breathing shallow and infrequent; pulse could just be detected at wrist; pupils small, but they acted feebly to light; conjunctival reflex was absent; body surface was cold. His breath had the odour of amyl nitrite or jargonelle pear, and the washings from his stomach the same, but even more marked odour. He recovered consciousness next day, and left the hospital two days later. Dr Bernays examined the remaining portion of the liquid which he had taken, and found that it was composed of half fousel oil and half spirit; the urine, which he also examined, contained traces of amylic alcohol. It will be noticed that the pupillary condition on his admission was one of contraction, and that during artificial respiration the pupils became dilated. Ord further states that the fumes of the spirit which were exhaled from the patient produced in those who attended him severe frontal headache, giddiness, and feelings of malaise which lasted for some hours. Swain [2] also records a fatal case from this impure alcohol.

From ordinary alcoholic liquors in which ethylic alcohol predominates fatal poisonings are not nearly so common. The most commonly reported cases happen in children of tender years. In one case a child of four took two ounces,[3] and in another, a boy of six, nine ounces of neat whisky.[4] In each case the child was comatose, the pupils widely dilated and fixed, the conjunctival reflex absent, pulse small, very rapid, irregular and uncountable, and the respiration deeply stertorous. They recovered after energetic treatment.

A case of acute alcoholism, followed by hyperpyrexia, coma, and death was reported from the Government Civil Hospital, Hong Kong. The temperature rose to 110° F., before death. Hyperpyrexia in cases of acute alcoholism is not unknown in tropical and semi-tropical countries.

The continuous use of the liqueur—absinthe—produces disastrous effects upon the nervous system of habitués; but this is owing to the contained santonin or wormwood. Absinthe is popularly believed to possess aphrodisiac properties, and has, when used in the form of infusion of wormwood, given rise to toxic symptoms.[5]

Treatment.—Restoration of bodily heat, by wrapping person in blankets and placing him in the recumbent position before a fire; use of siphon-tube and free lavage of stomach.

Post-Mortem Appearances.—The post-mortem signs generally are those of asphyxia. In the stomach, the characteristic odour of ethyl, methyl, or amyl alcohol—depending upon which form of alcohol predominates in the liquor taken—is likely to be found.

[1] *The Lancet*, vol. ii., 1889, p. 1225. [2] *B. M. J.*, vol. i., 1891, p. 903.
[3] *B. M. J.*, May 16, 1903, p. 1142. [4] *Ibid.* vol. i., 1903, p. 1492.
[5] *Lancet*, vol. i., 1889, p. 770.

In poisoning by amyl alcohol the mucous membrane of the stomach is likely to be more or less injected and softened. In the case narrated by Swain, the stomach contained some grumous fluid tinged with blood.

Chemical Analysis.—Alcohol may be separated from vomited matter or stomach contents by careful distillation, after they have been made neutral with sodium carbonate. Amylic alcohol may be separated by shaking up the mixture with chloroform after filtration, separating the chloroform layer, and allowing it to evaporate, when the characteristic odour will be perceptible. If necessary, this residue may be distilled with potassium acetate and sulphuric acid, when amyl acetate—recognised by its peculiar odour—will distil over.

Amyl Nitrite ($C_5H_{11}NO_2$)

Cases of poisoning by this substance are rare, those recorded being due to accident.

1. A young lady took by mistake a teaspoonful. An emetic was promptly given which acted freely. Twenty-five minutes later, when seen by a medical man, she was vomiting freely, the vomited fluid giving off fumes which saturated the air of the room with the characteristic odour of the drug. Her face was greyish-white, her eyes glassy and rolling in their sockets, the pupils widely dilated, her mouth wide open, the breathing spasmodic and irregular, almost Cheyne-Stokes in character, the pulse irregular and jerky at first, and slow and feeble later, and the skin cold and clammy with sticky perspiration. She recovered.[1]

2. Rosen tells of a student, aged 22, who, subject to epileptic fits, was given this drug for treatment by inhalation. Feeling an attack coming on, he prepared the bottle to get some for inhalation, but the seizure attacked him before that was possible. When he recovered consciousness, he experienced sensations which caused him to believe that he had swallowed some of the contents of the bottle. The mucous membrane of the mouth was slightly eroded. He had eructations and vomiting, a pale face, bloodless lips, and a pulse of 110 per minute. Gastric catarrh ensued. He recovered.

The treatment, where the poison has been swallowed, is to empty the stomach and wash freely, and to treat symptoms.

Camphor

The resin of camphor, because of its popular use as a personal disinfectant and as a preservative of clothing against moths, has given rise to toxic results in children who have inadvertently eaten of it. The Pharmacopœial preparations—liniments and spirit especially—have been drunk by mistake, sometimes with fatal results.

Cases.—A woman, aged 35, swallowed one ounce of oil of camphor in mistake for castor oil, which contained 96 grains of camphor. She had burning pain in the mouth, convulsions, retching, with a pale face, dilated pupils, breathing inclined to be stertorous, twitchings beginning in the face, arms being thrown to and fro and legs jerked about as in clonic stage of an epileptic fit. She recovered after treatment.[2] East records the case of a lad of nineteen who recovered after a dose of 120 grains,[3] and Schaaf, of an infant who died after 30 grains.[4]

Symptoms.—Vomiting, unconsciousness, foaming at mouth, pallor of face with lividity of lips, and, in children especially, convulsions. In one case which we saw, in addition to the foregoing symptoms, the pupils were dilated.

Treatment.—Evacuation of contents of stomach by siphon-tube and free

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[1] *B. M. J.*, vol. ii., 1880, p. 859. [2] *Ibid.* vol. i., 1896, p. 1556.
[3] *Ibid.* vol. i., 1886, p. 542.
[4] *Jour. de Chim.-Méd.*, 1853, p. 507; *B. M. J.*, vol. ii., 1898, p. 717.

lavage with water ; maintenance of bodily warmth ; stimulants *per rectum* ; artificial respiration.

Post-Mortem Appearances.—The characteristic odour of camphor will be found, and there is likely to be some inflammation or injection of mucous membrane of stomach.

Chemical Analysis.—Shake up contents of stomach or vomit with chloroform ; separate chloroform ; allow to evaporate spontaneously.

Fatal Dose.—Twenty grains have killed an adult ; adults have recovered, however, from doses eight times that quantity, and a child has recovered from the effects of swallowing a teacupful of camphorated oil, containing between 100 and 200 grains of camphor, although it had convulsions and all the signs of collapse.[1]

Turpentine

Spirits or oil of turpentine being used for a variety of domestic purposes gives rise, occasionally, to accidental poisoning in children and adults. Being volatile, its vapour produces certain physiological effects upon those who are exposed to it for lengthened periods. Cats and rabbits exposed to it die within a short time—less than an hour. Before death they exhibit uneasiness, unsteady gait, paralysis of hind limbs, difficulty in breathing, and convulsive movements. The proximate cause of death is asphyxia. Grapel records a case [2] of a woman who swallowed by mistake about 9 P.M. one to one and a half ounces of turpentine. At 10.40 P.M. she awoke feeling very cold and with a sensation of dying ; she was giddy, and on trying to walk, staggered in her gait. Next morning, micturition was accompanied by great pain, and was followed by the passage of clotted blood *per urethram*. For several days she suffered from pain in the loins, headache, loss of appetite, and blood after the act of urinating ; during the night she was partly delirious, and she was somewhat feverish. The urine had a pungent odour of " violets," which continued for twenty-four days, but in a less marked degree after the first three or four days. Her menses, which were eight weeks overdue, came on the day after she took the turpentine. In another case, a woman with suicidal propensities took half-a-pint of turpentine. The siphon-tube was passed soon after, free lavage of the stomach being employed for half-an-hour with cold water, but with the exception of the odour of " violets " in the urine, there was little left by which her act could be traced. The stomach washings smelled strongly of the turpentine, but there was no odour of it in the breath or upon the clothing. The woman recovered after prompt medical treatment.[3]

Symptoms.—Burning in mouth and stomach ; vomiting, thirst, giddiness, unconsciousness, strangury, odour of " violets " and blood in urine ; coma usually precedes death.

Treatment.—Evacuation of stomach by siphon-tube and free lavage with cold or tepid water, till washings are nearly free from turpentine odour ; then warm milk into stomach ; purgative dose of castor oil ; restoration of bodily heat.

Fatal Dose.—℥ss killed a child ; one teaspoonful, an infant. Four ounces and six ounces respectively have killed adults.

Fatal Period.—In the case of the child who took half-an-ounce, fifteen hours ; in the adult, twelve hours.

Eucalyptus

(*Eucalyptus globulus.*)—This drug is allied closely to turpentine in composition. It contains several isomeric terpenes having the common formula $C_{10}H_{16}$, to which, doubtless, its toxic effects are due. The popular use of this drug as a remedy for nasal catarrh and like affections, and its more common

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[1] Wilkinson, *B. M. J.*, vol. i., 1898, p. 299.
[2] *B. M. J.*, vol. i. 1901, p. 340.
[3] *Ibid.* vol. i., 1901, p. 640.

presence, therefore, in households, have given rise to accidental poisonings where it is swallowed by mistake. The two following cases are illustrative of its toxic effects:—

1. Orr narrates the case of a boy, aged 2¾ years, who drank two drachms of eucalyptus oil. He vomited immediately, and purging set in. Fifteen minutes later he was unconscious and collapsed, with quick pulse, stertorous breathing, and pupils contracted almost to a pin-head. After free emesis by emetics and administration of coffee he quickly rallied, and within an hour was out of danger.[1]

2. A cab-driver, aged 34, who had been drinking heavily for two or three days and who was suffering from a cold, bought six drachms of the oil from a chemist, and at 10.30 A.M. drank the whole quantity mixed with an equal quantity of water. At 12.30 P.M. he returned home looking dazed, and then seemed to become unconscious all at once. Given an emetic he vomited freely, the vomit smelling strongly of the drug. At 2.30 P.M. he was admitted to hospital. He lay in a passive condition, his face being cyanosed of a purplish colour, the pupils being slightly contracted and the conjunctival reflex almost gone; breathing was laboured; his mouth filled with foam; pulse, fast, thready, and feeble; skin moist and cold. Examination of chest showed evidence of congestive catarrh. After administration of strychnine hypodermically and oxygen inhalations he began to improve, and in one and a half hours after admission was able to answer questions. Toward midnight of next day, however, he complained of pain and difficulty in breathing, his temperature rose to 103° F., his pulse, 130-140, and his respirations to 40-48 per minute. He died the following day at 2.45 A.M.; being forty hours from time of taking the drug. Post-mortem examination showed a reddened and congested condition of tracheal and bronchial mucous membrane, the lungs large, bulky, and heavy, the costal and visceral pleuræ agglutinated together, the anterior margins of lungs, especially the right, being swollen and spongy, and on section, intensely congested, and, near the bases, easily broken down with point of finger. The gullet was normal; the walls of stomach thickened, and the mucous membrane swollen and velvety, especially around the cardiac end which showed marked ecchymosis which spread therefrom toward the centre of the organ.[2]

Kirkness has also related two experiences of poisoning by this drug in both of which recovery followed. In one of the cases the breath, urine, fæces, and skin of the patient smelled strongly of the drug for nearly a fortnight afterwards.[3]

Benzene (C_6H_6).—*See Naphtha.*

Naphthalin ($C_{11}H_8$)

This is a poisonous substance, although it has been sometimes described as harmless. Zangerle [4] narrates the case of a boy of twelve who came home one night with symptoms which were much like those of alcoholic intoxication. It appeared, however, that he had eaten two naphthalin camphor tablets which another boy had given him to as "bon-bons." Each tablet contained two grammes of pure naphthalin. Meyer experimented on rabbits and cats with these tablets, and found that they produced muscular inco-ordination of hind limbs and attacks of sneezing and vomiting. The animals died. Evers [5] records the case of persons who suffered from loss of appetite, headache, and eczema of both legs, from having slept under bedclothing which had been dusted over with naphthalin as a moth-powder. Gotze [6] and Fronmüller [7] record other cases of poisoning; the former, where the naphthalin was administered internally in enteric fever, the latter, from absorption in wounds, to which it had been used as an antiseptic application.

Nash records the case of a schoolboy, aged 13½ years, who ate by mistake a

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[1] *B. M. J.*, vol. i., 1906, p. 1085. [2] *Ibid.* vol. i., 1906, p. 558.
[3] *Ibid.* vol. i., 1910, p. 261; *see* also, *ibid.* vol. ii., 1909, p. 1656.
[4] *Therap. Monats.*, Feb. 1899. [5] *Berl. klin. Woch.*, 1884, p. 593.
[6] *Berl. klin. Woch.*, 42, 1884. [7] *Memorabilien*, 1883, v. 237.

piece of pure naphthalin (a moth ball) about the size of a filbert nut. Half-an-hour later he had severe abdominal pain, followed by aching and cutting pains down to the penis and along to the urethral meatus. The prepuce swelled. Within an hour micturition became frequent, the urine passed being of a brownish-yellow colour, becoming black "like weak ink." Two days later there was suppression of urine for twenty-four hours. He had no nausea, vomiting, or collapse. He got well.[1]

Aniline Oil, Anilin ($C_6H_5NH_2$), or Phenylamine

This is a colourless, oily fluid, which, after standing, may develop a shade of brown colour. It has a peculiar odour. It has very toxic properties, not only when swallowed but when absorbed through the unbroken skin. Several cases from both causes have been recorded. Müller [2] records that of a woman who swallowed about 25 c.c. of anilin, and Smith [3] that of another woman who swallowed about three ounces of marking ink, the greater part of which was anilin.

St Clair Thomson [4] narrates the case of a man who was prescribed as a menstruum for the aural application of cocaine equal parts of anilin oil and rectified spirit. The cocaine was introduced into the ear on a pledget of cotton-wool at night. The man slept well. He renewed the application at 5 A.M., because of the pain returning. At 7.30 A.M. he accidentally noticed a peculiar blueness of his finger-nails, and his wife remarked that his face also was blue. There was a like colour of lips and tongue. There was no fever nor mental disturbance, the pupils were normal, but the apex beat of the heart was observed to be two fingers breadth outside the left nipple line. The blue colour disappeared during the day, and the area of cardiac dulness again became normal. A very remarkable case of its effects on newly born children after absorption is narrated by Rayner.[5] The napkins of the infants in an institution were marked with an official stamp in large letters. The ink used was aniline chloride. The blue coloration, already described, appeared on the lips, gums, and palate of some of the children.

