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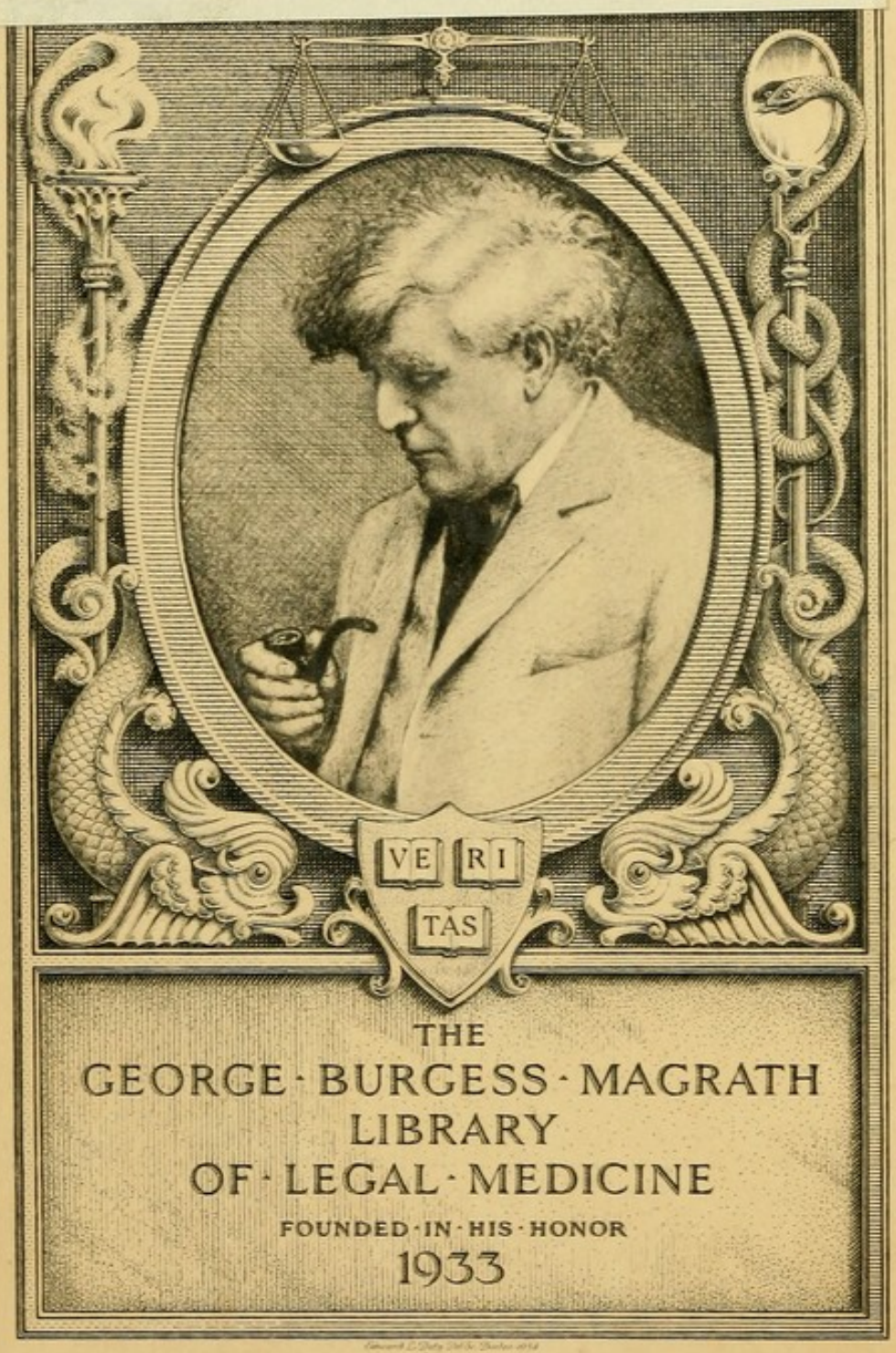

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FORENSIC MEDICINE.

Horace Green.

PRINCIPLES

OF

FORENSIC MEDICINE.

BY

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PREFACE.

THE original motive of the Author in undertaking this work was to furnish the members of his class with a system of Forensic Medicine, in which the several subjects should be arranged in the same order, and treated in the same way, as in his lectures.

Previous to the publication of the first part of this work, there was no book in the English language of a convenient size and form to serve as a class-book. This was an additional inducement to the present undertaking.

To furnish a short and methodical class-book, therefore, was the Author's first object, but it was not his only one. He has aimed at rendering his work useful to the practitioner, by simplifying some subjects, by forming in respect to others more accurate standards of comparison, and by analyzing with care those statements of authors which bear upon points of the greatest practical importance. He would instance, as an example of simplification, the subject of infanticide ; as accurate standards of comparison, the tables illustrative of the subjects of age and identity, and of the growth and development of the fœtus ; and, as examples of careful analysis, the observations of Orfila on the means of determining the stature of the body, those of Mr. Saunders on the teeth as a test of age, the tables illustrative of the subject of legitimacy, and the general results of individual cases of poisoning by some of the

more important substances comprised in the Toxicological portion of the work.

The work has been brought within comparatively narrow limits by the omission of all details of mere literary interest. The plan adopted in treating the several subjects, is to begin with a short statement of the existing provisions and requirements of the law, avoiding all unnecessary discussion as to the state of the law in former times and in different countries. The chief medical questions arising out of the law are then investigated under distinct heads ; practical rules for medico-legal examination are appended, and the subjects are illustrated throughout by cases.

Some of the more important questions, as Infanticide, Legitimacy, and Unsoundness of Mind, are treated at considerable length ; but the space devoted to each subject has been determined less by its importance than by the length of the discussions necessary to render it intelligible. The important subjects, for instance, included under the head of Toxicology, admit of being treated with much greater brevity than Infanticide or Unsoundness of Mind. Less space therefore has been devoted to them.

The subjects are arranged in the same order as in the Author's Lectures, and the headings will be found to coincide closely with the details in his prospectus. This arrangement will render the work more acceptable to the members of his class.

In accordance with the title which he has given to his work,—"Principles of Forensic Medicine,"—the Author has aimed at establishing such general principles and such standards of comparison as the nature of the subject allowed of. This has been a work of great labour and research.

In treating the important subject of Toxicology, an attempt has been made to render the tests for the poisons more easy of comprehension, and to impress them more effectually on the memory, by first arranging them in the order in which they

would be applied, on the supposition that the substance submitted to analysis was unknown, and then adding such as are most characteristic of the poison in question. Some useful analytical tables, on a new plan, have been added in the Appendix. In the case of some of the more important poisons, the value of individual symptoms, and the duration of the poisoning, have been deduced from an extensive and careful analysis of cases.

In handling those topics which do not involve any broad principles, but consist chiefly of details, use has been made of the best monographs and systematic works. To Beck's learned and elaborate Elements of Medical Jurisprudence the Author is indebted for several illustrative cases. To Ray's Medical Jurisprudence of Insanity, Dr. Gavin's recent work on Feigned Diseases, the first volume of Mr. Alfred Taylor's Elements of Medical Jurisprudence, Watson's Medico-legal Treatise on Homicide, and Christison on Poisons, the Author has also to acknowledge his obligations, for much valuable information, and many cases in illustration of the several subjects on which they have treated. In some portions of the work much use has been made of foreign monographs and systematic works.

As some portions of the work have been taken with little alteration from the Author's lectures, it is possible that some passages may be found which should have been marked as quotations, or which were originally but slightly altered from the authors whose works were consulted. Such oversights would be a subject of great regret with the Author; but the frequent references which are scattered through the pages of the work will shew, that there has been no intention of depriving the authors whose works have been laid under contribution of the credit which is their due.

15, Bloomsbury Square,
September 17, 1844.

ADVERTISEMENT.

THE work, of which this is the first part, is intended to supply a deficiency, which, as a teacher of Forensic Medicine, the Author has long felt—that of a *compendious* treatise on the subject-matter of his lectures.

This was the Author's first, but not his only, object. He has aimed at rendering his work useful to the practitioner, by simplifying some subjects, by forming in respect to others more accurate standards of comparison, and by analyzing with care those statements of authors which bear upon points of the greatest practical importance. In the present part, he would instance, as an example of simplification, the subject of infanticide; as accurate standards of comparison, the tables illustrative of the subjects of age and identity, and of the growth and development of the fœtus; and, as examples of careful analysis, the observations of Orfila on the means of determining the stature of the body, and those of Mr. Saunders on the teeth as a test of age.

The Work has been brought within comparatively narrow limits by the omission of all details of mere literary interest. The plan adopted in treating the several subjects, is to begin with a short statement of the existing provisions and requirements of the law, avoiding all unnecessary discussion as to the state of the law in former times and in different countries. This is followed by a short statement of the chief medical questions arising out of the law, which are then investigated under distinct heads: practical rules for medico-legal examination are appended, and the subjects are illustrated throughout by cases. Some of the more important questions, as

Infanticide and Legitimacy, are treated of at considerable length. In discussing the subject of Infanticide, the Author has departed from the rule generally observed, of confining himself strictly to a statement of the existing provisions of the law; and he has ventured, with reference to those provisions, to suggest some alterations which appear to him to be called for.

The subjects are arranged in the same order as in the Author's Lectures, and the headings will be found to coincide closely with the details in his prospectus. This arrangement will render the work more acceptable to the members of his class.

The book having been for some time announced, the Author, to prevent further delay, has determined to publish it in three consecutive parts, to the last of which will be appended a copious index. The present part contains much matter not to be met with elsewhere, and comprises the important subject of Infanticide. The second part, containing all the remaining subjects usually treated of in works on Forensic Medicine, with the exception of Toxicology, will be published early in November; and the third part, comprising the entire subject of Toxicology, with the preface and introduction to the entire work, will appear early in the month of March 1844.

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FORENSIC MEDICINE.

CHAPTER I.

MEDICAL EVIDENCE.

Courts of Law in which the Medical Man may be required to appear as a Witness.—Coroner's Court.—Provision for the Attendance and Remuneration of Medical Witnesses.—Distinction between a common and a skilled Witness.—The Medical Man a skilled Witness.—Directions for his Behaviour in a Court of Law.—Freedom from Bias.—Choice of Language.—Citation of Authorities.—Circumstances which affect the Admissibility of his Evidence.—Notes.—Confessions.—Dying Declarations.—Secrets.—Caution with regard to Duels.—The Medical Man not required to criminate himself.—General Summary.

Some knowledge of the usages of courts of law, and of the laws of evidence, cannot fail of being useful to any one about to appear in the witness-box ; and the same observation applies with still greater force to those who, from the nature of their professional avocations, are most frequently summoned as witnesses. The members of the medical profession are peculiarly liable to be called upon to appear in this character, and, for this reason, no work on forensic medicine is considered complete without a chapter on medical evidence.

The medical man may be summoned as a witness to the high court of parliament, the ecclesiastical court, the civil courts, the criminal courts, and the coroner's court. The questions which arise in the high court of parliament, and in the ecclesiastical and civil courts, though comparatively few in number, are amongst the most delicate and difficult which claim the attention of a court of law. They are questions which chiefly involve property and reputation ; and the witnesses summoned to give evidence concerning them are, for the most part, men of acknowledged eminence and experience in particular branches of the profession, such as midwifery and the treatment of the insane. In the coroner's court, and in the criminal courts, on

the other hand, the questions which arise are generally such as affect the life of the accused party, or expose him to the severest penalties of the law ; and it is in these courts that those engaged in the ordinary practice of the profession are most frequently called upon to appear. As, moreover, most of the cases which are subjects of inquiry in the criminal courts have been previously investigated before the coroner, and but a small proportion of the verdicts of the coroner's court lead to further proceedings in the superior courts, it follows that the coroner's court is that in which the medical witness is most frequently summoned to give evidence, and with the usages of which it is most important that he should be acquainted.

THE CORONER'S COURT.

It is not consistent with the object and limits of this work to trace the origin of the office of coroner, or to state the changes which have taken place in the mode of his appointment, the duties which he has to perform, or the obligations under which the law places him. That which the medical man is most interested in knowing is merely so much of the constitution and usages of the coroner's court as most nearly affects himself when appearing there as a witness.

The great object of the coroner's court is to inquire into all cases of death attended by circumstances of an unusual or suspicious nature; and, that no such case may escape inquiry, the law provides that when any person comes to an unnatural death, the township shall give notice thereof to the coroner, and that if the body be interred before he come, the township shall be amerced. It is the duty also of the persons who discover the body to apprise the coroner of the event ; and it is an indictable matter to bury a man before the coroner's inquest has sat upon him.

The court over which the coroner presides may consist of an indefinite number of persons summoned from the nearest householders, of whom twelve must agree in their verdict.

The jury having been called together and sworn, their first duty is to view the body ; for an inquest taken without a view of the body is void. This done, they proceed to hear evidence as to the cause of death.

The inquest was originally held on the spot on which the body was found ; but as this custom, though attended with obvious advantages, is in many respects inconvenient, the inquest is now commonly held in the nearest public-house.

The coroner has the power of summoning witnesses, and of compelling their attendance ; and a refusal on the part of the medical man to obey the coroner's summons, or to give evidence when he appears in court, renders him liable to be fined or committed for contempt. The authority of the coroner may also be enforced by the Lord Chief Justice of the Queen's Bench, who is the principal coroner of the kingdom.

Witnesses are examined on oath, except they happen to be Quakers or Moravians, in which case a solemn affirmation is allowed to be substituted for it.

The evidence is taken down by the coroner or his clerk, as nearly as may be in the very words used, and afterwards read to the witness, that he may make any corrections, or explain anything which has been misunderstood. To this draft of the evidence thus corrected, the witness signs his name, and the coroner afterwards attaches his signature to it. This written document may be referred to if the case should afterwards come before the superior court, and the evidence which has already been given before the coroner will be compared with that which the witness gives before the higher tribunal.

If the witness should be prevented by sickness from appearing in the superior court, or if he has died before the trial comes on, the evidence of such witness as given before the coroner is taken without any reserve or limitation, although it may not have been delivered in the presence of the accused, and although it be no longer possible to sift its truth and correctness by the process of cross-examination.

If the coroner's jury decides that the death in question was due to violence, and a reasonable suspicion attaches to any party, the coroner is bound to issue his warrant for the apprehension and committal of such person, that he may take his trial in the superior court.

The coroner is to enrol the verdict of the jury written on parchment, and return the inquisition, either to the justices of the next gaol delivery of the county or certify it into the Queen's Bench. He must also bind over the witnesses to appear at the trial, to give in the higher court the evidence they have given before his.

Until a recent period the coroner had the power of summoning the medical man to his assistance ; but he had no power to recompense him for his services. This injustice has been remedied by an act, entitled, "An Act to provide for the Attendance and Remuneration of Medical Witnesses at Coroners' Inquests."—(6 & 7 Gul. IV. cap. 89.) This act empowers the coroner to summon any legally qualified medical practitioner who may have been present during the last illness, or at the death, of the deceased ; or if the deceased person was not attended at or immediately before his death by any legally qualified medical practitioner, to issue his order for the attendance of any legally qualified medical practitioner, "being at the time in actual practice in or near the place where the death has happened ; and it shall be lawful for the coroner, either in his order for the attendance of the medical witness, or at any time between the issuing of such order and the termination of the inquest, to direct the performance of a post-mortem examination, with or without an analysis of the contents of the stomach or intestines, by the medical witness or witnesses who may be summoned to attend at any inquest ; provided that if any person shall state upon oath before the coroner that, in his or her belief, the death of the deceased individual

was caused partly or entirely by the improper or negligent treatment of any medical practitioner or other person, such medical practitioner or other person shall not be allowed to perform or assist at the post-mortem examination of the deceased." The act further empowers the majority of the jurymen, if dissatisfied with the evidence of the medical witnesses first examined, to name to the coroner in writing any other legally qualified medical practitioner or practitioners, and to require him to issue his summons for his or their attendance, and, if it appear necessary, for the performance of a post-mortem examination and analysis of the contents of the stomach and intestines. The coroner is further empowered to remunerate the medical witness. The fee is as follows: "1. To every legally qualified medical practitioner for attending to give evidence under the provisions of this act at any coroner's inquest whereat no post-mortem examination has been made by such practitioner, the fee or remuneration shall be one guinea. 2. For the making of a post-mortem examination of the body of the deceased, either with or without an analysis of the contents of the stomach or intestines, and for attending to give evidence thereon, the fee or remuneration shall be two guineas."

To this rule of remuneration, however, the act makes two exceptions. 1. In the case of a post-mortem examination, "instituted without the previous direction of the coroner," for which no fee shall be paid; and 2. In the case of an inquest "holden on the body of any person who has died in any public hospital or infirmary, or in any building or place belonging thereto, or used for the reception of the patients thereof, or who has died in any county or other lunatic asylum, or in any public infirmary, or other public medical institution, whether the same be supported by endowments or by voluntary subscriptions; then, and in such case, nothing herein contained shall be construed to entitle the medical officer whose duty it may have been to attend the deceased person as a medical officer of such institution as aforesaid to the fees or remuneration herein provided."

The act further provides, "that any medical practitioner refusing to obey the coroner's summons shall be fined the sum of five pounds, upon complaint made by the coroner, or any two of the jury, before any two justices having jurisdiction in the parish or place where the inquest under which the order issued was held, or in the parish where such medical practitioner resides; and such two justices are hereby required, upon such complaint, to proceed to the hearing and adjudication of such complaint, and if such medical practitioner shall not show to the said justices a good and sufficient cause for not having obeyed such order, to enforce the said penalty by distress and sale of the offender's goods, as they are empowered to proceed by any act of parliament for any other penalty or forfeiture." An act passed in the first year of the reign of her present Majesty, (1 Vict. cap. 68.) provides, that "the coroner shall, immediately after the termination of the proceedings at any inquest, advance and pay such

remuneration or fee to every medical witness summoned under the provisions of the act (6 & 7 Gul. IV. cap. 89.);" and, it further directs, the mode of repayment to the coroner of the sums so advanced.

The primary object of inquiry in the coroner's court is the cause of a death supposed to have happened out of the ordinary course of nature. The power of the coroner, by his warrant, to cause persons suspected of having been the occasion of the death to be apprehended and brought before him, and subsequently, on verdict found against them, to commit them for trial, is only incidental to the primary object of the inquiry, and in furtherance of the ends of justice. The verdict, or, as it is more correctly termed, the inquisition, of the coroner's jury is in no case final, either as to the cause of death or the party who occasioned it; for, although no other tribunal can originate an inquiry into the cause of death, where no person is suspected of having occasioned it, yet, notwithstanding the inquisition of the coroner to the contrary, the superior courts, in trying a person suspected of having occasioned the death of another, will inquire into the cause of death: and, again, though the coroner's jury may have found that the death had arisen from natural causes, or, as they usually term it, by the visitation of God, and so constructively have acquitted a party produced before them suspected of having caused the death, yet the same person may still be tried before the superior court. This is no violation of the well known rule, that a person's life shall not be put in jeopardy twice for the same crime; for the trial before the coroner is not the guilt or innocence of the suspected party, but the cause or occasion of the death. On the other hand, a verdict of not guilty in the superior court constitutes legal innocence: though it be possible subsequently to produce the strongest evidence of a man's guilt, and though he even confess it with his own mouth, no further proceeding can ever be taken against him for an offence of which the highest tribunal has declared him innocent. Again, if the coroner's court find that a man is guilty of murder, the inquisition, although sufficient authority for his arrest and imprisonment, in order to his appearance in the superior court, is not final. A verdict of acquittal in the superior court may be given in the face of this finding of the coroner's court.

The fact that the proceedings of the coroner's court are not final, that the medical man is liable to be summoned as a witness to the high criminal court, to repeat the evidence which he has already given before the coroner, and that his statements will be carefully compared with his written evidence, should make him very cautious and circumspect in his preparation for appearing in the coroner's court, and in the evidence which he gives there. He should consider, moreover, that the coroner's inquest, taking place immediately after the death of the deceased, when there is every facility for accurate examination, furnishes an opportunity that may never recur of throwing light upon crimes which, without such an institution, might entirely escape

detection. The absence from the coroner's court of those imposing ceremonies, which make an appearance in the superior courts so formidable, should not lead the medical witness to treat his duties lightly, or to perform them carelessly.*

MEDICAL EVIDENCE.

It is important that the medical man should understand the nature of the duties which he is called upon to perform if summoned as a witness. These duties are twofold. He has to *state* facts, and to *interpret* them; in other words, he may be, in the language of jurisprudence, both a *common* witness and a *skilled* witness. In some cases he is a *common* witness, in others a *skilled* witness; and in others, again, (and these are the majority of cases,) he is both.

As a *common* witness, his duty is to state facts; as a *skilled* witness, to state his opinion as to the bearing of those facts on the case under investigation. If he is examined as to facts which he has himself witnessed, he is also questioned as to his interpretation of them, and then he performs the double duty of a *common* and a *skilled* witness; but he may be summoned merely to state his opinion of the bearing and value of facts which have been observed by others, in which case he acts the part merely of a *skilled* witness.

This distinction, between the duties of a common witness and of a skilled witness, has not always been recognised by the members of our profession. Some of them have fallen into the error of supposing that they were not required to express opinions, but merely to state facts. Of this number was the late Mr. Abernethy, who, when summoned to give evidence in the case of a Lascar, who had died in consequence of a blow from a marlin-spike, refused to state his opinion, and was reprimanded by the judge, who told him that he was sent for "for the purpose of giving an opinion."† That no doubt may be entertained as to the obligation under which the medical man is placed to state his opinion, I will quote a legal authority. "The general rule is, that a witness must not be examined as to his opinion, for his testimony must be confined to evidence of facts. But in questions of skill and judgment, men of science or experience are allowed to give evidence of their opinion." "In criminal cases, the opinions of medical men of science are very frequently employed as evidence. A physician who has not seen the patient, may, after hearing the evidence of others, be called to prove, on his oath, the general effect of the disease described by them, and its probable consequences in the particular case. So in prosecutions for murder, medical men have constantly been allowed to state their opinion, whether the wounds described by witnesses were likely to be the cause of death."‡

* See Burn's Justice, last edition, tit. Coroner.

† Lect. Lancet, vol. xii. p. 227. ‡ Burn's Justice, tit. Evidence.

In order that the medical man may have all the facts before him on which his opinion is to be founded, he is often allowed to remain in court when mere witnesses to matters of fact are excluded; and, "by the law of Scotland, a medical witness is directed to remain in court till the medical opinion of other witnesses begins."

The medical man, then, should understand that he is required not merely to state such facts as he may have witnessed, but to state his opinion also when desired to do so.

In stating facts, and in drawing inferences from them, there are certain precautions which the medical witness ought to observe, and certain legal requirements of which he should not be ignorant. In the first place, the medical witness should approach the performance of his duties in a proper frame of mind. He should be perfectly impartial, and altogether indifferent to the merits of the case. Against this rule, too, the late Mr. Abernethy transgressed; for, in the Lecture already quoted, in speaking of the necessity for examining the lungs in all cases of suspected infanticide, he says, "it is your duty, I think, to try to weaken the effect of your testimony on this point."* This was a great error; for if there is one thing more essential for the medical witness to remember than another, it is, that he has nothing whatever to do with the consequences to which his opinions may lead, provided always that they are completely warranted by fact, and the result of sound knowledge and due reflection. The province of the medical witness is distinct from that of the counsel, the judge, and the jury. The counsel has a client, the medical man has no client; the judge is the interpreter and minister of the law; with the law the medical man has no business: the jury decide on the innocence or guilt of the accused party; the medical witness has nothing to do with either. Justice, as Mr. Abernethy says, always leans to the side of mercy; the medical witness knows nothing of the one or the other. If the existing laws are unnecessarily severe, on the legislature lies the odium, and on it devolves the duty of amending them: the medical man has nothing to do with their severity or their leniency, and so surely as he meddles with the one or the other, he does injury to the cause of justice. The name of Dr. Hunter will at once suggest an illustration of this last remark.

The foregoing observations apply chiefly to a misplaced humanity: the medical man should guard with equal care against the opposite error of sharing in the popular prejudice so generally excited against those accused of great crimes. The melancholy fate of John Calas, who was sacrificed to popular prejudice, which was shared by the medical witnesses, should serve as a warning against this error.† The advice now given coincides with the principle of our English law, that "when scientific men are called as witnesses, they are not entitled to give their opinion as to the *merits of the case*, but only as to the *facts proved on the trial*."

* Loc. cit. p. 227. † See Beck, p. 633.

Medical men are sometimes called on to give evidence for the prosecution, at other times for the defence. In such cases there is great necessity for caution; and it is obvious that no medical man can be justified in consenting to appear for either party, until, having heard all the facts on which his opinion must be formed, he can conscientiously give evidence in favour of the party for whom he is retained.

The medical witness approaching his duties with a mind thus free from bias, requires some instruction as to the mode in which his evidence shall be given.

Bearing in mind the distinction already laid down between his duties as a common witness and as a skilled witness, he should be cautious not to obtrude his opinions when facts only are required of him, nor dogmatically to assert as facts things which are merely matters of opinion. He should answer the questions put to him, whether by the counsel, the court, or the jury, clearly and concisely, and if none of these elicit the whole truth, it is his duty to supply what is wanting. Such additions as these are always gratefully received by the court.

The medical man should form his opinion entirely on the medical evidence and not from the collateral circumstances of the case. An eminent medico-legal authority, now living, offended against this rule in an important case, and was reproved for it. In the report of the case alluded to it is stated, that "Dr. ——'s evidence was substantially to the same effect" as that of a former witness, "though not so easy to analyse, from his persevering in giving the opinion he had formed from the collateral circumstances of the case as well as from the appearance of the body; just, in fact, as if he had been acting as a juryman: till very properly reminded by the court, 'we can judge of other circumstances as well as medical men.'"