Landouzy and Brouardel record ten cases of grave symptoms in children after wearing yellow boots, the colour being due to a liquid containing anilin. Analysis of the liquid showed that it contained 90 per cent. of anilin, and when injected subcutaneously into guinea-pigs produced similar symptoms in thirty minutes, but when administered by the mouth, somewhat later.[6] Anilin poisoning is sometimes exhibited among dyers. The Home Office issued early in 1906 a Memorandum in which attention was drawn to the dangers attendant on the use of aniline oil and alkaline bichromates in the manufacture of "fast-black" dyes. The Chief Inspector of Factories had found that in seven dye-works, of 60 persons employed in the mixing, preparing, and dyeing processes, 28 exhibited a pale grey or blue colour of the lips, 34 a characteristic pallor, and 5 chrome scars. Other not uncommon symptoms were headache, indigestion, and heartburn, distaste for food, drowsiness, tremor and slight weakness of grasp, and occasionally cyanosis and unconsciousness. It was suggested that persons weighing bichromate crystals or ladling out the prepared anilin liquor should wear india-rubber gloves.

Symptoms.—These appear rapidly, as a rule, after swallowing the poison, and consist of nausea and vomiting, giddiness, drowsiness lapsing into coma, along with a remarkable development of blueness of face and body; the skin is cold and clammy, the bodily temperature is subnormal, the pupils dilated and immobile, and the pulse small, feeble, and irregular. If the blood be examined during life, it yields a spectrum of met-hæmoglobin.

Post-Mortem Appearances.—The signs of death by asphyxia are met with. The blood is very dark in colour.

Fatal Dose.—From 3 to 6 drachms.

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[1] *B. M. J.*, vol. i., 1903, p. 251.
[2] *Deutsche. med. Woch.*, 1887.
[3] *The Lancet*, vol. i., 1894, p. 89.
[4] *B. M. J.*, vol. i., 1901, p. 957.
[5] *B. M. J.*, vol. i., 1886, p. 294.
[6] *Ibid.* vol. ii., 1900, p. 946.

Fatal Period.—Uncertain.

Treatment.—Wash out stomach freely with siphon-tube; administer stimulants hypodermically, or *per rectum*; sustain bodily heat; and use artificial respiration if necessary. In cases resisting benefit from the foregoing, bleed the patient at the arm and transfuse live human blood.

Chemical Analysis.—The poison may be obtained by rendering alkaline the vomited matter or stomach-contents and then distilling; or if the vomited matter be fairly free of organic solids, after filtration, the filtrate is made alkaline and shaken up with ether; the ether is then separated and allowed to evaporate spontaneously. The poison will be found in distillate or residue.

Acetanilide, Antipyrin, Phenacetin, Maretin, Exalgin

These synthetic drugs, which are nowadays so commonly prescribed as febrifuges or as anti-headache powders, not only give rise occasionally to toxic symptoms, but are taken by patients as an acquired habit. We have seen only one case of acquired antipyrin habit.

ACETANILIDE or ANTIFEBRIN poisoning has occurred not only from taking the drug but also from its inadvertent application to raw healing surfaces.

Dimsey narrates the case of a woman who took six "Daisy," or "Headache," powders daily for a month. Each powder contained between four and ten grains of the drug. She had no acute toxic symptoms, but her skin became of a bluish-grey colour. No met-hæmoglobin commonly found in such circumstances was, however, found in the blood.

Sobel records the case of a woman who took three headache powders at once and became cyanosed and collapsed, but recovered under treatment.

Marenchaux tells of an infant of five months who by accident was given three grains of the drug, and whose chief symptoms were marked cyanosis, coldness of body surface, and insensibility. The infant recovered.

Snow records the case of an infant upon whose raw, unhealed umbilicus this drug had been used as a dusting-powder, who suffered from like symptoms.

Chemical Analysis.—If a small portion of the drug be tested by the sulphuric-acid-potassium-bichromate test, the colour first produced is red changing to a dirty brown. Unlike antipyrin, it does not react with ferric chloride.

The results of a valuable inquiry into the prevalence of use of these drugs by Drs Kebler, Morgan and Ruff have been reported. These are exhibited in the following tables[1]:—

Name of Drug	Poisoning	Deaths	Habitual Use
Acetanilide . .	614	16	112
Antipyrin . .	105	5	7
Phenacetin . .	95	7	17
Totals	814	28	136

Cases Recorded in Medical Literature from 1884-1907:

Acetanilide . .	297	13	32
Antipyrin . .	488	10	—
Phenacetin . .	70	3	1
Totals	855	26	33

In acetanilide poisoning, 2·3 per cent. of the cases occurred from its external application.

The data composing the first part of the table were obtained from practitioners in the form of answers to questions issued in a circular letter.

ANTIPYRIN or PHENYLDIMETHYLPYRAZOLONE seems to be more popularly used, as it is, perhaps, more commonly prescribed medically, than the previous drug.

[1] Bulletin, No. 136, Bureau of Chemistry, United States Department of Agriculture, Washington, July 1909.

Blakeney [1] reports the toxic action of the drug in the following facts. His wife, otherwise in perfect health, complaining of a slight nervous headache, was given 10 grains of antipyrin (phenazone) in an ounce of water. Immediately after swallowing she complained of acute abdominal discomfort, with burning sensation in mouth and throat. Severe vomiting, with retching, followed. Hot water was administered, but much difficulty was experienced in swallowing, owing to rapid swelling of the lips and cheeks, which spread over the entire face, almost closing the eyes. Collapse followed the sickness, the pulse becoming imperceptible at the wrist. She fainted. Previous to this she had never in her life fainted. Urticaria appeared, which spread over her body. At the end of three days she had quite recovered. Analysis proved the drug to be pure. Two months before this, during convalescence from influenza, she had taken a doze of fifteen grains, which produced similar but less severe symptoms. Fournier [2] has reported three cases in each of which a black eruption appeared on the penis caused by this drug. The eruption consisted of dark blotches on the skin of penis, sometimes accompanied by œdema.

We had under observation for a lengthened period a lady who had acquired the habitual use of the drug. She never exhibited any skin eruption although at times she complained of violent itching of the skin Her complexion was of a bluish-grey colour, and her hair had become prematurely white.

Chemical Test.—The drug gives with ferric chloride a dark red colour which is destroyed in excess of mineral acids. It may thus be detected in the urine of habitual users of the drug.

Fatal Effect.—Of the cases recorded in the previous tables, it appears that its fatal effects only occur in from 2 to 2·6 per cent. of cases.

PHENACETIN or PARA-ACET-PHENETIDIN would seem to be more attended by fatal results than either of the two previously named drugs, if we may judge from the recorded figures. In the fatal cases which have been recorded the prominent symptoms were marked cyanosis of skin and mucous membranes, characterised as blue-black or mahogany-coloured, sub-normal temperature, and chocolate-coloured urine, containing blood. Met-hæmoglobin seems to exist in the blood in these cases.

Krönig [3] relates a case of fatal poisoning from taking powders each containing one gramme. The symptoms were headache, vomiting, and diarrhœa, cyanosis which gradually increased till death occurred within three days of taking the last powder, and general enfeeblement of circulation. The urine was of a chocolate colour, and toward the end contained blood.

Chemical Test.—Sulpho-vanadic-acid solution gives an olive-green coloration, which, on warming, changes to a black colour.

MARETIN.—This drug, used as an antipyretic, has been declared to be free from toxic effects, but this is not well founded. Chemically it is called carbamic-acid-meta-tolyl-hydrazide.

Port [4] reports a case which showed marked toxic effects. The patient was given 0·5 gramme (about 7 grains) twice daily for nine days to reduce temperature, its antipyretic action being well marked. After a few days, however, anæmia developed, the complexion assuming a yellowish tint, then dyspnœa supervened, followed by cyanosis. This writer mentions that Krœnig, Benfey, and Steinhauer were the only observers who had previously reported cases in which toxic symptoms had followed the use of 0·25 gramme doses twice daily for 16 days in one case, while the same dose given twice or thrice daily for from 7 to 57 days produced severe symptoms in the other cases.

EXALGIN or METHYLACETANILIDE has also given rise to toxic symptoms. Cases have been recorded by Bokenham and Jones,[5] Gilray,[6] Weber,[7] Bell,[8] and others.

The doses which caused the symptoms varied from 6 grains taken three times daily for a week, to 17½, 150, and 248 grains respectively taken in a single dose. In none of these, however, did the patient die.

Symptoms.—Unconsciousness ; delirium ; convulsions ; cyanosis ; pro-

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[1] *B. M. J.*, vol. ii., 1889, p. 85.
[2] Ann. de Derm. et de Syph., April 1899.
[3] *Berl. klin. Woch.*, Nov. 18, 1895.
[4] *Deut. med. Woch.*, Aug. 29, 1907.
[5] *B. M. J.*, vol. i., 1899.
[6] *B. M. J.*, vol. ii., 1892.
[7] *La Sémaine Med.*, 1894.
[8] *Lancet*, vol. i., 1899.

fuse perspiration ; and albumen or blood in urine. Met-hæmoglobin is found in the blood.

Treatment.—Consists of hypodermic injections of strychnine and atropine, stimulants, and general treatment of symptoms.

Paraffin Oil

Paraffin oil, or rock oil, or petroleum, whether obtained as a natural product or from the destructive distillation of oil shale, produces toxic effects when swallowed. Although these are not identical chemically, their effects when swallowed are practically alike. It must be said that compared with most other poisons paraffin oil is relatively less poisonous, the toxicity depending rather upon the quantity taken. It has been taken both accidentally and suicidally, but there is no case on record in which it has been used homicidally. This is doubtless owing to its tell-tale odour. It has caused death in the case of children. Carruthers [1] has recorded a case with unusual symptoms. A woman, aged 36, while under the influence of alcohol, swallowed half-a-cupful of paraffin oil. Half-an-hour later she was seized with violent abdominal pain and vomiting. Three hours later the pain in stomach still continued, and the vomited matter contained marked indications of the oil. Her breath had a distinct odour of it, and in her motions paraffin oil and blood were present. In the urine after standing, a quantity of oil formed a scum on its surface. The urine yielded 6 c.c of oil after distillation ; later, it contained blood and albumen. She recovered completely in a week.

The practical difference between petroleum and paraffin oil is that the former contains higher hydrocarbons than the latter. This appears to effect some difference in the symptoms produced. Johannsen [2] records a case in which a girl of twelve drank a quantity of American petroleum. Her symptoms were as follows :—she became cyanotic, her breathing quickened and laboured, she was drowsy, she vomited, and died comatose in five or six houxs. The vomited matter and motions contained the oil.

Buttersack narrates a case in which an enema of sesame oil was prescribed, and for which, by mistake, yellow paraffin oil was substituted. Two and a half hours later, the patient was vomiting, there was a chocolate colour of the blood, cyanosis, cold perspiration, the pulse being 120 and respirations between 24 and 32 ; she had clonic convulsions, sensorium disturbance, and sopor—symptoms indicative of met-hæmoglobinæmia. The treatment consisted of irrigation of lower intestine and of inhalation of oxygen. She gradually improved and got better. Subcutaneous injections of the oil from the bottle used up to 50 c.c. proved fatal to cats. Spectroscopic examination of the blood gave the characteristic spectrum of met-hæmoglobin.[3]

Post-Mortem Appearances.—The stomach will contain a marked odour of the oil ; but there may not be any unusual appearance in the mucous membrane of its wall. The signs, generally, are those of death by asphyxia.

Treatment.—Evacuation of contents of stomach by siphon-tube and free lavage with warm water ; administration of stimulants *per rectum* ; maintenance of bodily heat ; artificial respiration if required ; purgatives, to rid intestines of oil.

FORMALIN

The use of formaldehyde, or formalin, as the 40 per cent. solution in water of the former is called, as a disinfectant for the aërial disinfection of rooms, is bound sooner or later to give rise to cases of poisoning from its accidental or suicidal use. A few cases have already been recorded. Klüber [4] and Zorn [5] have each recorded a most interesting

[1] *The Lancet*, vol. ii., 1890, p. 442.
[2] *Med. Chron.*, 1898.
[3] *The Lancet*, vol. ii., 1907, p. 1502.
[4] *Münch. med. Woch.*, Oct. 9, 1900.
[5] *Münch. med. Woch.*, Nov. 13, 1900 ; *B. M. J.*, 1901, vol. i., *sup.* p. 9.

case. The patient in Klüber's case—a man of 47—drank some Apenta water in which formalin had been put by mistake; in the other case by Zorn, a man of 44 took about 15 c.c. of formalin by mistake. In the former case, the patient was completely insensible, could not be roused in any way, the face was pale, the body covered with sweat, the pulse was 78, and the temperature 99° F. Twelve hours after swallowing the poison, the man became conscious although still stupid, but again lapsed into a state of somnolency, from which he could now be roused. He had passed no urine for 19 hours. That night he became excited, laughed loudly, but was quite sensible; his eyelids became red, and there was profuse running at the eyes; the mucous membrane of the mouth and soft palate was red and inflamed. After a night's good sleep, he was well enough to return to work.

In Zorn's case, the patient had violent retching and vomiting shortly after swallowing the poison, accompanied by dyspnœa, vertigo, and a burning pain in mouth and stomach, his skin became cold, the bodily temperature sub-normal, the lips and extremities somewhat cyanosed, the pulse 126, and the respirations 44. He never lost consciousness, but on trying to stand, fell and hurt his forehead. There was complete anuria for 24 hours. The stools which he passed during the first day and night thereafter were six in number, were dark in colour, syrupy in consistence, and were accompanied by violent tenesmus. They contained Charcot-Leyden's crystals, much mucus, but no blood.

In the urine of each of these persons, formic acid was shown to be present by the blackening of ammonio-nitrate of silver, and by the characteristic reaction with anilin.

Treatment.—Use of siphon-tube and free lavage with tepid water. Ammonia internally, in the form of the diluted liquor or liq. ammon. acetatis has been recommended as an antidote,[1] because it combines with formaldehyde to form hexamethylemetetramin (urotropin) which is not poisonous, according to the formula: $6(HCOH) + 4NH_3 = (CH_2)6N_4 + 6H_2O$.

ABORTIFACIENT AND APHRODISIAC DRUGS

Ergot

Ergot is found in medicine as the powder, liquid extract, and ergotin, the last containing the active principles of the drug,—viz. ergotinic acid, sphacelinic acid, and cornutin. Its action is ecbolic and emmenagogic; it is, therefore, sometimes used as an abortifacient by quacks for illegal purposes. Ergotised rye, being occasionally used inadvertently for making bread, has given rise to chronic poisoning, and is toxic to animals as well as to man.