With regard to the language which the witness ought to make use of,—it should be plain and simple, avoiding as much as possible all technical terms, and when it is absolutely necessary to use them, explaining them in the clearest and simplest way.

It is scarcely necessary to add, that the witness should carefully avoid all figurative expressions.

On the trial of Donnal, Mr. Ticknor, a surgeon, was asked, "Supposing a person to have retchings and purgings for several hours, and that you find them attended with a frequent and fluttering pulse, in that state of the illness, what should you have prescribed?" Answer, "I should have prescribed diametrically opposite to the prescription of Dr. Edwards. I should consider that prescribed by Dr. Edwards as adding weight to a porter's back." Mr. Justice Abbott (afterwards Lord Tenterden) to the witness: "Don't speak metaphorically; you were speaking just now of a gentleman of experience and respectability. I don't wish you to conceal your opinion, but only to speak it in different language."

In this place an important question suggests itself. Is the medical witness allowed to quote authority in support of his opinions? On

this point there is much difference of opinion among the best medical and legal authorities. By the former the rejection of such appeal to authority has been viewed as "a compromise of the rights and dignity of the profession,"* whilst the latter have not always adhered rigidly to the rule of exclusion. Thus, whilst Judge Abbott, on the trial of Donnal for poisoning, disallowed Dr. Neale's appeal to the authority of Thénard in these words, "we cannot take the fact from any publication; we cannot take the fact as related by any stranger;" Dr. Crell, on the trial of Spencer Cooper, was allowed to expostulate with the bench on what seemed to him an unjust exclusion of medical authority, and to proceed with his evidence. There can be no doubt, however, that the common usage of our courts of law is to disallow these appeals to authority. If the rule which excludes authority from medical evidence is to be rigidly acted upon, it is much to be desired that the bench and the counsel should cease to usurp a right to quote medical authorities with a view of destroying the effect of medical evidence. Thus, on more than one occasion, in trials for infanticide, the obsolete and very partial authority of Dr. Hunter has been quoted both by the counsel and the court, in opposition to the evidence of medical witnesses.

This exclusion of all appeals to authority, however, is not attended with any bad effect, inasmuch as the medical witness is supposed to have qualified himself for his duties by making himself master of the opinions of the most eminent writers on the subject-matter of his evidence, and to have employed these opinions as the basis of his own inquiries and experience. In giving his own evidence, therefore, he is in reality embodying the opinions of the leading authorities of his profession.

The suggestions now made as to the mode in which the medical man ought to give his evidence will be of little use to him, unless he have previously prepared with care the subject-matter of his evidence. It will contribute greatly to the right performance of his duties as a witness, if he avail himself of the assistance and advice of other members of the profession, more especially of such as have devoted some attention to medico-legal inquiries. It has been recommended, too, that the medical witnesses about to be examined should first meet together and agree on the opinions which they shall express. When this can be done it must be useful, but where it is not practicable, the surest way to avoid those discrepancies which have cast so much discredit upon medical evidence, is to spare no pains in collecting the facts which are to be stated in evidence, to view them in all their bearings, and not to rest till the mind is thoroughly made up as to the inferences to which they lead, and, above all, strictly to observe the caution already given, to avoid all bias either for or against an accused party.

The foregoing observations relate chiefly to the mode in which the

* Smith, Analysis of Medical Evidence, p. 128.

medical man should give his evidence; the precautions to be taken in order that his evidence may be admissible still remain to be considered. These precautions may be treated under the heads of Notes, Confessions, and Death-bed declarations.

Notes.—When observing any facts which, at a future time, may become the subject-matter for legal inquiry, the medical man should not trust to his memory, but commit them to writing. This should be done, either on the spot, or as soon as possible after the transaction to which they relate.

These notes may afterwards be used by the witness to *refresh* his memory, but not to supply its place. If the facts thus committed to writing have been entirely forgotten, the notes will be of no use. The following are illustrations of the two rules here stated:—

"On the trial of Sir A. Gordon Kinlock, in Edinburgh, some years since, for the murder of his brother, the medical witness was about to give his evidence respecting the wound of which the deceased died, from notes made some time after the event, when he was stopped by the Lord Advocate, who explained to him the law on the subject."

So much for the time at which the notes should be taken. The following case illustrates the second caution with respect to notes, viz. that they are to be used merely to refresh the memory.

"On a recent trial for poisoning, the medical witness, after having detailed the action of some reagents which he had employed in the detection and identification of the poison, was about to refer to his notes before giving the results of his other experiments. Upon being asked when the notes were made, he answered satisfactorily by stating that they were taken at the time of the observations. The counsel for the prisoner then asked the witness whether he used the notes to refresh his memory, or whether he spoke only from what was written on the paper, without having any precise recollection on the subject. The witness, who did not appear in the least degree to suspect the object of such a question, stated that he spoke only from what he saw written on the paper, as his memory was rather defective. The counsel for the prisoner then objected to the witness's giving the results of these experiments, since he could only speak to the facts from the memorandum which he held in his hand. The counsel for the prosecution contended, that as the memorandum was written at the time of making the observations, its consents were admissible as evidence. But the presiding judge, Mr. Baron Bolland, ruled that the witness could not make use of the notes, because notes were available only to refresh the memory, and not to convey positive information relative to any subject altogether forgotten."

Confessions.—The medical man may receive confessions of guilt from those whom he is called upon to attend professionally, and it is important that he should know under what conditions these are admissible in a court of law.

"A confession, in order to be admissible, must be free and volun-

tary, that is, must not be extracted by any sort of threats or violence, nor obtained by any direct or implied promises, however slight, nor by the exertion of any improper influence." The duty of the medical man with regard to confessions is, therefore, clear. If called upon to receive a confession, he must take care not to hold out any sort of inducement to make the confession; he must receive what is said to him without comment, reduce it to writing as soon as possible, read it over to the person confessing, obtain his signature to it, and countersign it himself.

But the medical man, in receiving confessions, has another duty to perform. He ought to make a careful inquiry into the state of the mind of the party confessing.

The necessity of this caution is illustrated by a case quoted by Dr. Southwood Smith, in which the reputation of several young ladies in a country town was seriously injured, and the whole community thrown into violent commotion, by the voluntary confession of a patient delirious from fever, which was indiscreetly made public. The truth of the statement was subsequently solemnly denied by the patient. The striking case of the murder of Captain Pigot, of the Hermione frigate, is also quoted by the same author. In this instance "more than six sailors voluntarily confessed to having struck the first blow at Captain Pigot. These men detailed all the horrid circumstances of the mutiny with extreme minuteness and perfect accuracy; nevertheless not one of them had ever been in the ship, nor had so much as seen Captain Pigot in their lives." Mr. Finlaison, on whose authority this statement is made, adds, "At the Admiralty we were always able to detect and establish their innocence, in defiance of their own solemn asseverations."* The following instructive case, illustrative of the same point, was reported in the Times newspaper for Nov. 27, 1838:—A poor woman of the name of Grimshaw confessed that she had murdered her child, and she not merely confessed the crime, but minutely described the way in which she had committed it. All the evidence adduced went to prove her strong attachment to the child, shewn during a long illness and under circumstances of extreme privation. It appeared, too, that she had shewn symptoms of insanity. The evidence of the medical men who had examined the body, as well as that of other witnesses, went to establish her innocence. When the evidence was read over in her hearing, and she was asked whether she had any statement to make with regard to the child's death, she seemed much distressed in mind, and said in a low voice, "I thought I had murdered the child, but I will leave it with the doctors to tell whether I did it."

Dying Declarations.—This subject is closely connected with that of confessions. Dying declarations may be stated in evidence, and, so stated, they form an exception to the rule that all evidence in criminal cases must be given on oath. This sort of evidence is peculiar to the

* Lectures on Forensic Medicine, Med. Gazette, vol. xxi. p. 628.

case of homicide. "The general principle on which it is admitted is, that they are declarations made in extremity, when the party is at the point of death, and when every hope in this world is gone: when every motive to falsehood is silenced, and the mind is induced by the most powerful considerations to speak the truth: a situation so solemn and so awful is considered by the law as creating an obligation equal to that which is imposed by a positive oath administered in a court of justice. It is, therefore, evident, that declarations, though proved to have been made by persons in a dying state, are not admissible, unless it also appears that the deceased himself apprehended that he was in such a state of mortality as would inevitably oblige him soon to answer before his Maker for the truth or falsehood of his assertions." "It is not necessary that the deceased should *express* any apprehension of danger, for his consciousness of approaching death may be inferred, not only from his declaring that he knows his danger, but from the nature of the wound, or state of illness, or other circumstances of the case." If any hope whatever be entertained, whether that hope arises spontaneously in the mind, or is suggested by others, death-bed declarations cannot be received in evidence.

Thus, on the trial of Mr. Christie and Mr. Traill for the murder of Mr. John Scott, Dr. Darling being about to state what he had heard Mr. Scott say on his death-bed, was interrupted by the learned judge, Mr. Justice Bailey, with the question, "Did Mr. Scott at that time think himself in danger; did he give up all hopes of recovery?" Dr. Darling. "No; to the last he entertained hopes of recovery?" Mr. Justice Bailey. "The declarations made by a dying man cannot be received as evidence, unless the party at the time of making it were satisfied that recovery is impossible."

"It is a general rule, that dying declarations, although made with a full consciousness of approaching death, are only admissible in evidence where the death of the deceased is the subject of the charge, and the circumstances of the death the subject of the dying declaration." "As the declarations of a dying man are admitted, on a supposition that in his awful situation, on the confines of a future world, he had no motives to misrepresent, but, on the contrary, the strongest motives to speak without disguise and without malice, it necessarily follows, that the party against whom they are produced as evidence may enter into the particulars of his state of mind and of his behaviour in his last moments, or may be allowed to show that the deceased was not of such a character as was likely to be impressed by a religious sense of his approaching dissolution."

Having thus stated the law respecting dying declarations, it will not be difficult to prescribe the course which the medical man ought to adopt when called upon to receive such declarations. As dying declarations are but confessions, made under a more solemn and binding sanction, all that has been said on the subject of confessions is applicable here. The medical man should merely receive the declaration, with-

out putting any leading questions, but confining himself to such inquiries as may be necessary to clear up any ambiguity in the dying man's statements. He should record the very words used, and, if there be time for it, he should commit the declaration to writing, read it to the dying man, and obtain his signature to it. If the declarant's death take place so suddenly that there is no time for this, he should make a memorandum of the conversation at once, while it is fresh in his memory, and before the words used have escaped him. To this document the witness will be allowed to refer when he gives his evidence. Another essential part of the medical man's duty is to ascertain the exact state of the declarant's mind, whether he is calm and collected, or otherwise, whether he is under the influence of any particular bias, or entertains any strong feeling in favour of or against the accused.

Such are the points connected with the admissibility of the medical man's evidence. It still remains to state the usage of our courts of law with regard to *secrets* confided to him in the course of his professional attendance. "It was solemnly decided, in the case of the Duchess of Kingston, that in a court of justice medical men *are* bound to divulge these secrets when required to do so." "If a medical man," said Lord Mansfield on that occasion, "was voluntarily to reveal these secrets, to be sure he would be guilty of a breach of honour and of great indiscretion ; but to give that information which by the law of the land he is bound to do, will never be imputed to him as any indiscretion whatever."

It may be necessary to warn the medical man against taking any part in duels, even though his sole object in being present at them is to save life, and not to destroy it. He should also understand that no witness is obliged to give any evidence which may have a tendency to criminate himself.

In the trial already referred to, that of Mr. Christie and Mr. Traill for the murder of Mr. Scott, the professional man who attended Mr. Scott at the duel was summoned as a witness for the prosecution. In the course of the examination, he was asked whether he could identify the prisoner. Now, it appeared that the witness could have had no difficulty in swearing to the prisoner's identity, for he went in company with him to the duel. An answer in the affirmative would at once have criminated himself. The judge, seeing that he was ignorant of the tendency which his answer might have to inculpate himself, warned him of the dangerous position in which he was placed. In consequence of this, the witness declined answering the question which had been put to him.

The following short summary of the principal contents of this chapter cannot fail of being useful.

1. *As regards the state of the witness's mind.* He should never consider the merits of the case, nor allow his mind to be swayed by prejudice of any sort. He should guard most carefully against any bias in favour of or against an accused party.

2. *As to the mode of giving his evidence.* When he is examined as a *common* witness, he should confine himself strictly to the facts which he has seen; when he appears as a *skilled* witness, he should state his opinion on the facts. He should not be forward to state facts or express opinions which are not actually called for, but, at the same time, he should withhold no statement which is essential to the information of the jury. He should use the plainest and the simplest language, avoiding, as much as possible, technical terms, and all metaphorical expressions. He should quote no authorities, but merely state his own judgment. In cases of difficulty, he should, if practicable, provide the assistance of other medical men.

3. *Circumstances affecting the admissibility of his evidence.* In matters of importance, he should never trust to memory, but take notes, if possible, at the time, or as soon as may be after the facts or occurrences to which they refer. These notes may be used to *refresh* the memory, but not to supply its place. When called upon to receive a confession, he must take care to hold out no promise or threat of any sort. He must receive it without *comment*, reduce it to writing on the spot, read it over to the person making it, obtain his signature to it, and countersign it himself. In doing so, he must not omit to ascertain, to the best of his ability, the state of mind of the party making the confession. Similar rules apply to death-bed declarations. Such inquiries only should be made as are necessary to clear up any ambiguity in the dying man's statements. The very words made use of should be taken down, and if there is time for it, they should be read over to the dying man, and his signature should be obtained to the declaration. If the death take place so suddenly, that there is no time for this, a memorandum of the conversation should be made while the very words used by the dying man are fresh in the memory. In this case, as in that of confessions, every endeavour should be used to ascertain the state of the declarant's mind.

4. The medical man should further understand that he may be required in a court of law to divulge the secrets confided to him by patients; that he may expose himself to a criminal prosecution for taking any part in duels; and that he will not be obliged to give any evidence which would have the effect of criminating himself.

Consult on the subject of this Chapter, Philips and Starkie on Evidence; An Analysis of Medical Evidence, by John Gordon Smith, M.D.; Archbold's Summary of the Law relative to Pleading and Evidence in Criminal Cases, 1843. Also Burn's Justice, by E. V. Williams, title Evidence, of which much use has been made in this Chapter.

CHAPTER II.

PERSONAL IDENTITY. AGE. SEX.

THESE three subjects are thrown into one group, because they have a close connexion with each other; the three questions being frequently raised for the purpose of identifying an unknown party. Thus, supposing the body of a person unknown to be found, it may be necessary to ascertain the sex, and then the age, and afterwards to identify the individual by some marks known to be peculiar to him. In other instances these questions are raised separately. They are arranged in this Chapter in the order which appeared most convenient, the subject of sex occupying the last place, from its connexion with the topics contained in the next Chapter.

PERSONAL IDENTITY.

IDENTITY OF THE LIVING.—*Accidental Resemblance.—Distinction by Marks or Scars.—Family Resemblance.—Effect of Exposure to Fatigue and Hardship.—Change in the Colour of the Hair by sudden Emotion—by Disease.—Fraudulent Discoloration of the Hair.—Substances employed.—Means of Detection.—What Degree and Duration of Light is necessary to enable an Observer to identify another.*—IDENTITY OF THE DEAD.—*Cases.—Determination of the Stature by means of Parts of the Body.—Measurements of M. Sue and of M. Orfila.—Stature determined by the Length of the Cylindrical Bones.*

Questions of Identity are of frequent occurrence in our courts of law. A child claims an inheritance: is he the party he pretends to be? A man who has been robbed is required to identify the person by whom the robbery was committed; and a witness may be examined as to the identity of a party with whom he is acquainted. There is one instance, also, in which a jury may be impanelled for the sole purpose of trying the question of identity, viz. where a prisoner after conviction makes his escape and is retaken. In this case it is necessary to prove that the person who has been apprehended is the same who has made his escape. The question of identity may also be raised as to persons found dead; and in coroners' inquests the very

first step taken is to identify the body or any remains of it which may be found.

The subject of personal identity, then, divides itself into 1. *The Identity of the Living*, and 2. *The Identity of the Dead.*

1. IDENTITY OF THE LIVING.

In identifying living persons the aid of the medical man is rarely required, unless in the case of deformities or injuries, the nature or effects of which he may be called upon to explain ; or where changes have been produced in the external appearance by the application of colouring ingredients to the skin or hair. In these latter cases the medical man may apply his chemical knowledge to clear up the difficulties of the case.

In order to give completeness to the present subject, some questions will be briefly noticed which do not require medical evidence for their solution. There is no doubt that persons having no connexion with each other by relationship or descent may be so alike as not to be readily distinguished. Of this familiar fact the following is a remarkable example.

In the year 1772, one Mall, a barber's apprentice, was tried at the Old Bailey for robbing a Mrs. Ryan of Portland Street. The witnesses swore positively to the identity of the lad, and the whole court imagined him guilty. He said nothing in his defence but that he was innocent, and that he could prove it. His evidences were the books of the court ; to which reference being made, it appeared that on the day and hour when the robbery was sworn to have been committed, the lad was on his trial at the bar where he then stood for another robbery, in which he was likewise unfortunate enough to be mistaken for the person who committed it.

In some instances, where the resemblance has been even more striking, a distinction has been made by means of marks or scars, and in such cases medical evidence has been required.

" An individual was indicted and tried before Judge Livingston, at New York, in 1804, on a charge of bigamy, and the whole evidence turned on the question of his identity. He was called Thomas Hoag by the public prosecutor, but stated himself to be Joseph Parker. Several witnesses swore that they had known him under the name of Thomas Hoag, among whom was a female whom he had married and afterwards deserted. It was stated, that Hoag had a scar on his forehead, a small mark on his neck, and that his speech was quick and lisping. All these peculiarities were found on the prisoner. Two witnesses deposed that Hoag had a scar under his foot, occasioned by treading upon a drawing-knife, and that this scar was easy to be seen, and had been seen by them. On examining his feet in open court, *no scar was to be found on either of them :* and it was further proved that, at the period of his alleged courtship of the second wife

in Westchester county, he was doing duty as a watchman in the city of New York. The jury acquitted him."*

In the case of parties claiming inheritance, much stress has been laid on family resemblance as a means of identification. Thus, in the Douglas case, Lord Mansfield said, "I have always considered likeness as an argument of a child's being the son of a parent, and the rather, as the distinction between individuals in the human species is more discernible than in other animals: a man may survey ten thousand people before he sees two faces perfectly alike, and in an army of one hundred thousand men every one may be known from another. If there should be a likeness of feature, there may be a discriminancy of voice, a difference in the gestures, the smile, and various other things; whereas, a family likeness runs generally through all these, for in every thing there is a resemblance, as of features, size, attitude, and action." It is not necessary to discuss the justness of this opinion, as the medical man is not required to give evidence in such disputed cases of affiliation.

Another circumstance which may give rise to questions of identity is the change which may be produced in an individual by long exposure to fatigue and hardships, or by the long-continued effect of depressing passions. The following is an example:

"A noble Bolognese, named Cassali, left his country at an early age, and engaged in military pursuits. He was supposed to have lost his life in battle; but, after an absence of thirty years, returned and claimed his property, which his heirs had already appropriated to themselves. Although there were some marks which appeared to identify him, yet the change in appearance was so great, that none who remembered the youth were willing to allow that this was the individual. He was arrested and imprisoned. The judges were in great doubt, and consulted Zacchias, whether the human countenance could be so changed as to render it impossible to recognise the person. This distinguished physician in his consultation assigns several causes which might produce such an alteration, as age, change of air, aliments, the manner of life, and the diseases to which we are liable. Cassali had departed in the bloom of youth; he then entered on the hardships of a military life, and if the narrative of the individual in question was to be credited, he had languished for years in prison. All these causes, he conceived, might produce a great change in the countenance, and render it difficult to recognise him. The judges, on receiving this opinion, examined into the physical marks; and as the heirs could not prove the death of Cassali, his name and estate were decreed to him."*

The effect of sudden and violent emotion in producing a change in the colour of the hair is well known; and this change might possibly cause the question of identity to be raised. The same change has

* Beck, p. 409. † Ib. p. 408.

also been produced by disease, as in the following case related by Dr. Gordon Smith.

"I had occasion," he says, "to be at one of the public dispensaries in the western part of the metropolis lately, when a tall, apparently well-made, and remarkably fair woman presented herself. She had been for some time under the care of the gentlemen in attendance for a liver complaint. The singular clearness of her complexion attracted my notice, and the appearance of her eyebrows and eyelashes added to its unusual expression, for they were in a manner *pied*, being a mixture of light-brown and white hairs, of which the latter predominated. She is now about twenty-eight years of age, and the mother of two children. When about the age of thirteen, she was much afflicted with headaches, and did not menstruate till she was nearly twenty. At the former period, however, she went to bed one night during the summer season in her ordinary way and state of health; and about three in the morning was conscious of a sensation like fainting. She got up early (the nights being short) and found that the whole of her hair had become grey. It is now remarkably so; and from inquiries which my friend, her physician, has since made, I learn that this is not confined to the scalp, but extends to the axillæ, pudenda, &c."

Fraudulent discoloration of the Hair.—The question whether it is possible to change the colour of the hair from dark to light was raised in a case which occurred in Paris in the year 1832. A man named Bénoit was suspected of having committed murder, and tried before the Court of Assizes of the Seine. Certain witnesses deposed to having seen him in Paris at two in the afternoon with black hair; while others declared that they saw him at Versailles, with fair hair, at five or six o'clock the same evening. The man's hair was naturally jet black, and it does not appear that he wore a wig. The tribunal summoned Orfila and Michalon, one of the first hair-dressers of Paris, to solve the following question: Is it possible to change the colour of the hair from dark to light? Michalon replied in the negative; but Orfila on the contrary declared that it was possible, and that twenty-six years before (March 3rd, 1806) Vauquelin had read at the Institute a mémoire on the property which chlorine possessed of giving to black hair all the lighter colours, and even of changing it to white. In this case it must be borne in mind that the real question was not whether such a change was possible or not, but whether it could be effected in the short space of three or four hours, of which a considerable part must have been taken up by the journey to Versailles.

This case led to some careful experiments by Orfila, and subsequently by Devergie, in order to ascertain what changes in the colour of the hair might be effected by chemical means. Orfila examined the mode of effecting the change from light to dark, from dark to light, and from light red or chestnut to other shades of colour. Devergie

limited himself to the verification of Orfila's experiments on the effect of chlorine in changing the hair from dark to light.

1. Modes of changing the colour of the hair from light to dark.

One method is by a mixture of charcoal and grease. This is easily detected by its soiling the fingers for days after its application, and by placing a lock of the hair in boiling water: the grease swims on the surface, and the charcoal falls to the bottom of the vessel.

A second method is to moisten hair, previously freed from its oil by liquor ammoniæ, with a solution of nitrate of bismuth. The hair, on being allowed to dry, is covered with the crystallized salt of bismuth. This is removed with distilled water, and the hair is again allowed to dry. Hair thus prepared, on being steeped for a quarter of an hour in a solution of sulphuretted hydrogen, was uniformly changed to black, without being rendered brittle. When the oily matter of the hair was not previously removed, the change of colour was less complete.

The source of the change of colour in this case may be easily detected by treating the hair with dilute muriatic acid, or by a weak solution of chlorine. The hair is by this means restored to its original colour, and the resulting liquid yields on evaporation a white residue, which, on being dissolved in distilled water, has all the characters of a salt of bismuth.

The acetate of lead employed in exactly the same way yielded similar, but less perfect, results. The metal may be detected by the same means as in the case of the bismuth.

A mixture of litharge, chalk, and fresh lime, in the proportion of 3 parts litharge, 3 parts chalk, and 2 or 3 parts lime, was found still more effectual. This being dissolved in water, the hair is kept moist with it for three or four hours, and then allowed to dry. The chalk and oxide of lead attached to the hair are then removed with dilute acetic acid, and, lastly, the hair is rubbed with yolk of egg. The colour of the hair is thus effectually changed without any injury to its texture. These ingredients in variable proportions, according to the degree of change which it is desired to effect, compose the *Tinctura Pompeiana* of the shops, which effectually changes the colour of the hair from light to various shades of brown and black, without in any way injuring its texture. These ingredients can be detected by steeping the hair in dilute nitric acid. This dissolves all the ingredients with effervescence, and there result the nitrates of lead and lime. On testing the solution with sulphuretted hydrogen, we obtain the black sulphuret of lead.

Similar results were obtained by means of the *plombite of lime*, formed by boiling, during an hour and a quarter, 4 parts of sulphate of lead, 5 parts of hydrate of lime, and 30 parts of water. The change of colour is not produced by this agent unless the hair be kept moistened with it for some hours.

Nitrate of silver gave to light hair a violet hue, which became darker by exposure to light. This agent was easily detected by the colour, and by steeping the hair in a solution of 1 part of chlorine to 4 of water. The chloride of silver thus formed is detected by its clotted appearance, its insolubility in water and in nitric acid, and its solubility in ammonia.

A mixture of sulphate of mercury and oxide of copper dissolved in dilute acetic acid was also tried, but answered less perfectly than the preparations of lead. These latter would probably be preferred.

2. Mode of changing the hair from dark to light.

The result of numerous experiments performed by Orfila and Devergie with solutions of chlorine of different degrees of strength, may be thus summed up. Black hair may be changed to various lighter shades; as dark and light chestnut, dark and light blond, yellow, and yellowish white, by being steeped or washed in solutions of chlorine of different strengths, and during a longer or shorter time. Hair combed with a solution of chlorine is but slightly changed even after many repetitions of the process; and there is reason to believe that Orfila erred in supposing that it would be possible to obtain the marked effects produced by soaking the hair in a solution of chlorine if it were merely combed with that fluid for many hours. The chlorine is readily detected by its smell, even after washing the hair as many as fifty times with water; the colour of the hair is peculiar, by no means uniform, and not easily confounded with any natural colour; and the hair itself is hard, stiff, and brittle. These results are in strict accordance with those of my own experiments.