Stewart McKay reports the case of a woman, aged 30, who thinking herself pregnant procured from a chemist a 12-ounce bottle which she was told contained ergot, for the purpose of procuring abortion. She finished the first bottle in a week, but without the desired effect. She got a

[1] *Therap. Monats.*, Feb. 1901; *B. M. J.*, vol. i., 1901, *sup.* p. 7.

stronger mixture, finishing it in seven days. Before it was finished her arms began to ache, her skin to itch, and her fingers to swell. Her left index finger began to ache, and then became cold and got blue at the top. The remaining fingers of that hand and also those of the other hand showed a like sequence of symptoms, and by-and-by several of them became gangrenous at the extremities as far as the distal joints. She was a strong, healthy, country woman of splendid physique, had no heart lesion, and had normal arteries. In spite of the drug she failed to abort, but she had it procured by instrumental interference two weeks before she came to the hospital for treatment of the fingers.[1]

Few fatal cases from acute poisoning have been recorded, and then only when large quantities of the drug have been taken. In criminal abortion death may however happen from uterine hæmorrhage following its use. Davidson [2] records a case where a pregnant woman took " two handfuls " of powdered ergot. The next day her face and upper half of body were jaundiced, and ecchymoses were found under the eyes ; the lips and tongue were swollen and covered with dried, dark-coloured blood ; she vomited reddish mucus and blood ; she had great thirst ; her temperature was sub-normal ; the pulse could just be felt, but could not be counted ; and the cardiac beats numbered 150 per minute ; respirations were 48 per minute. She looked drowsy, apathetic and stupid. The urine contained blood. She died.

Symptoms of Acute Poisoning.—These include : pain in stomach, nausea, vomiting with or without blood, thirst, weak, rapid pulse, feeling of oppression in chest, sub-normal temperature, coldness of body, cramps, convulsive movements, stupor, delirium, convulsions, and coma.

Of Chronic Poisoning.—These are indicative of gastro-intestinal catarrh, of nervous exhaustion or excitement sometimes amounting to mania, and dry gangrene of parts at the extreme periphery of the circulation—fingers, toes, etc.—due to contraction of arterioles, and therefore to imperfect blood-supply.

Post-Mortem Appearances.—Jaundice may be found in the skin and mucous surfaces. The internal signs are sub-mucous extravasations of blood in stomach, extravasations in liver and kidneys, and in abdominal cavity. Careful examination of contents of stomach should be made for remains of the powder.

Treatment.—Use of siphon-tube with free lavage of stomach with warm water ; stimulants, hypodermically or *per rectum* ; inhalations of nitrite of amyl ; restoration of bodily heat.

Chemical Analysis.—The vomited matter, or contents of stomach, is mixed with boiling alcohol and filtered. The process being repeated several times, the filtrates are united and acidulated with dilute sulphuric acid. The bulk of alcohol being evaporated off, a portion of the residual liquid is examined spectroscopically ; if ergot be present, a spectrum is found composed of two bands, one in the green, and a second, broader and more marked, in the blue. A parallel test should be made with a solution of ergot identical in colour-tone to that of

[1] *B. M. J.*, vol. ii., 1906, p. 365.
[2] *The Lancet*, vol. i., 1882, p. 526.

the residue. If another portion be rendered distinctly alkaline with caustic potash and heated, the characteristic odour of trimethylamine —that of herring-brine—is given off.

Savin

(*Savina communis, Juniperus sabina.*)—This is an evergreen shrub common in gardens. The leaves and fruit contain a volatile oil having toxic irritant properties. It has held for centuries the reputation of producing abortion; indeed, its action for this purpose is mentioned in the old Scots ballad of Marie Hamilton. It is a debatable point whether savin has a specific ecbolic action, or whether, if this action is exhibited, it is not simply a part of a general toxic effect upon the body. Blyth [1] narrates a case in which he was engaged in which a pregnant woman took an infusion of savin tops, from the effects of which she died in twenty-six hours. Her symptoms were violent sickness, great pain, and diarrhœa. On post-mortem examination of the stomach and its contents, he was able not only to detect some of the savin tops, but also to separate a few drops of an odorous oil, like savin, by distillation. In several cases, strangury with bloody urine has been observed.

In 1908, an inquest was held at Walkley, near Sheffield, regarding the cause of death of a married woman, aged 38. It was shown in evidence that the deceased had gone to a woman herbalist who prescribed and sold to her oil of juniper which was to be taken in fifteen-minim doses. The deceased after partaking of a dose was seized with violent vomiting from which she rapidly sank and died. The deceased admitted before her death that she had partaken of this drug. The jury returned a verdict that death was due to an overdose of oil of juniper, and that it was taken for the purpose of bringing on a miscarriage.[2]

Post-Mortem Appearances.—These are mainly redness of pharynx and gullet and inflammation of stomach, in addition to irritation of kidneys. The remains of the plant ought to be sought for in the vomited matter and contents of the stomach.

Pennyroyal

(*Hedeoma pulegioides.*)—This is perhaps the most popular emmenagogue. Like savin, the plant contains a volatile oil which has toxic properties. Of late years, several cases of its toxic effects have been recorded. Wingate [3] records one in which a pregnant woman of 20 took a teaspoonful of the oil. She became unconscious with delirium, and was attacked by tetanic spasms producing opisthotonos, and exhibited all the signs of shock. She recovered, but did not abort.

Braithwaite records the case of a young married woman who had passed her time for menstruating by a week, and who took an infusion made from threepennyworth of pennyroyal with some added rum.

[1] "On Poisons," p. 442.
[2] *Med. Press*, 1908, p. 4.
[3] *Boston Med. and Surg. Jour.*, 1889.

This not having the desired effect, she bought "essence of pennyroyal" at the same cost at a herbalist's, and took it at 7 P.M., after eating a hearty tea. Ten minutes later she began to feel strange, and soon after became unconscious. When examined, she was insensible, pale, cold, with a pulse 72 and small; conjunctival reflex present, pupils moderately dilated and equal, light reflex absent. With difficulty she could be roused, her chief complaint being a marked sensation of numbness and tingling in her hands. After free emesis, she improved and gradually got well. She had taken half-an-ounce of the essence.[1]

Allen [2] narrates another of a woman who after taking a tablespoonful of the oil vomited persistently for four days, and died on the eighth day.

Post-Mortem Appearances.—Congestion of stomach and small intestines, due to irritant action of poison.

Tansy

(*Tanacetum vulgare.*)—This plant, which grows wild and is common in old-fashioned gardens, possesses a strong, pungent, but not disagreeable odour. It, also, has a popular reputation as an ecbolic. The plant contains a volatile oil with poisonous properties. Jewett [3] records a case of a woman of twenty-nine who took fifteen drops of the oil, and three hours later a teaspoonful. In a quarter of an hour after the larger dose she gave a shriek, became convulsed, during which respiration was suspended, and her face became cyanosed. The pupils were widely dilated. She also exhibited signs of shock. The odour of the oil was perceptible both in her breath and in the vomited matter, vomiting having been induced by an emetic. She recovered. Fatal results, however, have been produced; in one case, after about eleven drachms of the oil had been swallowed.

Post-Mortem Appearances.—These are practically negative. The tell-tale odour of the oil, however, is usually present in the stomach, upon which the diagnosis of cause of death must mainly be founded.

Treatment.—This is, on general lines, identical to that for any other irritant poison.

Cantharides

(*Cantharis vesicatoria.*)—The active principle of Spanish flies is *cantharidin*, which is insoluble in water, but freely soluble in hot alcohol, ether, chloroform, and fixed oils. When taken into the body it is chiefly eliminated by the kidneys and intestines. Popularly it is believed to have marked aphrodisiac action on both sexes, and it is also believed to have abortifacient action. It has been used criminally for both purposes. The officinal medicinal preparations of it are: *acetum cantharides*, the *tincture*, and *liquor epispasticus*. Besides these, there are several proprietary blistering preparations.

[1] *B. M. J.*, vol. ii., 1906, p. 865.
[2] *The Lancet*, 1897, vol. i., p. 1022.
[3] *Boston Med. and Surg. Jour.*, 1880.

It is usually administered for abortifacient purposes in the form of the powder, but other preparations have been given. It has been given homicidally in the form of blistering-paper mixture in soup.[1] A boy of twelve suffering from meningitis, and upon whose head behind the ear a cantharides blister measuring four inches square had been applied, took it off, chewed it, and died with the symptoms of poisoning.[2]

Symptoms.—A burning pain in throat and stomach; subsequent difficulty in swallowing; nausea and vomiting, the vomited matter

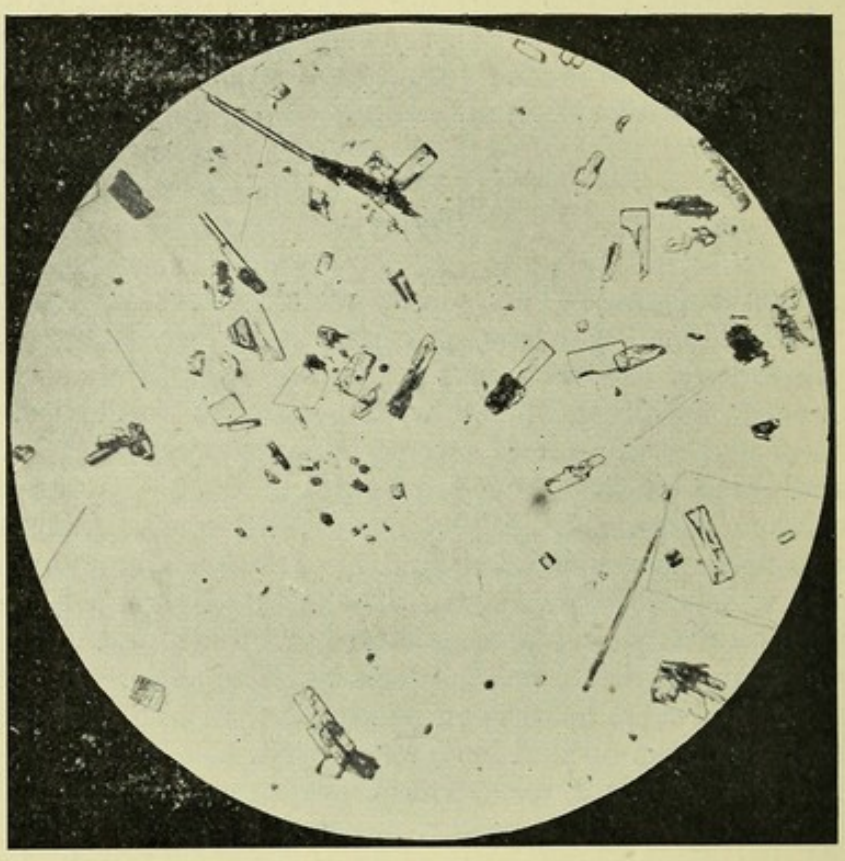

Fig. 130.—Photo-micrograph of crystals of Cantharidin obtained from the *Cantharis vesicatoria*, or Spanish fly. × 500 diameters. (Author.)

containing blood; intense thirst; there may be diarrhœa. Strangury, with great tenesmus and the passage of bloody urine, is a prominent symptom. In fatal cases, coma with convulsions usually precedes death.

Post-Mortem Appearances.—Gastro-intestinal inflammation, due to the vesicating action of the cantharidin. This is chiefly marked on mucous membrane of stomach and upper intestines. The kidneys exhibit marked signs of congestion and inflammation, macroscopically and microscopically, and bloody urine may be found in bladder. In view of the fact that the powder is commonly given, the stomach and intestinal tract should be carefully searched for remains of the shining *elytra* or wing-cases of the insect.

[1] *Jour. de Chimie*, 1846, p. 606.
[2] Muir, *B. M. J.*, vol. i., 1881, p. 1012.

Treatment.—Evacuation of stomach contents with siphon-tube and free lavage with tepid water, followed by demulcent fluids. After vomiting has ceased, excretion of urine should be aided by the use of warm demulcent drinks, as barley water, and the bowels should be cleared by a saline purgative, but *not by castor oil.*

Chemical Analysis.—If portions of the wing-cases have been found they should be set apart for special examination. The vomited matter or contents of stomach should be acidulated with sulphuric acid, and thereafter shaken up with chloroform, the chloroform layer separated and filtered, if necessary; the bulk of the fluid is then allowed to evaporate spontaneously, and a drop of the residue, mixed with a drop of olive oil, is taken up on a tiny piece of cotton-wool and applied to the skin on the inside of the arm near the elbow, when, if cantharides be present, its blistering action will become apparent. For the estimation quantitatively of cantharidin, Dragendorff's system must be used.

Fatal Dose.—Twenty-five grains of the powder killed a young woman; and one ounce of the tincture (Taylor) has produced a like effect. Recovery, however, has followed larger doses.

Fatal Period.—Uncertain.

Castor Oil Seeds

(*Ricinus communis.*)—The raw seeds of this plant produce very severe toxic effects when eaten. Even a single seed causes alarming symptoms. The toxic principle is *ricin*, which may be destroyed by boiling the seeds. Poisoning by the seeds is, however, rare in this country.

The following may be taken as typical cases :—

A farm labourer, aged 28, in robust health, on a visit to Liverpool, was watching bags of seeds being loaded on a foreign-going steamer. Not knowing what they were, he picked up a seed and ate it. It burned his mouth and throat a little while masticating and swallowing it. Almost immediately after, he felt weak and collapsed, and he staggered to a constable at the dock entrance. Feeling like to choke, he was sent to hospital. There he was found to be collapsed, his face being swollen and blue, pupils a little dilated, body surface and hands and feet cold, the latter being cyanosed. Respirations were shallow, temperature could not be registered in axilla or mouth, wrist-pulse imperceptible, no cardiac impulse, heart sounds being feeble and distant. When roused he answered questions sensibly, but otherwise was in a semi-conscious condition. His stomach having been washed out with warm saline solution and stimulants thereinto introduced, restorative warming measures and hypodermic injections of strychnine and atropine having been employed, he began to improve, and five days later was able to leave the hospital.[1] Hutchison,[2] Meldrum,[3] and Burroughs [4] have also recorded cases, and in some of these violent vomiting and purging, absent in the case described, were prominent symptoms. In the case recorded by Meldrum, which ended fatally, the man, a dock labourer, ate a couple of seeds.