3. Orfila has also examined the question, whether blond, red, or chestnut hair could be changed to other shades without being made black or white. He found that alcohol, ether, and the alkalis had no such power, but that dilute solutions of chlorine could change chestnut and red hair to blond.

The result of all these experiments on the possibility of changing the colour of the hair, is, that all the processes employed require time, and that with due care it is easy to detect the fraud which has been practised. If the question were actually raised in a court of law, it would be easy to expose the fraud by allowing the hair to grow, taking care that the suspected person had no access to the means by which the colour of the hair might be changed; or the shorter process of analysis might at once be used.*

One other question remains to be examined in speaking of the identity of the Living, viz. *What are the least degree and duration of light necessary to enable an observer to distinguish the features, so that the person may be afterwards identified?* That a very short duration of a brilliant light is sufficient for this purpose will appear from the fol-

* See Orfila, Traité de Méd. Légale, vol. i. pp. 127—142, and Devergie, Art. Identité.

lowing case: "A lady, a patient of the writer, lately told him that on one occasion, on her passage from India, she awoke in the middle of the night, and heard some one stirring in her cabin, but could see nothing, it being quite dark; when suddenly the cabin was so completely illuminated by a flash of lightning, that she could see distinctly a man rummaging one of her trunks, and discerned his features so accurately that she identified him next morning: some of the stolen things were found upon him, and he subsequently acknowledged the fact."*

The following curious case gave rise to the question, whether the light produced by the flash of a pistol was sufficient to discover the face of the person firing.

"On the 14th of May, 1808, at 10 P. M. the Sieur Labbe, Mayor of the commune of Foulanges, in the department of the Calvados, in passing on horseback along the highway with the widow Beaujean, his servant, on foot, was fired at with a gun from behind a ditch and through a hedge. He was wounded in the hand. It was an hour and forty-three minutes before the rising of the moon, and the night was dark; yet both Labbe and his servant swore that they recognised the assassins by the light of the discharge. One of the persons accused was arrested, tried, and condemned to death; but an appeal was taken to the court of cassation. The advocate consulted M. Lefevre Gineau, Member of the Institute, and Professor of Experimental Physics in the Imperial College of France, *whether it was possible that the priming, on being inflamed, could produce light sufficient to discover the face of the person firing.* Gineau, with his son, and Dupuis and Caussin, also professors, with several others, retired on the 8th of December, at 8 P. M.. into a dark room, and there Professor Gineau fired several primings, the spectators being stationed at different distances, in order to witness the effect. The light produced was strong, but fuliginous, and so rapidly extinguished, that it was impossible to distinguish the individual firing. 'It was scarcely possible to see distinctly the form of a head, and that of the face could not be recognised.' They then descended into the court-yard of the college, and loaded the gun with powder, but the results on discharging were the same." The sentence was reversed.†

The following case occurred in 1799:—"A man named Haines was indicted for maliciously and feloniously shooting at Edwards, Jones, and Dowson, Bow-street officers, on the Highway. Edwards deposed that, in consequence of several robberies near Hounslow, he, together with Jones and Dowson, was employed to scour that neighbourhood; and that they accordingly set off in a post-chaise on an evening in November, when they were attacked near Bedfont by two persons on horseback, one of whom stationed himself

* Cyc. Pract. Med. Art. Identity, by Montgomery.
† Quoted by Beck from the Causes Célèbres. Vol. iv. p. 329.

at the head of the horses, and the other went to the side of the chaise. The night was dark; but he swore that, from the flash of the pistols, he could distinctly see that the man rode a dark-brown horse, between thirteen and fourteen hands high, and of a very remarkable shape, having a square head, and very thick shoulders, and altogether such that he could pick him out of fifty horses: he had afterwards recognised the horse. He also perceived by the same flash of light, that the man at the chaise door had on a rough shag brown great coat."*

This difficult question is not perhaps satisfactorily decided by the experiments of Professor Gineau; for there can be no doubt that under the influence of strong excitement the perceptions are uncommonly acute, as the actions are unusually rapid. It might happen, therefore, that a person exposed to danger would have a quicker and more distinct perception than an experimenter. The question, then, is one which admits of satisfactory solution only by collecting cases occurring under circumstances of intense excitement. Foderé believes that if the night be dark, and the persons very near each other, such events as those now related are possible.

2. IDENTITY OF THE DEAD.

In cases of death by accident or violence, and in cases of exhumation, the medical man may be required to identify the dead; and he may be called upon not merely to assist in identifying the entire body, but, in certain cases, to examine such parts of it as may be found, with a view of determining the sex, age, and probable stature of the party to whom the fragments belong.

Where the entire body is the subject of examination, the same mistakes may be committed as in the case of the Living. The body, for instance, may be supposed to be that of some person actually living at the time; and more than one instance of this sort is on record.

When the medical man is consulted there is generally some peculiarity or deformity, on the nature of which he is required to state his opinion.

Thus, in the year 1814, Dupuytren identified the person of a murdered man chiefly by observing a malformation of the hip-joint. A similar observation led to the identification of a man who had been buried in a cellar three years. This case was examined by MM. Laurent, Noble, and Vitry at Versailles, in 1828. The body of the unfortunate Maria Martin was identified eleven months after her death by the absence of certain teeth from the upper and lower jaw, and by adhesions of the pleura, and other signs of inflammation occurring before death, it being proved in evidence that Martin had suffered from inflammation of the chest shortly before her mysterious disap-

* Montgomery, loc. cit.

pearance. A doubtful case, tried at Edinburgh, was decided by a dentist, who produced a cast of the gums which he had taken before death. So, also, the remains of the body of the Marchioness of Salisbury, discovered among the ruins of Hatfield House, were identified by the jaw-bone having gold appendages for artificial teeth. The remains of the unfortunate Charles I. were completely identified by the striking resemblance of the countenance, notwithstanding its disfigurement, to the coins and busts, and especially to his portraits by Vandyke. The fourth cervical vertebra was also found divided transversely, the corresponding surfaces being smooth, showing that they had been separated by a heavy sharp instrument. An interesting narrative of this exhumation was published by Sir Henry Halford.*

To show the possibility of mistakes being committed, even where our judgment is formed from deformities, or other peculiarities, the following case, related by Dunlop,† may be cited.

"A resurrection-man was tried for raising the body of a young woman from the churchyard of Stirling, nine weeks after death. The body was discovered and identified by all the relations, not only by the features, but by a mark which they believed could not be mistaken, she being lame of the left leg, which was shorter than the right. There was a good deal of curious swearing as to the length of time after death that the body could be recognised, but the jury was convinced that the *libel was proven*, and gave a verdict accordingly. Now I am certain that this was not the body of the woman who was taken from the churchyard of Stirling, but one that, at least six weeks after the time libelled, was buried in the churchyard of Falkirk, from which she was taken by this man, who also took the other for which he was tried; she also was lame of the left leg: thus, though guilty of the offence laid to his charge, he was found guilty by a mistake of the *corpus delicti*."

Where some fragment only of the body is discovered, as, for instance, an extremity or a bone, is it in the power of the medical man to furnish any useful information as to the probable stature of the party to whom the fragment belongs? Attempts have been made to answer this question in respect of the extremities, by M. Sue.‡ The measurements of M. Sue were made on subjects of medium height, chosen from appearing to him well proportioned. Some of the numbers are averages; others the result of only one measurement. The following table presents his measurements reduced to English feet, inches, and lines:—

* See these cases quoted at length in Cummin's Lectures, Med. Gaz. vol. xix.

† Beck's Med. Jur.

‡ Sur les proportions du squelette de l'homme, in the Mémoires présentés à l'Académie Royale des Sciences, tom. ii. 1755.

Age.	Body.			Trunk.			Upper Extremity.			Lower Extremity.		
	Ft.	In.	Lin.	Ft.	In.	Lin.	Ft.	In.	Lin.	Ft.	In.	Lin.
1 year .	2	0	0	1	2	5	0	9	7	0	9	7
3 years .	2	11	3	1	8	4	1	3	0	1	3	0
10 years .	3	11	0	2	1	7	1	8	4	1	9	11
14 years (average)	4	10	8	2	5	11	2	4	1	2	4	10
20-25 years (average)	5	8	2	2	10	1	2	8	0	2	10	1

Towards the 20th, and from that to the 25th year, the superior border of the symphysis pubis forms the exact centre of the body, and this centre continues constant for the more advanced ages, the only change which takes place in old age being the curving of the spine. Before the adult age, the centre of the body varies according to the age.

These measurements of M. Sue have been repeated by Orfila, both for the subject and for the skeleton.* On submitting these tables to a careful analysis, it appears that the statements of M. Sue must be received with caution. Thus of 44 males, who with 4 exceptions were adults, there were only 7 in whom the length from the vertex to the pubes was exactly equal to the length from the pubes to the sole of the foot; whilst in 23 instances, the former measurement exceeded the latter; and in 14 fell short of it. The greatest difference on either side was $2\frac{1}{3}$ inches English. Again, out of 7 females submitted to measurement, there was not one in whom the above measurements were equal, and the upper half of the body was longest in 6 and shortest in 1. The males on an average were longer from the vertex to the pubes by more than $\frac{1}{3}$ inch, the females by $1\frac{1}{6}$ inch. On pursuing the examination of the tables still further, and throwing together the instances in which the length from the vertex to the pubes happens to be the same, we find a considerable difference in the length from the pubes to the sole of the foot. This will be seen in the following table:—

* Traité de Médicine Légale, tom. i. p. 105.

	Length from Vertex to Pubes.	Length from Pubes to Sole of Foot.		
		Max.	Min.	Diff.
	Ft In. Lin.	Ft. In. Lin.	Ft. In. Lin.	In. Lin
8 Males .	2 9 6	2 10 7	2 7 11	2 8
7 Males .	2 9 0	2 11 5	2 7 0	4 5
2 Females .	2 7 0	2 7 11	2 5 6	2 5
3 Females .	2 6 8	2 6 0	2 4 4	1 8

From this table then, it appears, that in making use of Orfila's measures for the purpose of determining the stature of the body, we might, even if we employed the average, be in error to the extent of $2\frac{1}{4}$ inches. Similar results would be obtained from the table, giving the measurements of the skeleton. On classifying the measurements, moreover, according to the age of the subjects, I find that in the four of 20 or under twenty years of age, the length from the pubes to the sole of the foot exceeds that from the vertex to the pubes by more than $\frac{1}{3}$ of an inch, which is contrary to the rule laid down by M. Sue. For the after ages, with the exception of 40 to 50, the upper measurement exceeds the lower, instead of being equal to it, as is asserted by M. Sue. On turning to the table of measurements made on the skeleton we encounter still more remarkable deviations from the rule laid down ; for in one instance in which the upper part of the body measures 3 feet 1 inch 5 lines, the lower part measures only 2 feet 7 inches 11 lines, being a difference of $5\frac{1}{2}$ inches ; and, in another instance, the numbers are 2 feet $5\frac{1}{2}$ inches for the upper measurement, and nearly 2 feet $11\frac{1}{2}$ inches for the lower measurement, being a difference in the opposite direction of little less that 6 inches. It follows, then, that the statements of M. Sue are much too general to be used for purposes of great accuracy, and that in making use of the more exact measurements of Orfila, as means of determining the stature of the body, we might commit very serious errors. It is scarcely necessary to observe, that to any estimate of the height of the skeleton we must add $1\frac{1}{2}$ to 2 inches in order to have the real stature of the body.

The tables of M. Orfila also comprise measurements of the several cylindrical bones, from which he proposes to calculate the stature of the skeleton and of the living body. A glance at the subjoined table will show how little we can trust to such measurements.

Stature of the Skeleton calculated from the Length of the Cylindrical Bones.—(From Orfila's second table.)												
				STATURE.								
				Max.			Min.			Difference.		
	Ft.	In.	Lin.	Ft.	In.	Lin.	Ft.	In.	Lin.	In.	Lines.	
Humerus 6 obs.	1	1	0	6	1	3	5	9	9	3	6	
Ulna . 7 „	0	10	8	6	1	3	5	5	0	8	3	
Femur 7 „	1	6	1	6	0	0	5	7	0	5	0	
Tibia . 7 „	1	3	0	5	10	6	5	5	0	5	6	
Stature of Living Body, calculated from same data. (From Orfila's first table.)												
Humerus 19 „	1	2	6	5	8	1	5	4	6	3	7	
Ulna . 14 „	0	10	8	5	10	10	5	5	8	5	2	
Femur 12 „	1	5	9	5	9	8	5	4	6	5	2	
Tibia . 11 „	1	2	5	5	9	8	5	4	6	5	2	

It would appear, then, that even if we employ the average numbers, we might be led into error to the extent of more than 4 inches, and in no case of less than $1\frac{3}{4}$ inches.