Some observers, commenting upon Gullan's case, thought the seed which was eaten must have been a seed of *croton tiglium*, but investigation showed it to be a castor oil seed. While these toxic effects are generally found, Wrightson [5] remarks that he has seen boys and girls

[1] Gullan, *B. M. J.*, vol. i., 1905, p. 988.
[2] *Ibid.* vol. i., 1900, p. 1156.
[3] *Ibid.* vol. i., 1900, p. 317.
[4] *Ibid.* vol. ii., 1903, p. 836.
[5] *Ibid.* vol. i., 1905, p. 1312.

employed in shelling castor oil seeds in a factory who have eaten five or six at a time with no worse effects than those following a dose of castor oil. He does not, however, mention whether the seeds in these cases were previously boiled or not. Stephanoff has recorded the virulently poisonous effects of *ricin*, the active principle contained in the seeds.[1]

Treatment.—Washing out of stomach; warmth; stimulants; hypodermic injections of strychnine and atropine.

Fatal Dose.—Two seeds have caused death in an adult.

Santonin

(*Artemisia maritima.*)—Nat. Ord. = Compositæ. Wormwood has had for a long time a popular reputation as an aphrodisiac and has been used for this purpose. From the plant is obtained the active principle—Santonin—which is a crystalline substance, composed of brilliant, four-sided, flat prisms, white or faintly yellow in colour, hardly soluble in cold water, but freely soluble in alkaline water. It is commonly used as a vermicide in children. Robinson has recorded a case where an infusion of the plant was used for the first-named purpose. A gentleman took a quarter of a pint of the infusion at 8.30 A.M., after breakfast, and in an hour afterwards he was seized with vertigo, weakness and trembling in his limbs, a dragging pain in the lower part of abdomen, constant desire to micturate, and a burning sensation at the point of the penis. These symptoms lasted for about forty minutes, and then gradually passed away.[2] It has been not infrequently given in overdoses to children,[3] and it has been taken by mistake for Epsom salts. The wife of a farm labourer near Runcorn died three-quarters of an hour after swallowing over 100 grains of oil of absinthe for the purpose of procuring abortion. She got the drug from chemists in Liverpool. In a few minutes after taking the drug, she was found lying speechless.[4]

Symptoms.—In addition to giddiness, nausea and vomiting, pain in the stomach, saffron-yellow-coloured urine, with perhaps hæmoglobinuria, disturbance of vision takes place. Yellow vision or xanthopsia comes on, lasting for many hours, sometimes preceded by violet vision, which however is of shorter duration. In fatal cases, coma and convulsions precede death. Chronic poisoning from santonin is observed in absinthe drinkers, the main effects produced being total derangement of the nervous system and moral insanity.

Post-Mortem Appearances.—Nothing characteristic is found either in the stomach or in the body generally.

Fatal Dose.—0·12 gramme (about two grains) of santonin killed a boy of five and a half years in fifteen hours. But a man who took one ounce in mistake for Epsom salts recovered.[5]

Treatment. — Prompt evacuation of contents of stomach by tube or emetics. Injections of chloral *per rectum.*

Chemical Analysis.—By the Otto-Stas or the Dragendorff process

[1] Merck. An. Rep., No. 187, 1900, p. 166.
[2] *The Lancet*, vol. i., 1889, p. 770.
[3] *Ibid.* vol. i., 1879, p. 206.
[4] *B. M. J.*, vol. ii., 1902, p. 504.
[5] *Annal. univ. de Med.*

santonin is obtained from the chloroform solvent when used in acid solutions. Its identity is established by dissolving it in strong H_2SO_4 and a little water, warming the mixture, and then adding a few drops of ferric chloride, when a beautiful red passing into purple colour forms round the iron solution. In the urine, its presence may be proved by first adding a little caustic potash solution, when a red colour forms, next precipitating the reddened urine by baryta water, and filtering. If the red colour remains, it is due to santonin, urine itself losing by filtration the red colour originally formed.

Colocynth

(*Citrullus colocynthis* or Bitter Apple.)—The powdered fruit is occasionally taken for abortifacient purposes, its action being strongly cathartic, accompanied by abdominal pain and vomiting.

Two cases have recently been recorded. Burton [1] tells of a young woman, aged 18, recently married, who, thinking that she had become pregnant, took two teaspoonfuls of the powdered drug, which she had bought ostensibly for the purpose of removing moths from furs. Half-an-hour later, she was seized with a burning sensation in the abdomen, followed in six hours by violent vomiting and purging which lasted four hours. Ten hours later, the acute symptoms returned, and for several hours she was very ill. Butter [2] records the case of a married woman, aged 26, the mother of four children, who being pregnant three months took at 8.45 A.M. on a Sunday morning about four teaspoonfuls of the powder. Within two hours she began to vomit, followed by acute abdominal pain and purging. These continued incessantly all that day and night. Early on Monday morning (about 6 A.M.) she was given by a neighbour an emetic of mustard, salt, and water. After treatment by a hypodermic injection of morphine, and a mixture of chalk and opium, the symptoms quietened down. It did not produce abortion. Butter adds that this drug is commonly used in Essex for ecbolic purposes.

Nutmeg

(*Myristica moschata* or Musk Nut.)—If one may judge from the relative frequency this substance is taken, nutmeg is a favourite popular abortifacient. The nut is commonly ground or grated into a coarse powder, mixed with water, and swallowed.

Several cases have been recorded; among others by Hamilton,[3] Wilkinson,[4] Hamond,[5] and Johnston.[6] The quantity usually taken is about one whole nutmeg.

Symptoms.—There is some measure of gastric irritation, as evidenced by vomiting. But the drug seems to have a marked influence on the nervous system, producing some degree of narcotism, delirium, or choreic symptoms. In one of the cases the face was red and swollen, the eyelids being so swollen that the patient could hardly see between them; in the same case there were also delirium, great restlessness,

[1] *B. M. J.*, vol. i., 1907, p. 1364.
[2] *Ibid.* vol. i., 1907, p. 1537.
[3] *Med. Press.* Dec. 6. 1905.
[4] *B. M. J.*, vol. i., 1906, p. 539.
[5] *B. M. J.*, vol. i., 1906, p. 778.
[6] *Ibid.* vol. i., 1906, p. 984.

giddiness, and fear of death. In the case reported by Wilkinson, where four members of a family partook of the nutmeg in gruel for a cold, the mother and son exhibited narcotic symptoms, being sleepy and stupid, and the two other children, choreic symptoms. In Hamilton's case there were choreic spasms of the lower jaw, larynx, and heart. In more than one case cyanosis of lips and finger nails has been noted. Signs of collapse have also been observed. Abortion does not commonly follow.

Treatment.—Emptying of contents of stomach and treatment of symptoms.

Fatal Dose.—So far as we know, no fatal case has as yet been recorded.

Food Poisoning

It has already been more than once noted that toxic symptoms may follow the ingestion of certain foods prepared by the process of "canning," but in the bulk of cases these have been traced to the presence of mineral poisons in the food due chiefly to their solution by the acid juices of the contained food. The metallic poisons thus dissolved are mainly lead and tin; and there can be no doubt that toxic symptoms follow in such cases. But from time to time cases arise singly and collectively in which poisonous effects are produced which cannot be traced, after chemical examination, to the presence of any mineral poison in the food. Independently, therefore, of such mineral poisons and of parasitic conditions, food-poisoning may arise from alkaloidal principles in food which are produced by the action of micro-organisms on the organic substances, and which are of the nature of albumoses, tox-albumins, or ptomaines. Such toxic effects may follow the use of flesh meat, milk or cheese, bread, and other substances.

Meat.—It is but rare that mischievous effects follow the ingestion of healthy, properly cooked flesh meat. Should, however, an animal have been slaughtered after it has been drenched with drugs which are poisonous to man, toxic effects may result; but this is not the kind of case we are considering, although it must not be overlooked. Toxic results have not infrequently followed the ingestion, either in the raw condition or cooked, of the flesh of animals which before slaughter were the objects of certain diseases, such as puerperal or milk fever, peritonitis, metritis, foot-and-mouth disease, diarrhœal affections, or other diseases of a septic character associated with micro-organisms. Not uncommonly, also, have like effects followed the ingestion of meats which have been prepared in special ways and have been exposed, perhaps, to insanitary conditions after their preparation, as, for example, in the form of sausages, corned beef, brawn, potted meats, "canned" meats, and pies. It is, perhaps, well, therefore, to recognise that the toxic cause may be initially or intrinsically present in the flesh or prepared food, or that it may be adventitious or extrinsic—that is to say, that the meat originally healthy may have become contaminated by unhygienic exposure. Fischer [1] distinguishes two classes of meat poisoning—viz. (*a*) true meat poisoning which arises from eating the flesh or organs of diseased animals, mainly cows and calves, less fre-

[1] *Zeitschr. f. Hygiene*, Bd. 39, p. 445.

quently horses, swine, and goats which at the time of slaughter were suffering from septic, enteric, or, more rarely, pyæmic diseases; and (*b*) sausage-poisoning, known as *botulismus* or *allantiasis*. In the former class there may be little or nothing in the appearance, smell, or taste of the meat to distinguish it from perfectly sound meat, and in the latter, the meat may have come from healthy animals but has in time, perhaps in the process of manufacture, acquired toxic properties. This is true of all prepared meats as well as sausages.

In both classes, the intimate cause of the mischief is either a micro-organism belonging to the coli-typhosus group or to a ptomaine or tox-albumin. The organisms usually associated with such outbreaks of poisoning are the *bacillus enteritidis* of Gärtner, and its congeners, and the *bacillus botulinus*. The symptoms which follow the ingestion of meat which contains the former organism or its toxin are quite different from those which follow the eating of meat containing the latter. In the former, they are chiefly as follow :—(*a*) vomiting, (*b*) abdominal pains, severe and crampy in character, (*c*) diarrhœa, with frequent and foul-smelling evacuations, (*d*) headache with, perhaps, drowsiness, (*e*) pains and cramps in limbs, (*f*) vertigo, (*g*) fainting, (*h*) skin rashes, such as erythma, herpes, or purpura, (*i*) coldness of body, (*j*) rapid weak pulse, and (*k*) general collapse. In the latter—known as botulismus—the outstanding symptoms are neurotic in character; progressive muscular paralysis, accompanied by progressive emaciation. In Ossipoff's experiments by inoculation of guinea-pigs by this organism, the symptoms exhibited were : (*a*) suppuration of eyelids; (*b*) retention of urine and constipation; (*c*) dilatation of pupils; (*d*) paresis of limbs; (*e*) dyspnœa; and (*f*) progressive asthenia, ending in death.[1] In Germany, especially, series of cases have been reported from eating sausages, in which the most marked symptoms were extreme dryness of the skin and mucous membranes, dilatation of pupils, and paralysis of the upper eyelid muscles; and accompanying these were : nausea, vomiting, diarrhœa, which is, however, never choleraic in character, dryness of mouth, nose, and pharynx, constipation, perhaps, and disturbance of vision, amounting at times to diplopia.

The *bacillus enteritidis*—an ærobic organism—commonly now called Gärtner's bacillus, was discovered by that observer in the Frankenhausen outbreak in 1888, and was given by him that name; the *bacillus botulinus*—an anærobic organism—by van Ermengem in 1895, who had isolated it in that year from cultures made from preserved ham.

The post-mortem appearances found in the bodies of mice, guinea-pigs, and rabbits which had been inoculated with the *b. enteritidis* are (*a*) swelling and redness of intestinal mucous membrane with injected blood-vessels, (*b*) small hæmorrhagic extravasations in the mucous membrane of intestine and in pleuræ and pericardium, and, in many cases, (*c*) hæmorrhagic or fibrinous pleurisy with pneumonic infiltration of the lower lobes of the lungs. In man they are practically identical.

From experimental inoculation of guinea-pigs with *b. botulinus*, the post-mortem appearances found by Ossipoff were marked changes in the intimate structure of the grey matter of the spinal cord, and less marked changes in the medulla, cerebrum, and cortex of the cerebrum.

[1] *Ann. de l'Inst. Pasteur*, Dec. 1900.

In man, the post-mortem appearances which have been found are: (*a*) white, dried, parchment-like condition of mucous membrane of mouth, throat, and gullet; (*b*) gastric mucous membrane is injected and marked with hæmorrhagic extravasations; (*c*) the spleen is enlarged and congested; (*d*) the kidneys are congested; and (*e*) the lungs are œdematous, with evidence of bronchitis or pneumonia. Ballard [1] has reported upon a fatal case of a gardener who died eight days after eating sausage, called "German sausage," after having suffered from vomiting, purging, etc., and latterly, from lung mischief with rusty, viscid sputum. Klein subjected mice to experiment with this sausage, and found like symptoms produced.

The *b. enteriditis* produces a toxin of a very resistant character. Cooking, smoking, or pickling does not impair its virulency, whereas that of *b. botulinus* becomes innocuous on heating to 140°–158° F.

Fischer, in his investigation concerning the nature of the toxin of Gärtner's bacillus, asserted that he obtained from cultures of that organism a poisonous proteid substance which withstood one and a half hour's boiling. This statement was not at the time, however, generally accepted. But it has been to some extent confirmed by the researches of Cathcart,[2] who from experimentation concludes as follows:—(1) that cultures of Gärtner's bacillus grown on broth do not excrete any large amount of toxin into the broth; (2) that suspensions in broth made from agar culture and killed by heating for thirty minutes at 60° C. are fairly toxic; (3) that the most toxic preparations are obtained by autolysis of bacilli in presence of toluol; (4) that autolysis occurs best in presence of distilled water or normal saline; (5) that the toxin withstands boiling to 100° C. for thirty minutes; (6) that *paratyphoid β. bacillus* on autolysis yields a filtrate as toxic as the bacillus of Gärtner; and (7) that the toxin of Gärtner's bacillus is of the endotoxin type. These facts throw light on those cases in which severe toxic effects have followed the ingestion of meat broths which have been boiled for a short time in cooking.

Gärtner's bacillus is fairly well distributed. It has been found by Karlinski,[3] for example, in the duodenum of a healthy man who committed suicide, and in the small intestine of a young healthy goat; and it has also been found in polluted drinking waters, in the milk of cows suffering from diarrhœa, in the intestinal discharges of such animals, in oysters from polluted oyster-beds, and in other shell-fish from polluted waters.

Incubation Period, or *Period of Onset of Symptoms*.—The interval which, on the average, occurs between the taking of meat containing *b. enteriditis* and the first symptoms is from 6 to 12 hours. It is probably, however, shorter than this in the case of toxin.

Morphological and Cultural Characters of B. Enteriditis Group

Morgan,[4] in an exhaustive paper on the Micro-organisms of Meat

[1] *Sup.* 11th Report, Loc. Gov. Bd., 1881.
[2] *Jour. of Hygiene*, vol. vi. No. 2, April 1906.
[3] *Centralb. f. Bakteriolog*, 1889, p. 289.
[4] *B. M. J.*, vol. i., 1905, p. 1257.

Poisoning, has concluded from his experimental investigations (1) that there exist in the intestines of healthy animals organisms which conform morphologically and biologically to the bacillus of Gärtner and to the *paratyphoid A.* bacillus, and (2) from their agglutinative reactions, that they fall into one or other of the following sub-groups—viz. (*a*) *B. enteriditis, Aertryck*, or hog-cholera type ; (*b*) *B. enteriditis, psittacosis* type ; or (*c*) *B. paratyphoid A.*, or unknown type.

The *b. enteritidis* group generally are distinguishable as follows :— (1) they are short ovoid bacteria, 0·2μ to 0·4μ in length, frequently in twos ; (2) they are not stained by Gram's method ; (3) they are moderately motile like *b. typhosus*, possess usually from 4 to 6 long flagella, but sometimes as many as 10 or 12, around the periphery ; (4) colonies grown in gelatin are polymorphous, not unlike those of *b. coli*, and have usually a transparent margin ; (5) they do not form indol, or, at most, only in extremely small amounts ; (6) they do not coagulate milk : after about ten days they make milk transparent, and the milk becomes yellowish, like milk-coffee, and markedly alkaline in reaction ; (7) they ferment grape-sugar with much gas formation, and usually, also, lactose, maltose, etc., and even glycerine ; (8) they rapidly render bouillon turbid, forming a thin pellicle on the surface, which is easily broken ; (9) their growth on potato is scarcely visible, or they may form a thickish, dirty-yellowish or brownish layer ; (10) they grow fairly well in neutral-litmus milk without changing colour or producing acid ; (11) in neutral red agar + 0·3 per cent. of grape-sugar, more or less marked fluorescence develops, the colour being discharged and gas being formed ; (12) on Drigalski-Conradi medium they form bluish colonies after 16–18 hours, somewhat larger and less transparent than those of *B. typhosus*.

The diagnosis of meat poisoning may be founded upon (1) the simultaneity of attack of several persons after eating food common in supply to all attacked, (2) the discovery of an organism of the *b. enteritidis* group in the remains of the food partaken of, and (3) the response to agglutinative reaction of the blood of those attacked (Widal's reaction) on one or other of the three types of organisms belonging to this group, which have already been named.

A very large number of outbreaks of meat poisoning on the continent of Europe have been recorded by Kolle and Wassermann, Ostertag, and others. It is, perhaps, sufficient to say that Ostertag in his work on Meat Inspection,[1] has collected the statistics and main facts of 85 outbreaks occurring between 1880 and 1900, the largest number of these happening in Germany, in which over 4000 persons were involved. The *Aertryck* type of *b. enteritidis*, which has been alluded to, receives its name from having first been discovered in the Aertryck outbreak of 1898 by Nobele. Many outbreaks have been recorded also in this country. Their causes differ, however, from those of the Continental outbreaks in that, whereas the latter were in the main due to the eating of the flesh of animals which before slaughter were known to be suffering from some form of septic disease, those in this country have almost invariably been caused by preparations of meat, such as pies of various kinds, canned meats, hams, brawn, etc., in most cases made from pork. The following table gives details of these outbreaks :—

[1] Eng. Edit., 1904, p. 718 *et seq.*

OUTBREAKS OF MEAT POISONING IN GREAT BRITAIN AND IRELAND

Year.	Place.	Cause.	Number attacked.	Deaths.	Reference.	REMARKS.
1878	Whitchurch (Salop)	Roast leg of pork	2 families	2	Sup. Rep. Med. Off. Loc. Gov. Bd. for 1890, p. 189	Pork when eaten fresh on Sunday did no harm. After eating on Monday persons became ill. Incubation, 4 hours in those who died; 7-19 hours in the case of survivors.
1880	Welbeck	Cold boiled American hams	Large number	4	,, ,, also Report for 1880	Klein found a bacillus, hitherto undescribed, in remains of hams and in kidneys of a man who had died, which killed animals on inoculation, their organs being similarly affected as those of the man.
1881	Nottingham	Baked pork	Several families	1	,, ,,	Bacillus found identical to that of Welbeck.
1881	Chester	American sausages	1	1	,, ,,	Attack came on half-an-hour after eating. Symptoms—gastro-enteritic, followed by pneumonia.
1882	Oldham	Canned pigs' tongues	Large numbers	0	,, ,,	Symptoms—gastro-enteritic.
1882	Bishop Stortford	Rib roast of beef	3 families	0	,, ,,	,, ,,
1882	Whitchurch (Salop)	Pork brawn	10 families	0	,, ,,	Incubation, 1-5 hours. Bacilli found like those in Welbeck case, but not definitely identical.

		("blown" tin)				to be a toxin.
1886	Carlisle	Game pies (cold)	20	1	,, ,,	Incubation period, 6 hours and upwards. No organism found. Thought to be a toxin.
1886	Iron Bridge	Veal pie (warmed)	12	0	,, ,,	Two kinds of motile bacilli found. One, after culture and inoculation into mice, caused gastro-enteritic symptoms and death.
1887	Retford	Pork pie or brawn	80	1	,, ,, also Report for 1887	Bacillus found. Cultures killed mice by feeding. Gastro-enteritic symptoms. Incubation period, 8-30 hours.
1888	Middlesborough	American bacon	not known	400	,, ,, also Report for 1888	Outbreak thought at first to be one of epidemic pneumonia, but latterly to be due to meat poisoning, of which pneumonia was most marked symptom. Klein found a bacillus, different from Friedländer's bacillus and Fränkel's *dip. pneumoniæ*, which he called *b. pneumoniæ*. Sufferers were found to be users of the same hams.
1889	Carlisle	Pork pies and boiled pork	25 or more	0	,, ,, also Report for 1889	Incubation, 24 hours upwards. Mice fed with the pork or pie gravy stock died with same gastro-enteritic symptoms as patients.
1891	Portsmouth	Meat pie	13	0	,, ,, and at p. 249	Two kinds of bacilli found: (1) a non-motile, and (2) a motile organism. The former was toxic to mice and caused death. The latter liquefied gelatin and gave off an offensive odour.

OUTBREAKS OF MEAT POISONING IN GREAT BRITAIN AND IRELAND—*continued*

Year.	Place.	Cause.	Number attacked.	Deaths.	Reference.	REMARKS.
1896	Mansfield	Potted meat	150	0	*B. M. J.*, vol. i., 1896, p. 613	Incubation after 24 hours. Gastro-enteritic symptoms.
1898	Chadderton and Oldham	Veal and pork pies	73 } 85 12 }	4	*Ibid.* vol. ii., 1898, p. 1456	Veal pies most virulent on 2nd and 3rd days after cooking. No complaint as to taste, appearance, or smell. When eaten fresh, pies did no harm. Incubation — average 6 - 8 hours ; shortest 4 hours, longest 29 hours. Gastro-enteritic symptoms.
1898	Hatton	Veal pies	185	1	*Ibid.* vol. ii., 1898, p. 600	Darham found in liver of deceased person a bacillus very like that of Gärtner. Gastro-enteritic symptoms.
1899	Sheffield	Tinned corned beef	24	1 (a child)	*Ibid.* vol. ii., 1899, pp. 1120, 1367	Incubation period was short. Gärtner's bacillus found.
1900	Salop	Stewed goose giblets	7	2	*Ibid.* vol. ii., 1902, p. 1372	Incubation—about 8 hours.
1902	Derby	Pork pies	120 Other cases traceable to the Derby pork occurred in Cheltenham and St Pancras (London)	2 (at least)	*Ibid.* vol. ii., 1902, pp. 807, 901, 990, 1551	Gastro - enteritic symptoms. Delépine isolated Gärtner's bacillus from the pork pie, and from the blood, spleen, and intestines of a fatal case, as well as from blood and spleen of animals which died two or three days after feeding on pies.

1906	Partick (Glasgow)	Canned ox-beef	12	0	Rep. of M. O. H.	Incubation — less than one hour in some cases; average about 4 hours. Gärtner's bacillus found within 24 hours. Positive Gärtner reaction with blood of those attacked.
1907	,,	Canned chicken	5	0	,,	
,,	,,	Potted meat	3	0	,,	
1908	Murrow (Cambs)	Pork brawn	18	3	*Jour. of Hygiene*, vol. viii., No. 5, Nov. 1908	Gastro-enteritic symptoms headache, muscular weakness, prostration, temp. varying 100° to 103° F. Post-mortem appearances: intense inflammation of stomach and intestines.
1909	Limerick	Stew; made from mutton, remains of beef, and potatoes	73	9	*B. M. J.*, vol. i., 1909, p. 1171	B. Gärtner found. Acute gastro-intestinal symptoms. Incubation period 6 hours upwards. Post-mortem appearances: no inflammation of stomach or intestines; pale, swollen, velvety aspect of mucous membrane; liver large, hyperæmic, soft, sprinkled with small, pale yellowish areas.

While meat poisoning commonly betrays itself by a common attack upon several persons, it must not be overlooked that it may exhibit itself in single individuals. Of late years not a little attention has been given to the relationship of food poisoning and coma. The following, related by Waterhouse,[1] may be taken as a typical example :—

A man, aged 54, while in good health, took breakfast at 8 A.M. At 11 A.M. he was seen to reel across the room and become unconscious. When seen a few minutes later, he was deeply unconscious and could not be roused. He had vomited on his clothes. He was breathing through his nostrils deeply and with increased frequency, but without stertor ; skin was pale and clammy ; temperature sub-normal ; pulse 120, small and of low tension ; conjunctival reflex diminished but not abolished ; pupils equal and moderately dilated, and reacted sluggishly to light. There was no local paralysis. Examination of portions of food left untouched showed a piece of bacon off which he had breakfasted, at one end of which was a part about the circumference of a Tangerine orange which was quite moist, rotten, and stinking. After washing out of stomach, application of warmth to body, and administration of a hypodermic injection of atropine and strychnine he began to improve, but did not recover consciousness till next forenoon. Thereafter he gradually got well. Other cases will be found under the following references.[2] In certain cases of gastro-intestinal disturbance of an acute character there may be present a certain measure of cyanosis. It is difficult to account for its presence, but it commonly co-exists with severe diarrhœa in which the stools are of a most fœtid and offensive character. It has been suggested by certain observers, among others Stokvis and Chienosse,[3] that this cyanosis is not due to vascular or respiratory conditions, but to toxins of intestinal origin. These observers have also pointed out that it is usually associated with met-hæmoglobin in the blood, in one case, sulph-hæmoglobin, and that the urine of such persons has the property of quickly converting oxyhæmoglobin into met-hæmoglobin.

Cold boiled ham has been the cause of several attacks of poisoning. Among the earliest recorded was the Welbeck case,[4] the facts of which were minutely investigated by Ballard. Seventy-two persons were attacked and suffered more or less severely, and four died. The symptoms of the illnesses were, mainly, pain in the abdomen, diarrhœa, and vomiting, the diarrhœa being quite unrestrainable ; at first the patients complained of coldness, which was accompanied by rigors or shiverings ; then followed some degree of fever, the temperature rising to 101°–104° F. ; in addition, there was great muscular weakness. Klein examined portions of the kidneys of one of those who died, and found in the capillary vessels emboli composed of masses of bacilli. He also examined a portion of the ham, and found the same bacillus. On cultivation of the bacillus and injection into mice, rats, dogs, and guinea-

[1] *B. M. J.*, vol. i., 1906, p. 258.

[2] Kennard, *B. M. J.*, vol. i., 1906, p. 80 ; Mercier, *ibid.* vol. i., 1906, p. 141 ; Watson, *Lancet*, vol. ii., 1889, p. 1198 ; Broadway, *ibid.* vol. ii., 1903, p. 755.

[3] *La Sémaine Méd.*, No. 49, 1905, p. 577.

[4] Sup. to Tenth Ann. Rep. of Loc. Govt. Bd. for 1880.

pigs, the same line of symptoms as that found in the persons attacked was manifested.

As the effects of a free tea given to men in 1890, the facts of which are recorded by Stewart, 100 men were seized with severe vomiting and diarrhœa, great pain and tenderness in gastric and hypogastric regions, much loss of power in lower limbs, much prostration, and, in some cases, alarming symptoms of collapse. Three or four days later, aching of teeth and gums appeared, with ulcers on gums and over buccal mucous membrane. The meal consisted of boiled beef, ham and tea.[1] The precise cause of the symptoms was not traced.

Hot-baked pork eaten by members of five different households in Nottingham produced the same train of symptoms as the foregoing. Fifteen persons were ill, and one died. The same bacillus as in the Welbeck cases was found in the tissues of the deceased. Glücksman[2] reports the death of one man, and the illness of a second, from eating pickled and smoked pork, due to the presence of the *B. proteus vulgaris* in the meat.

Ballard from a close examination of the circumstances of the Middlesborough so-called pneumonia epidemic of 1888, formed the opinion that the pneumonia was merely the prominent symptom of an outbreak of meat poisoning, which arose from the consumption of American bacon.

Barker[3] narrates the history of a series of persons—twenty-four in all—who were attacked after eating "corned" beef, of whom one died. The beef was contained in "cans" holding 6 lbs. The symptoms were: faintness, giddiness, drowsiness, sickness, great muscular weakness, persistent vomiting, intense frontal headache, colic, diarrhœa, cold and clammy skin, small and rapid pulse, dilated pupils, shallow breathing, and sub-normal temperature. Bacteriological examination of the beef showed the presence of the *B. enteritidis* of Gärtner. Packer[4] records the history of the illness of seven members of a family after partaking of a supper of stewed goose giblets, scraps of goose, and slices of beef. They all took violently ill during the night with purging, abdominal pain, and vomiting, and one boy of fourteen died seven days later. On post-mortem examination of the deceased, intense congestion of stomach and intestines was found. The stomach and contents were examined and analysed for mineral poison, but none was found; it was, therefore, concluded that the cause was ptomaines. Durham[5] made an investigation into an outbreak of illness caused by eating pork pies and veal pies which occurred in Chadderton and Oldham in July 1898, in which 52 persons were attacked, of whom 4 died. All the fatal cases occurred in those who had partaken of pies which were 48 hours old or older. The cause of the mischief was the growth of Gärtner's bacillus in the pies. The outbreak in Derby in 1902 from pork pies involved 120 persons of whom 2, at least, died. Various other outbreaks of poisoning have arisen from other forms of pies, as game pies and pork pies. In such cases the cause is likely to be Gärtner's bacillus, or the anærobic *bacillus botulinus* of van Ermengem,

[1] *Lancet*, vol. ii., 1890, p. 637; *ibid.* vol. ii., 1890, p. 422.
[2] *Centralblatt f. Bakt.*, xxv. No. 20. [3] *B. M. J.*, vol. ii., 1899, p. 1367.
[4] *B. M. J.*, vol. ii., 1900, p. 1372. [5] *Ibid.* vol. ii., 1898, p. 1797.

the latter of which is not infrequently found in sausages, hence the name *botulismus*.