This minute analysis of the tables of M. Orfila has been rendered necessary by the undue importance which he himself attaches to them ; for he says, " we are certain that it will be possible in the greater number of cases, on consulting these tables, and on having regard especially to the lengths of the femur and humerus, to arrive sufficiently near the truth." Nothing that has been said is intended to prevent the medical man from paying some attention to the length of the cylindrical bones, with a view to form an opinion as to the stature of the body, but merely to caution him against placing too much reliance upon these data.

The following table presents the average measurements in English feet, inches, and lines, obtained from forty-four male and seven female subjects.

	Stature.	Vertex to Pubes.	Pubes to Foot.	Upper Extremity from Acromion.	Femur.	Tibia.	Fibula.	Humerus.	Radius.	Ulna.
Male .	5 6 6	2 9 6	2 9 0	2 5 6	1 5 8	1 2 7	1 2 2	1 0 5	0 9 5	0 10 2
Female	5 1 0	2 7 1	2 5 11	2 2 8	1 4 6	1 1 9	1 1 5	0 11 7	0 8 8	0 9 9

AGE.

Age of the Living.—Position of the Centre of the Body.—The Teeth—Order and Time of Appearance of the first Set—of the permanent Set.—Age of the Dead.—Process of Ossification.

The law makes many distinctions in regard to Age, and defines with much minuteness the privileges, immunities, and responsibilities which belong to the several periods of life. It rarely happens, however, that the medical man is required to give evidence on this point; and the occasions on which his opinion may be required will become less numerous as our system of registration of births comes into more complete operation.

It is chiefly as a preliminary means of identification that the question of age is important, and, like the general question of identity, it divides itself into two parts. 1. The Age of the Living; and 2. The Age of the Dead.

1. MEANS OF DETERMINING THE AGE OF THE LIVING.

Many attempts have been made to give to this subject an air of importance, and much learning has been expended upon it.—The arbitrary division of human life into several periods, the equally arbitrary assumption of certain ages as periods of unusual importance and danger (the climacterics), and the laboured general description of the changes which take place in the external appearance of the body and in the faculties of the mind,—all these are wanting in the precision necessary for medico-legal purposes. The more precise observations of M. Quetelet on the stature and weight of the body, consisting of averages drawn from separate measurements, of which the extremes are very wide apart, are also obviously inapplicable to the determination of age.

The same objection applies to the position of the centre of the body as a test of age. It may be stated, in general terms, that the centre of the body at birth is at the umbilicus; in the adult, at the pubes; for the intermediate ages, at intermediate points, nearer to the umbilicus in the infant, and to the pubes in those approaching the adult age: that in the female, moreover, in consequence of the lower extremities, but especially the thigh bones, being shorter than in the male, the centre of the body is above the pubes. That these statements are very inexact may be inferred from the measurements of Orfila, from which it appears that of 44 adult males only 7 had the centre of the body at the pubes. (p. 24.)

The observations which have been made on the period of puberty in

the two sexes, and of the change of life in the female, also show the little dependence that can be placed on these occurrences as signs of age.

During the periods of childhood and boyhood we possess more precise, though still very imperfect, means of ascertaining the age in the successive appearance of the teeth both of the first and second dentition.

The following is the order and probable period of the appearance of the first set or milk-teeth. It is merely necessary to premise that the teeth of the lower jaw precede those of the upper.

1. Central incisors . . . 5— 7 months.
2. Lateral incisors . . . 6— 9
3. First molars . . . 8—15
4. Canine teeth . . . 15—18
5. Second molars . . . 18—24

The milk-teeth then amount to 20. They make their appearance at different times in different children, beginning earlier, and ending later, in some than in others. Some are born with the incisors above the gums; others have no teeth till the end of the second year; and others, again, live many years without having a single tooth. Too much reliance, therefore, must not be placed on this test of age.

The following table presents the order and probable time of the appearance of the permanent set of teeth, with the number of teeth existing at each age.

AGE.	INCISORS.		Cuspis.	BICUSPIDATI.		MOLARS.	
	Central.	Lateral.		Anter.	Poster.	Anter.	Poster.
7 years	..	..	..	..	..	4	..
8 years	4	..	..	..	..	4	..
9 years	4	4	..	..	..	4	..
10 years	4	4	..	4	..	4	..
11 years	4	4	..	4	4	4	..
12—12½	4	4	4	4	4	4	..
12½—14	4	4	4	4	4	4	4

It is important to ascertain how far this table may be employed as a standard of comparison in determining the age of children, especially as the laws relating to the employment of children in factories turn chiefly on distinctions of age. We are indebted to Mr. Saunders for some very interesting inquiries on this point.*

* The Teeth a test of Age.—By Edwin Saunders.

He selected the two periods of 9 and 13 years, and observed the number of teeth existing at those periods in many hundred children. The following are the results at which he arrived.

Out of 457 boys *at 9 years of age*, 219, or nearly one-half, had the number of teeth stated in the foregoing table; namely, 4 central incisors, 4 lateral incisors, and 4 anterior molars. Of 251 girls, of the same age, 168, or considerably more than one-half, had the same number of teeth. Throwing the two sexes together, 387 out of 708 or more than $\frac{4}{7}$ of the entire number had the full complement of teeth. The remainder in both sexes consisted of children who in place of the full number of 4 of each kind of teeth, had a smaller number of one or the other. Thus in a large proportion of the children, one, two or three, out of the four lateral incisors were wanting, and so of the other teeth. In 52 cases only the lateral incisors were entirely wanting.

If, then, in each column of the foregoing table, opposite the age of 9 years, we substitute for the number 4, the numbers 1, 2, 3, or 4, and assert that wherever any of those numbers of teeth are found to exist, there we may assume that the child is in its 9th year, our assertion will be borne out in 656 out of 708 cases, or in about 13 in every 14 cases. This statement will be seen more distinctly in the following table.

457 Boys.	251 Girls.	708 Boys and Girls.	INCISORS.		Anterior Molars.
			Central.	Lateral.	
219	168	387	4	4	4
77	41	118	4	3	4
91	27	118	4	2	4
5	3	8	4	1	4
34	4	38	4	0	4*
6	3	9	3	3	4
10	0	10	3	2	4
3	1	4	3	1	4
10	4	14	3	0	4*
2	0	2	2	2	4

The analysis of the observations made on children in their 13th year is not so easily effected, but the result is represented in the following table, in which the mark (—) stands for any number of teeth less than 4, and (0) indicates the entire absence of teeth.

* 8 years.

223 Boys.	109 Girls.	332 Boys and Girls.	INCISORS.		Cuspis.	BICUSPIS.		MOLAR.	
			Cent.	Later.		Anter.	Poster.	Anter.	Poster.
103	65	168	4	4	4	4	4	4	4
9	6	15	4	4	4	4	4	4	—
7	5	12	4	4	4	4	—	4	—
1	2	3	4	4	4	—	—	4	—
88	28	116	4	4	—	—	—	4	—
7	0	7	4	4	—	—	—	4	—
215	106	321							
3	1	4	4	4	0	—	—	4	—
1	0	1	4	4	—	—	0	4	—
3	0	3	4	4	—	4	—	4	0*
0	1	1	4	4	—	4	0	4	0
0	1	1	4	4	0	4	4	4	0†
1	0	1	4	4	0	—	0	4	0‡
8	3	11							

From this table it appears that rather less than half the boys, and more than half the girls, and as nearly as possible half of the two sexes taken together, had the full complement of teeth stated in the first table as occurring in children of 12½ to 14 years of age; that by far the majority of both sexes had one or more of the several orders of teeth; and that in 11 instances only were some or other of the teeth entirely wanting. In three cases a child of 13 might have been mistaken for one of 12 to 12½ years; in one instance a child of the same age for one of 11, and in one instance also for one of 10. In a vast majority of instances, however, we should be justified in stating that a child having one or more of the several teeth indicated in the first table opposite to the period of 12½ to 14 years had completed its 13th year; and we should be more likely to be right in the case of a girl than in that of a boy.

It is highly probable, from these considerations, that by substituting in the first table the numbers 1, 2, 3, or 4, for the number 4, we shall have a very useful, though by no means a certain, test of age.

The permanent set of teeth is not complete till the *dentes sapientiæ* have made their appearance. This usually happens from the 18th to the 25th year, but it sometimes takes place much later; and one case is recorded by Dr. Hamilton of a man of 80 who died from the irritation produced by cutting his wisdom tooth.

* 12—12½ years. † 11 years. ‡ 10 years.

Among the signs of age on which some stress has been laid is the white line around the margin of the iris,—the *arcus senilis*. I may here state, that I have seen this circle completely formed in one man of 42, and in another of 39, and that I have known it absent in a man of 79, and in another of 85.

All the other indications of age in the Living are deceptive, and a general description of them can answer no useful purpose. Cases of premature old age, of unusual vigour at advanced periods of life, and of that rare restoration in the aged of some of the structures and functions proper to an early period of life (rejuvenescence), will sometimes prevent us from even guessing at the age with any accuracy.

2. MEANS OF DETERMINING THE AGE OF THE DEAD.

The process of ossification enables us in the case of the Dead to determine the age with some degree of precision. The following history is drawn from the observations of Orfila,* which are chiefly founded on those of Béclard.†

At 2 *months*, ossification of the os magnum, os cuneiforme, and os cuboide.

At 4 *months*, ossification of the branches of the os hyoides.

At 5 *months*, ossification of the lower apophyses of the os hyoides.

At 6 *months*, an osseous point in the ensiform cartilage, and in the anterior arch of the atlas. Bony union of the body and alæ majores of the sphenoid bone.

6 *months to* 1 *year*. Ossification of the cribriform and nasal plate of the ethmoid bone.

1 *year*. An osseous point in the first bone of the coccyx, in the great tuberosity of the humerus, in the head of the femur and tibia, in the first cuneiform bone, in the coracoid process of the scapula, and two points in the odontoid process of the second cervical vertebra. There is bony union of the two portions of the posterior arch of the vertebræ, and of the several portions of the temporal and ethmoid bones.

2 *years*. Ossification of the epiphyses of the metacarpal and metatarsal bones, an osseous point in the inferior extremity of the radius and fibula, in the transverse process of the seventh cervical vertebra, and in the base of the sphenoidal cells; and bony union of the two points of the odontoid process.

2½ *years*. Patella and lesser tuberosity of the humerus ossified.

3 *years*. Bony union of the body of the second vertebra with the odontoid process, and of the three portions of the fourth and fifth bones of the sacrum.

3 *to* 4 *years*. Ossification of the great trochanter of the femur, the cuneiform bone of the carpus; and bony union of the styloid process of the temporal bone.

4 *years*. Ossification of the second and third cuneiform bones.

* Vol. i. p. 106. † Anatomie Générale, p. 495.

4 *to* 5 *years.* Ossification of the trapezius and lunar bones, formation of the ethmoid cells, and bony union of the body and processes of the second cervical vertebra.

5 *years.* Ossification of the upper extremity of the fibula, of the epiphyses of the phalanges of the carpus, and of the epiphysis of the third phalanx of the great toe.

6 *years.* Ossification of the lower extremity of the ulna, of the pisiform bone, and of the epiphyses of the first phalanges of the 2nd, 3rd, 4th, and 5th toes.

7 *years.* Ossification of the internal condyle of the humerus, and of the first piece of the coccyx.

7 *to* 8 *years.* Osseous point in the olecranon.

8 *years.* Osseous point at the upper extremity of the radius.

8 *to* 9 *years.* Ossification of the scaphoid bone of the carpus, and of the posterior epiphysis of the os calcis. Bony union of the two osseous points forming the head of the humerus.

12 *years.* Osseous point on the inner edge of the lower articular surface of the humerus.

13 *to* 14 *years.* Ossification of the lesser trochanter of the femur.

13 *to* 15 *years.* Three portions of the os innominatum firmly united by bone. Cartilages of larynx sometimes found partially ossified.

15 *years.* Osseous point in the inferior angle of the scapula. Bony union of the parts of the sacrum to each other, of the coracoid process to the body of the scapula, and of the two portions of the os calcis.

15 *to* 16 *years.* Osseous point in the summit of the acromion.

15 *to* 18 *years.* Osseous point in the sternal extremity of the clavicle, bony union of the sphenoidal plate to the body of the sphenoid bone, and formation of the spinous processes of the sacrum.

15 *to* 20 *years.* Ossification of the last bone of the coccyx.

16 *years.* Osseous point in the cotyloid cavity, in the head of the thigh bone, and in the head and tubercles of the ribs.

17 *to* 18 *years.* Ossification of the margin of the scapula. The epiphyses of the phalanges of the fingers and toes joined to the bodies of those bones.

18 *years.* Osseous points in the summit of the transverse and spinous processes. Bony union of the two trochanters and of the head of the femur to the body of the bone.

18 *to* 19 *years.* Bony union of the epiphyses of the metatarsal bones.

18 *to* 20 *years.* Bony union of the epiphyses of the metacarpal bones, of the lower extremity of the femur, and of both extremities of the humerus to the body of their respective bones.

18 *to* 25 *years.* Union of the body of the sphenoid to the occipital bone, of the three pieces of the tibia, and of the marginal epiphysis of the ilium.

21 *years.* Union of the lower extremity of the femur to the body of that bone.