Brawn [1] has also given rise to toxic symptoms, the most recent example of which occurred at Murrow (Cambridgeshire), in 1908, and which involved 18 persons, 3 of whom died; so also have mutton, as in Glasgow in February 1884 from which two persons died and many suffered,[2] paté de foie gras,[3] and other articles of meat diet.

Meat-stew made from fresh mutton, the remains of a fore-quarter of beef, and potatoes gave rise to a serious outbreak in November 1908, in an orphanage at Limerick. Of the total 73 girls who were attacked, 9 died. The peccant material in the stew was proved to be the remains of a part of the beef. Part of this had been cooked and eaten on Tuesday, October 27, and the remainder roasted on Thursday, October 29. About three or four pounds of the latter were left over in the larder from the 29th till the following Tuesday, November 3, when they were cooked in the stew and eaten by the inmates. By 6 P.M. a large number of the girls were simultaneously seized with acute gastro-intestinal symptoms, and by the following day a still larger number. Inquiry regarding the source of the beef showed that it had been bought ready killed by the contractor, and at the unusually low price of 3d. per pound. It could not, therefore, be deemed of prime quality.[4]

Bread

Hot cross buns caused the illness of over a hundred persons in Inverness, on Good Friday, 1882.[5] Honey occasionally gives rise to illness.[6] It would appear, however, that this is due to the products of poisonous plants gathered by the bees.

Milk and Cheese

Milk and cheese sometimes contain poisonous products or bacilli, and when consumed in the raw conditions, produce severe poisonous effects. At a school treat at Greenwich in 1899, 60 persons, scholars and teachers, were attacked by violent vomiting and diarrhœa, followed by collapse, after having partaken of Madeira cake and milk. They all recovered. Outbreaks of milk-poisoning are of periodic occurrence at Malta. Zammit [7] has investigated the cause of several of these, and has found it to be the *B. enteritidis sporogenes*, due to accidental contamination. Niven [8] and others have reported similar outbreaks.

Milk epidemics sometimes assume serious proportions in respect of numbers of those attacked. In October 1901, a severe outbreak took place in Partick, Glasgow, involving about 600 persons of all ages. It was reported to the medical officer of health that many persons were seized with the following symptoms—viz. violent vomiting, diarrhœa with tenesmus and, in some cases, bloody stools, accompanied by marked prostration. The acute stage of the

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[1] *B. M. J.*, May 10, 1873; vol. i., 1884, p. 1057.
[2] *Ibid.* vol. i., 1884, p. 576. [3] *Ibid.* 1900, p. 524.
[4] McWeaney, *B. M. J.*, vol. i., 1909, pp. 1171, 1643.
[5] *B. M. J.*, 1882, vol. i., p. 551. [6] *Therap. monatschr.*, 12, 1898.
[7] *B. M. J.*, 1900, vol. ii., p. 1151. [8] *The Lancet*, vol. i., 1895, p. 146.

illness lasted as a rule for 3 or 4 days, but in many cases general lassitude and weakness lasted for a week or more later. On investigation of the facts, Dr Arbuckle Brown, the medical officer, found that many of the cases occurred on the 8th, and the remainder on the 9th. A few cases, however, happened on the 10th, but they were traced to the same cause as the others. In view of the numbers attacked and the distribution of cases, a common cause was indicated, and the only factor common to all the cases was a common supply of milk from a particular dairy. The dairy was inspected, and found to be in good sanitary condition ; the employees were examined and found to be in good health. The farm from which this particular supply of milk came was next inspected, and it was found to be in a good sanitary condition. The farmer, however, stated that one of his cows had sickened on the 7th October, became worse on the 8th, and died on the 9th after the morning milking-time. The milk from this cow on the 7th, 8th, and possibly also on the 9th, was used and sent to the dairy in Partick. The carcase of the cow had been disposed of before the inspection, and the cause of death was not ascertained. An undoubted sample of the affected milk was unfortunately not attainable, but a sample which was alleged to have caused sickness in two adults was examined chemically and bacteriologically with negative results. Consideration of all the facts, however, point to the milk of this cow as the source of the outbreak, and, although exact proof is awanting, to a bacteriological cause.

From the action of the butyric acid bacillus it is believed a toxic substance is formed which has been isolated by Vaughan [1] in the form of needle-like crystals, to which he has given the name of *tyrotoxicon*.

Ice-cream Poisoning.—In July and September 1902. eighteen boys employed in the London post office became ill after partaking of ice-cream. Their symptoms were: epigastric pain, abdominal colicky pains, headache, nausea, nervous depression, and in some cases, vomiting and diarrhœa. Twenty-four samples were obtained from ice-cream shops in the neighbourhood indicated by the boys, and out of these Klein reported that thirteen samples were poisonous as tested by guinea-pig inoculation. Among the organisms isolated were *bacillus mesentericus*, *b. coli*, a virulent variety of *b. lactis aerogenes*, some of the *proteus* group, and one anærobic organism unnamed. The General Powers (London) Act, s. 42, gives power to insist that the ice-cream mixture after having been boiled should be frozen immediately, and the possible period of contamination thus shortened.[2]

In 1905, an outbreak due to ice-cream took place in Birmingham which affected a large number of persons, chiefly children. From inquiries made by the Public Health Department, 52 cases could be traced directly to the ice-cream. The onset of attack was sudden, appearing soon after eating the cream, the main symptoms being abdominal pain, vomiting, diarrhœa and prostration.[3]

Although it is perhaps more commonly found in cheese, there can also be little doubt of its presence at times in ice-cream, milk, and curds. It produces the following symptoms of poisoning—viz. violent vomiting ; urgent and incontrollable diarrhœa ; great sickness ; thirst ; dryness of mouth and tongue ; cramps in the legs ; and collapse.

In 1901, in Finsbury, London, nine persons were seized with acute toxic symptoms after having eaten Dutch cheese.. The medical officer of health himself ate an ounce or two of the suspected article, and although he observed nothing unusual in its taste, he suffered acutely from the same symptoms as the others. Further inquiry showed that in all seventeen persons were attacked, the symptoms consisted of epigastric pain, rigors, vomiting, diarrhœa, prostra-

[1] *The Practitioner*, 1887.
[2] *B. M. J.*, vol. ii., 1902, p. 1172.
[3] *Ibid.* vol. ii., 1905, p. 258.

tion, and some fever. In Bermondsey, thirteen cases of a similar kind were recorded. The symptoms generally passed off within forty-eight hours. Analysis proved the presence of a poisonous substance possessing the properties of tyrotoxicon.[1]

Similar outbreaks have occurred in Michigan in 1883 and 1884.

Fish, especially when "canned," may cause a similar train of poisonous symptoms; but even when pickled by smoking, they occasionally produce harmful effects. Croudace [2] reports the case of a mother and two children, who half-an-hour after eating a bloater began to feel swollen and itchy about the face, and to have pains in the chest and stomach, followed by vomiting which was violent. There was no diarrhœa. They recovered. Tinned salmon is a comparatively common cause of illness, sometimes fatal [3]; and sardines, also, but perhaps less frequently.[4] In the case recorded by Stevenson where a man died from the effects of eating six sardines, his body after death rapidly developed widespread emphysema. Stevenson from the fish left in the tin, the vomited matter, and the contents of the stomach recovered alkaloidal extracts, all of which were poisonous to rats. Cases of poisoning by mackerel have also been recorded.[5]

Shellfish, as oysters, mussels, and cockles, sometimes cause remarkable symptoms after their ingestion. At the Stirling County Ball, October 1895, several persons who had in common partaken of oysters were suddenly attacked with symptoms of irritant poisoning. For complete information on the subject of the "Cultivation and Storage of Oysters and certain other Molluscs in Relation to the Occurrence of Disease in Man," we must refer the reader to the Report of the Local Government Board, 1896. Poisoning by mussels is now well ascertained to be due to a toxin which is present in the flesh of the living mussel. Brieger has isolated this toxin, to which he has given the name of *mytilotoxin* (from *Mytilus edulis*, the name of the mussel). The symptoms produced are of gastro-intestinal catarrh, accompanied by a sense of oppression in the chest, difficult respiration, skin eruptions, and, in severe cases, by unconsciousness and wide dilatation of pupils. Sir Charles Cameron,[6] Permewan,[7] and others, have recorded cases of fatal poisoning. Doubtless a similar cause may operate after the ingestion of cockles; but in most cases the symptoms are not severe, and are mainly confined to vomiting and "nettle-rash" on skin.

Jörgen Thesen has written a treatise on a paralytic form of mussel poisoning, which deals with seven cases which occurred in the summer of 1901, of whom two died. One of the fatal cases was that of a man who had eaten six of the uncooked mussels, the other, that of a boy who had eaten about forty of the molluscs cooked. The paralytic symptoms manifested were peripheral in character, and involved the muscles of the limbs, trunk, neck, and face. Its onset was rapid. In

[1] *B. M. J.*, vol. ii., 1901, p. 1765.
[2] *Ibid.* vol. ii., 1897, p. 1771.
[3] *Ibid.* vol. ii., 1891, pp. 84 and 273.
[4] *Ibid.* (Stevenson), vol. ii., 1892, p. 1326.
[5] *Lancet*, vol. i., 1889, p. 1154, 1221.
[6] *B. M. J.*, vol. ii., 1890, p. 150; *Lancet*, vol. ii., 1890, p. 174.
[7] *The Lancet*, vol. ii., 1888, p. 42.

the cases which ended fatally, the paralysis extended to the respiratory muscles and caused death in twenty-four hours. In the cases which recovered, chiefly children, the symptoms were mainly gastro-intestinal in character. Nine other persons who had eaten of the shellfish, cooked or uncooked, escaped unharmed. From the mucus of the stomachs of those who died a poison was extracted which, when injected into mice, killed them with symptoms of curare-like poisoning. Thesen found that the mussels in the harbour of Christiania became poisonous only in June, and in a degree directly in ratio to the contamination of the water at the place where they grew. Mussels then were found which gave extracts which produced effects resembling either strychnine or curare poisoning. No specific bacteria were found in the shellfish.[1] A similar outbreak occurred in Wilhelmshaven in 1885.[2]

Treatment.—Early evacuation of contents of stomach and free lavage with warm water; stimulants, hypodermically and *per rectum*; hypodermic injections of morphia or strychnia; maintenance of bodily heat; purgative medicines.

Cases of criminal prosecution for poisoning by food are rare. The following case possesses many points of great interest. At the Autumn Circuit Court held in Glasgow in September 1877, before Lord Moncrieff and a jury, Robert Cochrane, captain of the ship *Crown Prince*, was indicted on the charge of having, while on a voyage between London, Melbourne, Calais, the Falkland Islands, and Queenstown, Ireland, failed to provide the crew with a proper supply of food and drink of a sound and wholesome quality, so that their lives or health were endangered or injured, inasmuch as on Nov. 20, 1876, a quantity of pork in a putrid state was supplied to the crew whereby six persons were shortly thereafter seized with serious illness, the result of blood poisoning, and died at different times during the months of December 1876, and January 1877, and seven others were seized with like illnesses and suffered great bodily pain, their lives being endangered and their health being seriously injured. From the evidence, it would seem as if the crew themselves were not unanimously in favour of the view that their illnesses were caused by the pork, but they were agreed that the outbreak was of a mysterious character. At one port during the voyage, because of the illness of some members of the crew who were there conveyed to hospital, fresh men signed articles, and most of them also were seized before they were many days on board. As the ship carried a cargo of guano, some of the men attributed their illnesses to that cause. In any case the crew became alarmed at the mysterious outbreak of illness, and on putting into the Falkland Islands the ship was cleaned and lime-washed. During this time the crew lived on shore, and their health became improved. But the ship had not resumed her voyage a couple of weeks until the crew again began to suffer.

The main symptoms of the illness were these: vomiting and purging which occurred daily, followed sooner or later by numbness and stiffening of hands or feet, or both, accompanied by pains in the limbs and tenderness of the skin, and in the more severe cases by paralysis.

[1] Jahrb. *f.* Kinderheilkunde, May 1902; *B. M. J.*, vol. ii., 1902, s. p. 33.
[2] *Lancet*, vol. i., 1889, p. 862.

In three of the worst cases the men were delirious for three days before their death. One of the officers of the ship more observant than the others arrived at the opinion that the cause of the illness was not the pork, but a certain large barrel of sugar from which the men were supplied for their coffee, and along with their lime-juice. He advised the captain to have the cask re-headed, and a different supply to be given to the men. When the ship arrived at Glasgow, the captain was apprehended on the above charge. Between the date of apprehension and the trial the sugar was submitted to analysis, and it was found by two different analysts to contain 1·65 grains of arsenious acid per pound. Notwithstanding this fact, some of the medical witnesses for the Crown held to the opinion that this was a less likely cause of the illness than the pork, but on the evidence of the late Sir Douglas Maclagan who stated that this proportion of arsenic in sugar which was used daily was not only capable but more likely than putrid pork to produce the foregoing results, the Court directed the jury to return a verdict of not guilty and the accused was liberated.