20 *to* 25 *years.* Union of the first piece of the sternum to the rest of the bone, of the transverse and spinous processes of the vertebræ to their bodies, and of the tubercle of the rib to the body of the bone.

25 *years.* Formation of the laminar epiphyses of the iliac surface of the sacrum.

25 *to* 30 *years.* Complete union of the first to the second bone of the sacrum, and of the epiphisary discs of the vertebræ.

40 *to* 50 *years.* Union of the ensiform cartilage to the lower extremity of the sternum.

40 *to* 50 *or* 60 *years.* Union of the sacrum and coccyx.

The state of the osseous system will also furnish some clue to the age, especially during the latter periods of life. The internal cavities of the bones increase, from the absorption of the osseous matter, and the bones from the same cause become lighter. The bones of the head are solidly united, but, on account of the absorption of their diploe, become thin. The lower jaw becomes shallow, the alveolar processes are absorbed, and the angle again becomes obtuse, as in childhood. The spinal column is curved. The cartilages of the larynx and ribs are completely ossified. The osseous tissue generally is more dense, dry, and fragile, and abounds in earthy materials. In advanced age, moreover, the heart and arteries become more or less extensively ossified.

SEX.

Sex of the Living.—*Legal relations.—Doubtful Sex.—Male Organs resembling those of the Female. Androgyni.—Female Organs resembling those of the Male. Androgynæ.—Blending of some of the Characters of the two Sexes.—Directions for examining Cases of Doubtful Sex.*—Sex in the Dead.—*Characters of the Osseous System.—Case in Illustration of the Subjects of the present Chapter.*

THE medical man may be required to distinguish the Sex of the Living or of the Dead. This subject, then, like the foregoing, divides itself into two parts. 1. The means of ascertaining the Sex of the Living; and 2. The means of determining the Sex of the Dead.

SEX OF THE LIVING, INCLUDING THE SUBJECT OF DOUBTFUL SEX.

We may be required to determine the sex of the new-born child, or of the adult. "In the case of a new-born child, the determination of the sex may be of vital importance, if it be the issue of parents possessed of real or landed property: its right of succession mainly depends on its sex; and should it die, the disposal of the property which it would have enjoyed as a male must be arranged in accordance with the evidence of its sex." "In reference to tenancy by the courtesy, the right of the father to possess a life-interest in the real property belonging to his wife, may depend on the ascertainment of the sex of their new-born infant. For if the wife be tenant in tail-male, and delivered of a son born alive, the husband's right is secured;

whereas, if she have only a daughter, the husband is not entitled to be tenant by the courtesy, because such issue was excluded from succession by the nature of the tenure."

It may be necessary also not merely to ascertain the sex, where that can be done, but also, in doubtful cases, to determine which sex most predominates; for it appears, on the authority of Coke upon Littleton, that "an hermaphrodite, which is also called Androgynous, shall be heire, either as male or female, according to that kind of the sexe which doth prevail, and accordingly it ought to be baptized."

The same difficult question has arisen at a later period of life, as in the case quoted by Beck of a young nobleman of doubtful sex, whose parents consulted a medical man that they might know whether he should be educated as a male or female.

There are three different conditions of the organs of generation which may present difficulties to the medical examiner.

1. The male organs may resemble the female.
2. The female organs may resemble the male.
3. The organs of the two sexes may be blended, some one or more organs of the one sex being superadded to, or substituted for, those of the other.

1. The male organs may resemble the female. (Androgyni.) The most common malformation of this sort is where the scrotum is divided into two parts, which sometimes contain the testicles, while at others those organs, one or both, are situated behind the external ring. The cleft scrotum corresponds to the labia of the female. There is also in some cases a *cul de sac* corresponding in situation with the vagina. The penis is short and imperfectly formed, and, like the clitoris, imperforate. The canal of the urethra opens at its base, or in the perineum, near the anus. It is often enlarged at its commencement, so as to resemble the vagina; and instances have occurred in which sexual intercourse has taken place through this enlarged canal of the urethra. From the position of the opening of the urethra beneath the imperforate penis, these persons are called *hypospadians*.

The existence of the testicles in the folds resembling the labia, the communication of the opening beneath the imperforate penis or in the perineum with the bladder, the absence of all communication of the *cul de sac* which occupies the place of the vagina with the cavity of the uterus, and, in the adult, the absence of menstruation,—will enable us at once to distinguish the sex. It will scarcely be necessary to examine the conformation of the body generally, which, in most of these cases, nearly approaches that of the male. The development of the muscles, the tone of the voice, the tastes and habits, are more those of a man than of a woman. Nevertheless there are cases in which an enlargement of the breasts and a preference for the society of the male exist, which in the absence of a careful examination of the organs of generation, might lead us into error. In other instances the sexual passion is absent. Many cases of this sort are related in books, and the

majority of them are referred to by Beck.* There are also preparations illustrative of these malformations in most of our museums.

Sometimes the penis, whether well or ill-formed, is found confined to the scrotum by a particular formation of the integuments. This malformation, with the other deviations from the normal structure just described, occurred in two cases, one a negro, the other a European, of which Cheselden gives engravings.† In the case of a child baptized and brought up as a girl, Mr. Brand by a slight incision liberated the restricted parts, and proved to the parents that they had mistaken the sex of their child.‡

There is still another malformation belonging to this division, and which might possibly give rise to doubt as to the sex, viz. a deficiency of the urinary bladder, and of the lower and anterior portion of the abdominal parietes, the place of which is occupied by a red and sensitive mass of an irregular fungus-like substance, with the ureters opening upon it. This defect is generally accompanied by important alterations in the organs of generation. "The urethra is deficient, and the penis consequently imperforate. It is also very short, never exceeding two inches even in the adult. The vesiculæ seminales open near the fungous mass above-mentioned, or in the urethra, or in a small tubercle at the root of the penis. The testicles are generally natural, either contained in the scrotum, or they have not descended. The sexual appetite in some of these individuals has been weak; in others strong; in others altogether wanting."§ The persons who have this malformation are called *Epispadians.*

2. The female organs may resemble the male. (Androgynæ.) An enlarged clitoris is the most common form of malformation belonging to this class. Sir Everard Home relates an instance of this kind occurring in a Mandingo negress,‖ and other cases occurring in Europeans are also on record. None of them presented any real difficulty, though some have excited great interest. The absense of testicles from the labia, the presence of a vagina and uterus, the occurrence of menstruation, either of these singly or all combined, render the distinction easy.¶

Another malformation belonging to this class is a prolapsus uteri. Sir Everard Home mentions the case of a Frenchwoman who was shewn as a curiosity, and whom he himself examined. The prolapsus was evident on inspection. She pretended to have the power of a male.** The following case is from Mahon††: "Margaret Malaure came to Paris in 1693, dressed as a man. She considered herself as possessing the organs of both sexes, and stated that she was able to

* Elements of Medical Jurisprudence, pp. 75 et seq.
† Anatomy, p. 314.
‡ Quoted in Brewster's Edin. Encyc. art. Hermaphrodites.
§ Dr. Duncan, jun. in Edin. Med. and Surg. Journal, vol. i. pp. 54—58.
‖ Phil. Trans. vol. lxxxix. p. 157.
¶ See the cases illustrative of this malformation detailed at length in Cyc. of Anatomy and Physiology, art. Hermaphroditism.
** Phil. Trans. vol. lxxxix. p. 157. †† Vol. i. p. 96, quoted by Beck.

employ both. Her person was exhibited; and several physicians and surgeons agreed with the common opinion so much, as to give certificates that she was an hermaphrodite." She was consequently ordered to change her name and wear male attire. "Saviard, an eminent surgeon, was, however, incredulous. He examined her in the presence of his brother practitioners, and found that she had a prolapsus uteri which he reduced." The difficulty thus solved, she was allowed again to resume her female attire.

3. The organs of the two sexes may be blended, some one or more organs of the one sex being superadded to, or substituted for, those of the other.

Many cases of this malformation are on record. An ovary has been found on the left side and a testis on the right, in cases reported by M. Sue,* Professor Rudolphi,† and Professor Mayer,‡ as also in a case dissected by Varole.§ The reverse malformation occurred in the case of Hubert Jean Pierre,‖ and in a case mentioned by Arnaud.** In other instances again the external organs have approximated closely to the female type, and the internal to the male, or the reverse.††

It is unnecessary to add that no case of real hermaphroditism is on record. "No monster has been described, having both a penis and clitoris; nor with a testis and ovarium on the same side—we may venture to say, with testes and ovaria; nor having a prostate and uterus."‡‡ There can be little doubt that what was really a prostate has been called a uterus, and that the testicles and ovaries have been mistaken for each other.

In examining doubtful cases the following points must be taken into consideration:—The growth of the beard and hair on different parts of the body; the formation of the shoulders and hips; the development of the breasts; the fulness of the thighs; the voice; the desires excited by the presence of either sex; the presence or absence of the menstrual discharge or of vicarious discharges. In the sexual organs we must note the size of the organ corresponding to the penis or clitoris, and whether it is perforate or imperforate; the form and mode of attachment of the prepuce; the presence or absence of parts corresponding to the nymphæ; if the labia majora exist, the presence or absence of the testicles. The openings which exist must be carefully examined with a sound, to ascertain whether they communicate with the bladder or uterus, or are merely *culs de sac.* The presence or absence of the hymen and carunculæ myrtiformes should also be noticed.

* Morand de Hermaphroditis, Paris, 1749.

† Abhandl. König. Akad. der Wissenschaft zu Berlin, für 1825, s. 60.

‡ Case of Durrge or Derrier. See Cummin's Lectures. Med. Gaz. vol. xix.

§ Mém. de la Soc. Méd. de Paris, tom. iv. p. 342.

‖ Mém. de l'Acad. de Dijon, tom. ii. p. 157. ** Op. cit. p. 283.

†† For cases of this kind occurring both in man and animals, see the very complete and learned essay of Dr. Simpson, in the Cyclopedia of Anatomy and Physiology, art. Hermaphroditism.

‡‡ Ed. Med. and Surg. Journal, vol. iii. p. 208.

SEX OF THE DEAD.

When the entire body is submitted to our inspection we shall find no difficulty in distinguishing the sexes, except in the rare instances of malformation just described, and dissection will enable us to determine the sex where it would scarcely be possible to come to any decision during life. It is chiefly, however, when the skeleton or some part only of it remains, that we shall be required to determine the sex after death.

The skeletons of the two sexes closely resemble each other before the age of puberty, but in the adult there are some differences which will enable us to distinguish them.

The *bones* of the female are lighter, more cellular, less marked by asperities and less curved by muscular action, than those of the male: the processes are less strongly marked, and the joints smaller. The *skull* of the female is smaller, more oblong, less depressed at the sides; the face is more oval, the frontal sinuses less strongly marked, the nostrils smaller, the jaws and teeth smaller, and the chin less prominent. In the *chest* we observe that the sternum is shorter and more convex, the ensiform cartilage thinner, and ossified later in life, the ribs more delicate and their cartilages longer, and the antero-posterior diameter longer than the lateral. The *vertebral column* is longer, and the bodies of the vertebræ are deeper in the female than in the male. The *pelvis*, however, of the two sexes presents the most striking contrast. The ossa ilia are more expanded and horizontal in the female; the sacrum more concave; the pubes more shallow; the angle formed by the descending rami more obtuse; the pubic arch wider; the tuberosities of the ischia more widely separated; the foramen ovale larger, more triangular, and more oblique; the acetabula wider apart; the thigh consequently more oblique, and the inner condyle of the thigh-bone longer; the entire pelvis more shallow but larger in its outlets than in the male.

The following are the dimensions of a well-formed female pelvis:—

Brim.

Antero-posterior diameter	. . .	$4\frac{1}{2}$ inches.
Transverse „	. . .	$5\frac{1}{4}$ „
Oblique „	. . .	$5\frac{1}{8}$ „

Inferior openings.

Antero-posterior diameter	. . .	4 inches.
Transverse „	. . .	4 „

The following condensed report of a singular case, investigated at Paris about ten years since, and in which proof of identity was successfully deduced from the remains of a female who had been interred eleven years, will form a fit conclusion to the present chapter. The official report, of which this is an abstract, was drawn up by

Orfila, Chevallier, Barruel, and Boys de Loury, the medical examiners engaged in the investigation.*

"In the year 1821, a widow lady, of the name of Houet, residing in the city of Paris, disappeared; and certain persons, Bastien, Robert, and Robert's wife, who had taken the house, No. 81, Rue de Vaugirard, were suspected of having made away with her. A judicial inquiry was pending for some time in the Court of Assize; but the accused, for want of evidence, had been set at liberty. Not long ago, however, some information was obtained touching a body said to have been buried for about eleven years in a particular garden. An investigation was accordingly set on foot; and by dint of patient and ably directed research, such satisfactory evidence was procured of the identity of the remains, and of the manner of the death, that the prisoners were convicted and punished.