POISONOUS STINGS, AND EFFECTS OF ACRID JUICES OF PLANTS

The most common poisonous stings met with in this country are those from dragon flies, bees, and wasps, in addition to that of the common viper which is met with in different parts of Great Britain. The most serious symptoms sometimes arise from wasp stings, and occasionally death itself is produced. Frew has recorded a case in which a young lady of twenty-three was stung behind the angle of the jaw, and in a few minutes after, she felt faint, and then complained of a horrible sensation of choking and of pains over chest and abdomen. The sting had been removed, and ammonia applied. The neck swelled rapidly, and pains in the chest and abdomen became agonising. She then became insensible, and died. The whole time which elapsed between the sting and the occurrence of death was not more than 15 minutes. After death the neck and lower part of the face were found much swollen, and the tongue was so much swollen that it filled the mouth so that the throat could not be seen.[1] Cooke narrates another fatal case where the sting was made in the throat of a young lady of twenty-four. She complained of feeling numb all over and of losing her sight; her face turned pallid; and she died in about twenty-five minutes after the sting.[2] A third case, not however proving fatal, is recorded of a medical man who received in quick succession five stings from bees. After intolerable feeling of itching over shoulders and upper chest and back, he found himself getting short of breath, and was forced to lie down; his heart became slow and irregular; the respiration rapid, shallow, and laboured; he had symptoms of partial paralysis of the sphincters, as he had great difficulty in preventing the voidance of contents of bowel and bladder; he never lost consciousness, and recovered in about two hours. On the parts of the body which

[1] *B. M. J.*, vol. i., 1896, p. 145.
[2] *Ibid.* vol. ii., 1898, p. 1429; *vide* also *B. M. J.*, vol. ii., 1900, p. 1437.

itched, a papular rash appeared.[1] Stings on the tongue have in them an element of danger from the local swelling, apart from any constitutional disturbance. Nott gives the facts of a case in which a boy of thirteen was stung in that part, and in whom the tongue became greatly swollen, hard, tender, and immobile within twenty-five minutes after. No operative interference, however, was necessary, and there were no remote toxic effects.[2]

The effects of stings of wasps or bees upon occasion simulate closely the effects of sunstroke. On p. 243 are recorded the facts of a case in which, indeed, the recorder hesitated in his diagnosis as between wasp-sting and insolation. In the summer of 1906, while resident for a time in Canada, we had an experience which further illustrates this subject. Residing with a relative in the suburbs of Montreal, we were hurriedly summoned indoors to see this relative, who had been suddenly seized with an acute illness which, from a similar attack in the previous summer, had been called sunstroke by the local medical men then summoned. The patient exhibited the following symptoms :—he was unconscious, had marked cyanosis of the face, spasmodic jerky breathing, hands and face, though cold to the touch, were covered profusely by perspiration, there was only a flickering pulse at the wrist, and there had been voidance of contents of bowel and bladder into his clothes. Artificial respiration was at once started, and brandy was administered by the mouth. Soon thereafter consciousness returned, and in two days he was again well. It appears that he was a keen apiarist, and kept some hives of Ligurian bees. In the afternoon of his attack before he was seized, he was working with them without any veil or gloves, and had got very severely stung, although from the absence of acute pain he had hardly felt the stings. His first attack was of the same character and was associated with exactly similar circumstances as this attack.

Newton records similar symptoms from the sting of the honey bee.[3]

Discomfort, at least, may be produced by the bites or stings of other insects. Cantlie narrates that while some 200 men of the London Scottish Volunteers were encamped in a Hampshire wood, about one-third of the force were severely bitten by flies, which turned out to be sand flies (a species of *simulium*). Some of the men suffered more than others from the bites of the insect, which were chiefly situated about the knees. One man felt cold and shivery, and his temperature was found to be 102·5° F. The skin of the knees was puffy and painful. His case was typical of some dozens ; but in the others, the œdema extended more or less widely from the knees, and in some, the inguinal glands were swollen and tender. Horses also suffered. The insect is somewhat smaller than a house-fly, has a blackish head, thorax, and upper abdominal surface, but is striped black and white on the under abdominal surface, and has clear and transparent wings.[4]

Caterpillars of the " woolly-bear " variety are apt to produce irritation of the skin, shown by erythema and slight œdema. There may also be some rise in bodily temperature. In one case, recorded by the aforenamed observer,[5] four persons were so attacked ; they had

[1] *B. M. J.*, vol. ii., 1900, p. 680. [2] *Ibid.* vol. ii., 1900, p. 1311.
[3] *Lancet*, vol. ii., 1890, p. 268 ; *B. M. J.*, vol. ii., 1900, p. 679.
[4] *B. M. J.*, vol. i., 1900, p. 1023. [5] *Ibid.* vol. ii., 1899, p. 315.

all been handling caterpillars of the above type which they kept in a box.

Stings of the common viper are not uncommon in certain of the wilder parts of England and Scotland, and in some instances have proved fatal. Badaloni [1] has shown that in cold weather the bite of this animal is but slightly, if at all, poisonous; but in hot weather, while the animal is active, the physiological effects of the bite upon the human being are more serious. They consist of dilatation of pupil, reduction of bodily temperature, and paralysis, in addition to the swelling of the part stung, which is more or less widespread.

Cass recounts the facts of a fatal case of viper bite in a young boy of over four years. The child was bitten between 11 and 12 A.M. on June 8, but on account of the distance to be traversed before medical aid could be obtained, the child was not seen by him till about 5 P.M. Meanwhile, the father applied to the two small punctures, which were visible on removal of the child's stocking, some carbolic lotion and tar. The boy, at 5 P.M., was found curled up on two chairs, his face hidden under his arm and away from the light, and in a state of abject terror. He looked dull and had been sick many times. His temperature and pupils were normal, his pulse about 100. The bitten leg was intensely swollen as far up as the knee, was of a dull white colour, boggy to touch, with occasional dark bluish patches under the skin. The skin was very hot, but not tender to touch. That night he was restless and half comatose, but could be roused by shouting. He had been severely purged, and passed his excretions involuntarily. The temperature was still normal, the pulse, 110. The leg was now swollen up to the groin. The pupils were sluggish. On the 10th he was practically moribund. The temperature was normal; the pulse feeble and very rapid; heart sounds faint; eyes were fixed, pupils slightly dilated, corneal reflex almost gone; respiration was more rapid; purging had ceased, but urine was passed involuntarily. The swelling of limb had fallen. He died at 2 A.M. the following morning.[2]

Russell [3] records the case of a boy aged 14 who, while picnicking in Surrey, was bitten on the thumb by a common adder, but who, after severe illness and extensive swelling of the arm, chest, and neck, eventually recovered.

Allen [4] records the case of a man, aged 30, who when walking through a wood in the Lake District on Sept. 21, 1902, came across an adder or viper (*vipera berus*) which was basking in the sun. Cutting a forked stick he pinned its head to the ground, which he cut off leaving only one-eighth of an inch of the body attached. In from 15 to 20 minutes afterwards he picked up the head in his hand to examine it, when it bit him on the middle finger, just above the nail, with one of its fangs only. A drop of blood appeared at the puncture, which he sucked three or four times and spat out. Pain like a wasp-sting, shooting up to the axilla, commenced in a few seconds. He proceeded at once to walk to the nearest village, about half-a-mile away, but had gone only about fifty yards when he began to experience difficulty in seeing and breathing. Then followed a tingling sensation in the tongue, back of mouth, and lips, which became swollen, the tongue protruding from the mouth. Pain in stomach then came on which prevented him from walking, and he had to lie down in the grass; cold perspiration, pouring from his face. He then began to vomit, which somewhat relieved him, and he was able to walk to the nearest cottage. He was seen by a medical man an hour and a half after receipt of the bite, who found him suffering from collapse, vomiting, and diarrhœa. Pupils were dilated, pulse, 110, imperceptible at wrist, extremities cold, and body bathed in perspiration; and there was slight drowsiness, although he was quite conscious when addressed. By next day the arm was very much swollen and painful, the lymphatics running toward elbow and armpit being marked out as fine red lines. On the third day the arm and right side of chest were covered with large distinctly yellow-coloured ecchymosed patches, the swelling was still considerable, but the pain was much less. He got well.

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[1] *The Lancet*, May 5, 1883.
[2] *B. M. J.*, vol. ii., 1901, p. 1467.
[3] *B. M. J.*, vol. ii., 1901, p. 147.
[4] *Ibid.* vol. ii., 1902, p. 1584.

The viper, which was 19 inches long, contained seven eggs, one of which had just hatched, the young viper measuring six inches.

Another case of exceptional interest is recorded by Edleston. Dr Peck, Medical Officer of Health of the Chesterfield District of Derbyshire, when on the gathering-ground of the water-supply on the high land north of Baslow testing for peaty acids, was bitten on August 5 by an adder. Seeing the adder, and thinking it to be a common grass snake, he picked it up, when it immediately bit him first on the right hand and then on the left. He killed the adder, and then sucked one of the wounds, he thinks that on the left thumb. This was about 2.30 P.M. He states that almost immediately he began to feel a tightness of his brow, as if something had been firmly tied round it. He then became faint, and very soon vomited. The faintness continued to increase, his lips, tongue, and fauces began to swell, and he had difficulty in breathing ; but, with frequent rests, he managed to hold on his way towards the keeper's cottage whither he was helped by the keeper and his wife. Medical assistance arrived about 5.30 P.M. He was then in bed, was vomiting at frequent intervals, and appeared to be extremely exhausted. The wounds, which were little more than pricks of the skin, were squeezed, ammonia was applied, and they were washed with carbolic lotion. The right thumb was slightly swollen and bruised looking. Patient's general state was as follows :—face and head were blueyblack in colour ; lips swollen and cyanosed ; pulse imperceptible at wrist and heart sounds inaudible ; skin quite cold but bathed in perspiration. Stimulants were given and digitalin and strychnine injected hypodermically ; warmth applied to and around the body. Patient complained of pain in regions of spleen, and of bladder, vomiting was now incessant, followed by diarrhœa and strangury. He was unable to pass urine notwithstanding the desire and frequent attempts to do so. It about a couple of hours he began to feel somewhat better. By 9.30 P.M., however, the vomiting still persisted, pulse had become very weak, and numbered about 130. Further hypodermic injection of digitalin and strychnine was given, and hot applications to the body were renewed. Next morning he seemed much better, his pulse being 120, respirations normal, and heart sounds definite but muffled ; his temperature was 95° F. in axilla and mouth. The right arm was now greatly swollen, and discoloured from hand to armpit, and the swelling and discoloration extended forward on the chest and backward to the back. The left arm was free from swelling, but the bite on the thumb had a bruised appearance. The swelling on right upper limb continued on the following day, being of the nature of a firm œdema, and had spread over chest and down over abdomen and also to back. The limb itself was cold to the touch, and the extensor aspect of the fingers had a greyish-purple tint. By mid-day of August 8, the swelling had assumed the appearance of a large bruise, and the posterior aspect of the arm a raw-beef appearance. The vomiting, which had continued since its onset soon after the bite, had now almost ceased. From this date onward the swelling and discoloration began to abate and the patient's general condition to improve, so that he could be removed to his home in Chesterfield. By August 22 the swelling had practically subsided, but there was still some pain in the right hand, the skin of which was desquamating.[1] Orton narrates the facts of another case which occurred in the New Forest to a soldier doing duty in the training of the Territorials. The symptoms were practically identical to those in the former case, and the patient was able to leave his bed in a week.[2]

Deaths from venomous snakes are much more prevalent in tropical and sub-tropical countries, such as India, Africa, and Australia. In India, alone, the annual death-toll is about 20,000. Much excellent work on the poison of the cobra and other snakes has been done by Elliot,[3] Lamb,[4] Fraser,[5] Calmette,[6] and others. According to Lamb, of the different

[1] *B. M. J.*, vol. ii., 1909, p. 654. [2] *Ibid.* vol. ii., 1909, p. 702.
[3] *Ibid.* vol. i., 1900 ; *ibid.* vol. ii., 1900, p. 217.
[4] *Lancet*, vol. ii., 1902 ; *Indian Med. Gaz.*, vol. xxxvi., No. 12, 1901 ; *Scientif. Memoirs of Med. and San. Depart. Gov. of India*, 1903.
[5] *B. M. J.*, vol. i., 1896, p. 957. [6] *Ibid.* vol. ii., 1895, p. 399.

snakes in India, only four are dangerous to man—viz. (*a*) of the Colubrines, (1) the cobra, (2) the kraits; (*b*) of the Viperines, (3) the *daboia* or Russell's viper, and (4) *echio carinata* or phoorsa. The physiological effects of these venoms on warm-blooded animals or on man differ somewhat. That of the cobra seems to act directly on the spinal cord and brain. An animal when bitten becomes rapidly lethargic, then its hind legs become paralysed, then, later, the fore legs, until it becomes completely paralysed and is unable to move, although the breathing continues for a time until paralysis of the respiratory centre takes place, then breathing ceases and the animal after some general convulsive movements dies, the heart continuing to beat for a short time after respiration has stopped. The venom has a hæmolytic action on the red corpuscles and the blood imperfectly coagulates, forming only soft clots. When a man is bitten, there are usually at first sickness and vomiting, but the sequent symptoms are precisely the same as in an animal, cessation of respiration being the last visible sign of animation. The symptoms, however, do not usually set in until an hour or two after the bite, although death as a rule follows about six hours later. The venom of Russell's viper, on the other hand, has no direct effect on the central nervous system. If it does not kill quickly, the victim may survive for several hours, or, it may be, a day or two. The poison seems to act upon the blood itself, destroying the red corpuscles, affecting destructively the capillary vessel walls, making them more permeable, and destroying the normal coagulating power of the blood. It also depresses the heart's action. When a lethal dose is injected into a small mammal so that it is quickly killed, large intravascular thrombi are formed. It is not unlikely that this also happens in death which follows rapidly after a bite.

Treatment.—Serum antitoxin treatment is the only treatment in the cobra bite which has been found to be of any value. Calmette prepares his serum by immunising horses—viz. by the periodic injection at intervals of small amounts of the venom until a point is attained when the antitoxins formed in the blood are able to resist the injection of many times the fatal dose of venom to an untreated animal. It may take eighteen months to two years to complete this immunisation in a horse. When this is attained the animal is bled, the blood is allowed to coagulate, and the separated serum contains the antitoxins. The serum is then standardised in the usual way against guinea-pigs, so that 1 c.c. of serum mixed with 0·001 gramme of cobra venom may be inoculated into a rabbit without producing symptoms, and is put up for use in 10 c.c. bottles.

For antidotal purposes, it will be obvious that the amount of serum to be injected in a case of cobra bite will depend upon two factors in each individual case—viz. (*a*) on the amount of venom injected by the snake, and (*b*) the average amount of venom which is lethal to man; to these may be added a third factor—the length of time which has elapsed from time of the bite to time of injection. The first factor being unknown, it is probably safest to assume the existence in the body of the bitten person of a lethal amount of poison, and therefore 30 c.c. should at once be injected, and especially if the bitten person is in the condition of incipient paralysis. Calmette has calculated that the

minimal fatal dose of dried cobra venom for a man weighing 60 kilos is about 14 milligrams, and that the amount of poison, estimated dry, inoculated by a cobra in a single bite is about 20 milligrams. The effect of the serum will be the more prophylactic the nearer the time of bite the serum is injected. Should the first amount seem not to produce a remedial result, the dose may be repeated. The serum may be injected subcutaneously into any loose part of the body such as the flank, but if circumstances are favourable, and, especially, where the symptoms are urgent, the serum may be injected directly into a vein at the bend of the elbow. While local measures are in many cases of some use, when immediately applied to the bite, such as the application of a strong solution or crystals of potassium permanganate or of strong ammonia, they are of little value when applied only some time after the infliction of a bite. Perhaps the most effective local measure, when the part bitten will permit of it, is the application of a tightly-applied ligature to cut off the circulation till further local and general measures may be employed.

Calmette and Massol have conducted researches regarding the character of the cobra venom and its antitoxin,[1] from which they have arrived at the following results—viz. (1) that the toxic substance of the venom is soluble in liquids containing 50 per cent. to 80 per cent. of alcohol; (2) that the antitoxin is insoluble in, and after some time in contact is destroyed by, alcohol; (3) that when the two are mixed the combination becomes completely insoluble in alcohol at a concentration of 64 per cent.; (4) the antitoxin in presence of venom ceases to be destroyed by ethyl and other alcohols, even in a strength of 80 per cent.; (5) that the toxic substance of the venom is not coagulated by heat at 76° to 80° C.; and (6) that antitoxin is destroyed by heat at 70° C.

Stinging Fishes.—Perhaps the most common of the stinging poisonous fishes of our native coasts are the *Trachinus draco*, and *Trachinus vipera*, commonly called by fishermen the "Weever fish," the *Trigla lyra*—a gurnet or gurnard—called by the Kerry fishermen the "piper," and the *Trygon pastinaca*—a ray-fish, known as the "fire-flaire." Of these, perhaps the most commonly met with is the "weever," because it is often found in the nets of herring and mackerel fishermen. The fish varies in size between 9 and 12 inches long. If is not unlike a mackerel, but is more slender and has much longer posterio-dorsal and ventral fins, which extend from close to anterior fin to near the tail. It has an iridescent appearance, and shows transverse stripes on the back of different colours, not unlike the mackerel. Its flesh is not poisonous to eat, but it is capable of inflicting severe stings from certain spines which are situated on the dorsal fin and on each gill cover.[2] Evans, from experiments made with several grammes of weever poison obtained from nearly 2000 weever fish, finds that the poison at first acts locally, by producing gangrene of tissue at the point of injection and local paralysis. It is because of the paralysing effect of the poison on the fish stung by the weever that they fall a ready prey

[1] *Ann. de l'Inst. Pasteur*, Dec. 25, 1907.
[2] Briot, *Comptes rendus de la Soc. de Biolog. de* Paris, 1902-3-4.

to the assassin fish. Evans further affirms that the weever virus has a very marked hæmolytic action.[1]

Kenny[2] and others have reported personal experiences from weever stings. Kenny was stung on the inner aspect of left thumb while fishing off Hastings. Although the wound bled freely and crystals of potassium permanganate were applied, he suffered from severe pain in wound and arm, with sequent slight enlargement of axillary glands.

Treatment of the sting consists in removal of any portion of spine which may be in the wound and incision of the skin including the wounded puncture; wash with carbolic or lysol solution; apply a compress of oil of turpentine and hot boric acid fomentations on the part around.

Skin Eruptions from Acrid Vegetable Juices.—In exceptional instances cases have been recorded in this country of the poisonous effects upon the skin of the acrid juice of *Rhus toxicodendron*. Nicholson[3] and Neale[4] have recorded cases, and Stevenson[5] gives a note on the subject of poisonous effects so produced. Neale states that in the Botanic Gardens, Edinburgh, a student, one day as the Professor of Botany was descanting on the poisonous properties of this plant, broke off a twig from the plant, and smeared some of the juice on his left arm. A few days later the whole arm to a point midway between shoulder and elbow became intensely red and swollen, and covered with a pemphigoid eruption, some of the bullæ of which were of the size of pigeon's eggs. Many references to recorded cases will be found in the article noted below.[6]

Sir Ray Lankester has drawn the attention of the public to the dangers which may arise among the occupants of houses from the sumach vine or rhus toxicodendron having been planted as a creeper on the walls. Probably by reason of ignorance, gardeners have supplied under the name of *ampelopsis Hoggii* plants of the sumach. This sumach-tree is one of the species the juice of which is used to make a lacquer or varnish. The poison is a fixed oil and it exists in all parts of the plant, stem, leaves, etc. It has a most irritating action on the skin, and enough may be taken on the fingers from handling the plant to produce violent irritation of nose, eyes, ears, or skin when touched or rubbed by the polluted fingers. This irritant action is not general, since some persons are found immune to it, while others suffer most severely.[7]

The Japanese primrose—*Primula obconica*—gives rise to urticaria in certain persons. Neale, in the article quoted, gives the case of a lady who was attacked in this way; and many other observers have recorded similar cases.[8]

In the plant *jequirity*, a leguminous plant, native of Brazil, resides an active principle, which when applied to the conjunctiva in the form

[1] *B. M. J.*, vol. i., 1907, p. 73.

[2] *Ibid.* vol. ii., 1906, p. 608; *ibid.* vol. ii., 1906, p. 739; *ibid.* vol. ii., 1908, July 18; *ibid.* vol. ii., 1908, p. 627.

[3] *Ibid.* vol. ii., 1901, p. 147.

[4] *Ibid.* vol. i., 1897, p. 1346.

[5] *Ibid.* vol. i., 1897, p. 972.

[6] *Ibid.* 1899, vol. i., p. 762.

[7] *Daily Telegraph*, Aug. 1908; *Spectator*, Dec. 31, 1907; *Med. Press*, vol. i., 1901, p. 695.

[8] *B. M. J.*, vol. ii., 1899, p. 1543; *ibid.* vol. ii., 1906, p. 1034.

of an infusion of the plant in water, produces a peculiar inflammation. At first this result was supposed to be due to micro-organisms present in the infusion, but Klein has shown that the bacillus found has nothing to do with the production of the conjunctivitis. The effect is produced by an active principle in the plant itself.

Arrow Poisons.—Primitive peoples dipped the tips of their arrows in some substances which experience had prompted them had a toxic effect. The poisonous substances used have been various, including the sap or inspissated juices of plants belonging to the Strychnos and Strophanthus families, and to the Euphorbiaciæ.[1] Curare or wooraré seems to be a compound of extracts of various substances, but seems always to contain as one of its ingredients the extract of one of the Strychnos group. The characteristic action of curare is that while consciousness remains unaffected, the person or animal betrays anxiety, and paralysis of the voluntary muscles gradually supervenes. In other cases, the arrow poison seems to consist of a tenacious thin mud, taken from certain swamps, which possesses toxic properties. Poisoned arrows, brought to this country and used as articles of decoration, have occasionally given rise to toxic results.

White narrates the case of a servant girl who, while standing on steps engaged in dusting shields on the wall of the hall of a house, overbalanced, and in falling her arm was pierced by the point of an Indian arrow. The arrow-point was withdrawn within two minutes. Half-an-hour later, she was in a collapsed condition, with shallow, jerky breathing and feeble pulse. Breathing gradually became slower until it ceased. Artificial respiration had to be maintained for two hours, with occasional use of the interrupted galvanic current to the diaphragm, before signs of improvement were manifested. For three or four days after she remained in a drowsy state. The poison was believed to be wooraré or curare.[2]

The poisoned arrow is still a weapon of warfare among the tribes of Central Africa. Parsons has contributed a most interesting article on arrow wounds received by soldiers in a campaign in Northern Nigeria.[3]

The dust of certain foreign woods causes irritation of the skin, sometimes, indeed, amounting to dermatitis. One of these, now imported into this country for ornamental and decorative purposes, is the wood of the satinwood tree. The Report of the Chief Inspector of Factories in his report of 1906 gives details of outbreaks of skin disturbances from this cause. Gardner [4] reports a case in the person of a cabinetmaker of 30 years' standing who had never before suffered from any irritation of the skin, but who was attacked with an eruption on face and arms while working with satinwood. The first signs were itching of skin at the back of the neck, and the development of a papulo-vesicular rash on the backs of the hands, which latter became moist and spread up the forearms. His face became so erythematous that the practitioner whom he then consulted diagnosed the disease as erysipelas.

[1] *B. M. J.*, vol. i., 1909, v. 1207; *ibid.* vol. ii., 1899, p. 1222 (Koch).
[2] *Lancet*, vol. i., 1889, p. 739.
[3] *B. M. J.*, vol. i., 1909, p. 212.
[4] *Ibid.* vol. i., 1908, p. 1231; *ibid.* vol. i., 1905, p. 822.

POISONING BY FUNGI

Owing to the absence of any easy and ready test whereby the edible from the non-edible fungi may be differentiated, and probably, also, to the general morphological likeness which many of them possess, serious and fatal poisonings occur from time to time. The ordinary town dweller, unless he be the possessor of special knowledge, is usually unable to decide between a poisonous fungus and an edible mushroom; consequently it is usually among such persons that mistakes arise which are followed by such serious consequences. The mushroom, *Agaricus campestris*, and others of the same group, are, when cooked, such a table delicacy that they are eagerly sought after in the country. When properly cooked and eaten in moderation they commonly produce no ill effect; at the same time, there are certain persons who betray an idiosyncrasy to mushrooms. Nash [1] relates an instance of this kind in which a man, familiar with mushrooms, pickled some which he had gathered, and which he, his wife, and a friend partook of at breakfast. The wife vomited after eating, the man himself was ill all that day with most acute pain in his chest, and with a feeling of numbness in the left arm, for relief of which morphia had to be administered hypodermically, while the friend was quite unaffected.[2] It is also generally believed that mushrooms under all circumstances are a safe article of diet, but that is not true, at least regarding one species. In Berne some persons ate a quantity of *Helvella* or *Morchella esculenta*, which had been bought in the dried state, and some hours afterwards were seized with vomiting and abdominal pain. Demme and Berlinerblau,[3] who investigated the subject, arrived at the view that the nitrogenous substance of the mushroom is capable of undergoing certain putrefactive changes leading to the formation of poisonous products of a ptomaine-like character. Some of the dried fungi in question yielded a substance which, by reason of its action on cold-blooded animals, resembled curare more than muscarin.

Frossard records the case of a healthy woman of 30 years of age who, while preparing mushrooms for family breakfast, between 8 and 9 A.M., ate some of them raw. When the rest were cooked, they were eaten at breakfast by four other members of the family besides herself. The mushrooms were of unquestionable repute. At 11.50 A.M. she felt sick and was purged, but did not complain of pain. She, however, became unconscious almost at once, her limbs becoming rigid and her eyes "turned-up." She died at 1.30 P.M. without recovering consciousness. Post-mortem examination of her body next day showed marked decomposition, the features being unrecognisable, and the skin of a green colour all over the body. In the stomach twenty mushrooms, undigested,

[1] *B. M. J.*, vol. ii., 1905, Sept. 9, 16 and 23.
[2] *Lancet*, vol. ii., 1901, p. 1014; *B. M. J.*, vol. ii., 1902, p. 1104.
[3] *Lancet*, vol. i., 1889, p. 440.

were found, some of these being whole, others in half, and neither peeled nor masticated. The gastric mucous membrane was inflamed.

Perhaps it would be true to say that the fungus most commonly pickled by mistake for the mushroom is the *Agaricus muscarius*, or, as it is now more generally called, *Amanita phalloides*. Ford [1] has stated that at least 300 cases of fatal poisoning from this fungus have already been recorded. It and its congeners contain an active narcotic principle which is brown in colour, is non-crystallisable, has no taste or odour, and is soluble in alcohol and ether but insoluble in water. Kobert in 1891 discovered that aqueous and saline extracts of *A. phalloides* were powerfully hæmolytic, dissolving red corpuscles even in a dilution of 1 in 125,000, and that the hæmolytic principle could be destroyed by digesting the extract at 20° C. with pepsin and pancreatin. He concluded that the principle was of the nature of a toxalbumin, which he called *phallin*.[2] These conclusions, however, were disputed by Bourqueldt in France and Kunkel in Germany, the former contending that, if *phallin* were the only toxic principle present in the fungus, poisoning should not occur when the fungus was properly cooked, since *phallin* was destroyed by a temperature of 70° C., and the latter, who had experimented with *Amanita citrina*, because he could not find any principle present which had a hæmolytic action. Ford found that if extracts were heated to 80° C., they lost their hæmolytic property, and that if they were digested with pepsin and pancreatin, toxic substances, sufficient to kill animals, still existed. Ford calls this " amanita toxin," a principle which Kobert had already isolated. In addition to the toxalbumin and the alkaloid, Kobert has later declared his discovery of a third toxic substance.

Not a few instances have been recorded of poisoning by this fungus in this country.[3]

It will suffice, however, to give details only of one typical group. Plowright [4] records the circumstances of four fatal cases from eating this fungus which occurred at King's Lynn. The first, a boy of twelve, ate about one-third of the raw top of a fungus. Symptoms appeared first 13 hours after eating, in the form of vomiting, diarrhœa, and great thirst, which were succeeded by severe abdominal pain, and by slight convulsions before death, which took place 81 hours after eating. The second, a boy of five, died 68 hours after eating. The third was a group composed of a man of 32 years, his wife, aged 22, a daughter aged 7, and a son, aged 22 months. They had gathered this fungus in mistake for mushrooms, the amount being about three-quarters of a pound, and after cooking ate it for tea. The mother and the boy, however, ate some of it raw while it was being prepared. They all were ill. The boy died 45 hours after eating, and the mother on the fourth day after. The father and daughter were very ill, but recovered.

[1] *B. M. J.*, vol. ii., 1906, p. 1541.

[2] St Petersburg. *med. Woch.*, 51 and 52, 1891 : *Bulletin Soc. Mycol. de France*, vol. xvii., 1902, p. 420 ; also vols. xviii., xx., and xxi.

[3] *B. M. J.*, vol. ii., 1882, p. 1120 ; *ibid.* vol. i., 1883, p. 132 ; *Lancet*, vol. ii., 1879 ; *B. M. J.*, vol. ii., 1905, p. 541 ; *ibid.* vol. ii., 1907, p. 766 ; *Presse Méd.*, Sept. 30, 1899.

[4] *B. M. J.*, vol. ii., 1905, p. 541.

The average period of time which elapsed between the eating and the onset of symptoms in these cases was from 10 to 12 hours.

Symptoms.—The symptoms may be briefly summarised thus: abdominal pain, vomiting, cramps in stomach and diaphragm, diarrhœa, intense thirst, cold sweats, collapse, and, not infrequently, delirium with severe headache, more or less complete anuria, and convulsions.

Post-Mortem Appearances.—Absence of rigor mortis; marked post-mortem lividity; inflammation of gastro-intestinal mucous membrane; localised ecchymoses of alimentary canal, pleuræ and lungs, and liver; fatty degeneration of liver; fluidity of blood; and hyperæmia of cerebral meninges.

Treatment.—Emptying and free lavage of stomach with dilute solution of potassium permanganate, hypodermic injection of morphia to relieve pain, and of atropine and ether, and subcutaneous administration of normal saline (℥i common salt to 1 pint of sterilised water).

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