"The first part of the inquiry—the juridical exhumation—was conducted by M. Boys de Loury. After excavating different parts of the garden for about five hours, one of the workmen hit upon a hollowed spot, in which there were bones. The greatest care was taken to uncover them with the least possible disturbance; they were evidently those of a human body, reduced almost to a perfect skeleton. A drawing was made of the parts *in situ*. The figure reposed on the left side; the head was bent forward on the neck; the vertebral column was curved; the right fore-arm was raised, so that the bones of the hand nearly touched those of the face. The pelvis was turned obliquely upwards, resting on the left haunch. The thigh-bones were raised considerably, and the legs were crossed beneath them. The colour of the remains generally was between an ochre and a brown; and when the earthy matter was removed from some of the long bones, the uncovered parts were found to be of a deep red colour.

"The grave was four feet deep, funnel-shaped, measuring five feet and a half in length at its upper part, but at the bottom only two and a half: its greatest breadth was about two feet. Some lime-stone had been placed over the body, so as to form a sort of vault. Having made these general observations, the particular parts were next examined. The skull was small and lengthy in its shape: it seemed, by the way, from the position of the head, that the body had been thrown into the grave head foremost. The parietal bones were very yielding; the sutures were well knit; the teeth white, and had been used with care; three molars were wanting, and one of the incisors was carious. A small quantity of light-coloured or ruddy hair was found, having some grey mixed with it.

"The state of the neck was particularly striking. The third, fourth, fifth, and sixth cervical vertebræ, as well as the right clavicle, were held together by a blackish mass, in the composition of which there could not be recognised any tissue. *This mass was surrounded at its lower part by several twists of a cord two lines in diameter;* the

* Cummin's Lectures, Medical Gazette.

cord was in a very decayed condition, and no knot could be found upon it. Minute attention was subsequently given to this *pièce de conviction*, and the obvious inference, that the deceased had been *strangled*, was fully borne out by all the direct and collateral circumstances.

"The bones were small and delicate; those of the extremities not at all curved by muscular motion: the marks of the insertion of the muscles were few and faint. The cranium was small and oblong from front to rear; the ossa innominata largely spread out; the cavity of the pelvis not deep; the anterior part of the sacrum concave; the subpubic holes triangular; the cotyloid cavities wide asunder: finally, the upper opening of the pelvis presented exactly the diameters usually found in well-shaped females. So that putting all these characters together, there cannot be a doubt but that this was the skeleton of a woman.

"Among the bones of the left hand was found a gold ring, of small diameter, carved in *facettes;* and several small well-formed finger-nails were also discovered. Some portion of cloth, probably part of a stocking, was found near the legs; but, upon exposure to the air, it rapidly crumbled to dust.

"Other reporters, MM. Orfila, Marc, Barruel, and Chevallier, were afterwards added to M. Boys de Loury; and three or four elaborate documents were drawn up, of the first of which the following is the *résumé*:—

"'From the preceding facts, we feel ourselves justified in concluding,

"'1. That these bones are those of a *human* skeleton.

"'2. That the skeleton is that of a *female*.

"'3. That this female had attained the *age* of from 60 to 70.

"'4. That her stature was about 4 feet 8 or 9 inches (nearly 5 feet Eng.).

"'5. That the hair of the female, which was of a bright blond colour in youth, was mixed with grey at the time of her death.

"'6. That the hands were small.

"'7. That during life, the bones had never suffered any injury.

"'8. That this woman died of strangulation, and that the act was, to all appearance, homicidal; and

"'9. That the body must have lain for several years in the earth.'

"A very ample report follows, stating the processes which were adopted for analyzing chemically the various debris about the body. Thus the earth at the bottom of the grave was examined, as were also certain concretions which were taken to be biliary calculi, and the softened masses in the neighbourhood of the pelvis; but nothing very important was detected in this search.

"Justice was satisfied. The prisoners, who had been long suspected, were brought to trial, condemned, and sentenced to forced labour for the remainder of their lives."

CHAPTER III.

IMPOTENCE. RAPE. PREGNANCY. DELIVERY.

In the last chapter the subject of sex was examined as a means of identification; in this it is considered in relation to the generative function, and comprises the subjects at the head of the chapter.

IMPOTENCE.

Legal Relations. — Grounds of Divorce. — Impotence in the Male. — Physical Causes. — Moral Causes. — Impotence in the Female. — Physical Causes. — Sterility. — Rules for the Examination of Persons supposed to be Impotent.

The subject of impotence is generally examined together with that of sterility, but without sufficient reason; for the question of Sterility, considered apart from that of Impotence, is never raised in our courts of law. The term Impotence, in the sense in which it is usually employed, presupposes sterility as a natural consequence. In the female, moreover, to whom the term steril is alone properly applied, it is obvious that we have no means of deciding the question of sterility, except as it forms a part of the general question of impotence. Having once determined that there is no physical impediment to sexual intercourse, we can go no further, at least during life, and have no means of determining whether or not the female is barren. For these reasons, the subject of sterility is only cursorily considered in the present chapter.

The medical man may be required to ascertain whether or not a party is impotent. 1. In suits for divorce. 2. In accusations of rape; and, 3. In cases of contested legitimacy. In the present chapter the subject has a general application, but relates chiefly to questions of divorce.

Marriage, regarded as a mere contract entered into by two parties, presupposes, as do all other contracts, a free exercise of the will, ability to fulfil the terms of the contract, and compliance with certain requisite formalities. The first two conditions are the only ones with which the medical man has to do.

With regard to the first condition, the free exercise of the will, the medical man may be required to ascertain whether either or both parties at the time of the contract were capable of exercising a sound

discretion, and whether they betrayed any imbecility of mind or not. In rare instances, too, he may be required to determine whether the contracting parties were of too tender or too advanced an age.

The earliest age recognised by law for the formation of the marriage contract is 14 in the male, and 12 in the female. "But the ecclesiastical courts look rather to the habit, strength, and constitution of the parties; they only inquire whether they be *habiles ad matrimonium*, and not how many years they may have numbered; and, indeed, the common law will hold even infantile marriages, solemnized with due formality, valid, when the parties on reaching the ages just stated, do not demur to the contract."

It is with the question of ability to fulfil the principal term of the contract — the procreation of children — that the medical man has chiefly to do; and this he may be required to ascertain by inspection and examination of the parties.

The law of England, as laid down by Blackstone, is this:—"A total divorce (that is, a divorce *à vinculo matrimonii*, as distinguished from a partial divorce *à mensa et thoro*) is given whenever it is proved that corporeal imbecility existed *before* the marriage. In this case, the connexion 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." On this subject Mr. Chitty says, "In a suit of nullity by reason of the alleged impotency of the husband, a certificate twelve years after the marriage, that the wife still was *virgo intacta*, although *apta viro*, coupled with two several confessions by the husband of his incapacity, and with proof that the woman's health had suffered, though the husband had not given in his answer, and that he had removed into France, and had refused to undergo surgical examination, was holden sufficient in the ecclesiastical court."

It appears, then, that in suits of nullity of marriage the medical man will have to examine not merely into the fact of impotence, but to determine whether or not it existed at the period of the marriage.

The subject of impotence divides itself into impotence in the *male* and impotence in the *female*.

1. IMPOTENCE IN THE MALE.

Of this there are two classes of causes,—*Physical*, and *Moral* or *Mental*.

The *Physical Causes of Impotence* are *a*. Age. *b*. Malformation or defect of the penis. *c*. Defect or disease of the testicles. *d*. Constitutional disease or debility.

a. *Age*.—A too tender or too advanced an age may be regarded as

a cause of impotence. Before puberty, that is, before the seminal secretion has taken place, complete sexual intercourse may be assumed to be impossible. As this age is variable, it will not be possible to define it ; we must therefore rest our judgment on the general conformation of the body, the character of the voice, the growth of the hair, and the development of the organs of generation themselves.

But impotence may arise from the infirmity of age as well as from immaturity ; and the question arises, At what age do the powers of procreation cease ?

This question has acquired an unusual interest in consequence of the celebrated Banbury Peerage Case, which was brought before the House of Lords and decided in the year 1813. The principal argument urged against the claimant was, that the ancestor under whom he claimed could not have been the son of Lord Banbury, because that nobleman was eighty years old when the child was born. In reference to this question of age, Sir Samuel Romilly expressed himself as follows : "The objection to the age of Lord Banbury may at once be dismissed. The law of England admits of no age at which a man may not become a father ; and many medical authorities may be cited to show that this rule is founded on reason. Dr. Gregory, of Edinburgh, whose name must be familiar to all admirers of science, says upon this subject,—'Magna autem de his rebus differentia ; decantantur enim exempla senum in castris Veneris strenue merentium, postquam centum annos compleverant ; neque sane dubium, aut adeo rarum octogenarium patrem fieri.' Haller likewise pronounces a man of ninety to be capable of procreating. Parr became a father in his one hundred and fortieth year. In short, the liberality of the law on this subject is excessive ; for there is no age, from seven upwards, at which a man is denied the privilege of having children."* On the same occasion, Lord Erskine made the following remarks : "But what evidence is there of Lord Banbury having been impotent ? There is no statute of limitations on the powers and faculties of man. Instances of robust longevity might be cited still more extraordinary. Sir Stephen Fox married at the age of seventy-seven, and had four children ; the first child was born when the father was seventy-eight, the second and third were twins in the following year, and the fourth was born when the father was eighty-one. Parr became a father when even his son was of a more advanced age than Lord Banbury."† The Attorney General, Sir Vicary Gibbs, who opposed the claimant's title in the House of Lords, evidently felt the objection on the score of age to be far from valid, for he shifts his argument as rapidly as possible from it to more secure ground. He says, "age may not be a proof of impotency, but it is evidence of it. The probability of the Earl's begetting a child at eighty is very slight, and it is not increased

* A treatise on the Law of Adulterine Bastardy, by Sir Harris Nicolas, p. 444. † Ibid. p. 508.

by the appearance of another child two years later. Instances have been adduced of these extraordinary births, but none have been cited in which a man at eighty-two, having begotten a son, had concealed the birth of such son."* We may conclude that the objection here urged did not appear to the objector himself to have any great weight from the slight stress he lays upon it, and from his anxiety to escape to an objection altogether different. With regard to age, then, it is clear that no limit is fixed by law, or can be assigned by science, at which the power of procreation ceases. Old age, provided it be a robust old age, is obviously no impediment to procreation ; and in the case of Lord Banbury there is ample evidence of his having been capable of strong exercise until within a short period of his death.†

b. Malformation or defect of the penis.—In this place it is necessary to premise that it is now generally admitted, that impregnation may take place, provided the semen be introduced within the orifice of the vagina ; it will also be shown, when speaking of the possibility of impregnation taking place in a state of unconsciousness (p. 85), that the venereal orgasm is not essential to render sexual intercourse fruitful. Small size or partial mutilation of the penis, therefore, cannot be accounted as a cause of impotence. Provided what exists or remains of the penis is sufficiently large to admit of introduction within the orifice of the vagina, and there be no impediment to the emission of semen, fruitful intercourse may take place. Thus a removal of the glans penis, of the corpora cavernosa, (as in the case quoted by Dr. Paris from Piazzoni,) or of a very considerable portion of the organ, (as in the case of a soldier quoted by Frank, in whom a large part of the penis was carried away by a musket-ball,) did not produce impotence. A still more extreme case is related by Mr. Hurd,‡ in which, in consequence of disease followed by amputation, there was only a very small protrusion of the organ on pressure, and yet the patient after the amputation became the father of two children. An amputation of the penis close to its root would in all probability cause impotence, though, for the reasons already assigned, fruitful intercourse is perhaps not altogether impossible.

For the same reason, the opposite malformation, viz. an excessive development of the penis, whether normal or as a consequence of disease, can scarcely be regarded as a cause of impotence, inasmuch as though intercourse, in the ordinary sense of the term, were impossible, still impregnation might take place.

Another malformation of the penis (*hypospadia*) was described in the last chapter (p. 34). Here the urethra opens either upon the penis, behind its usual situation, or in the perineum. In most of these cases, the question of impotence admits of easy solution. When the

* Sir H. Nicolas, op. cit. p. 452.
† Ibid. p. 508. Lord Erskine's Defence.
‡ London Med. and Surg. Journal, vol. iv.

orifice of the urethra is situated on the penis itself, especially on those parts of the organ which would be introduced into the vagina during sexual intercourse, the party cannot be accounted impotent. Several cases of this kind are recorded. "Belloc says, that he knew a person at Agen, in whom the orifice was at the bottom of the frænum, and who had four children resembling their parent, and what is still more remarkable, two of them had the same malformation."* Frank has seen a case of this sort transmitted through three generations. Kopp saw a peasant near Hanau with five children, in whom the opening was 11½ lines from the extremity of the glans.† Dr. Blundell says, "I know an individual, the father of a very fine child, marked strongly with the paternal resemblance, and in this person the urethra opens in the corpus spongiosum, between one and two inches of the glans."‡

Beck has collected seven other cases of hypospadians who had children.§

In the cases now quoted, the orifice of the urethra was situated upon the penis: in other rare instances the opening of the canal is in the perineum. It is obvious that in such cases, provided the penis be well-formed, nothing more is necessary in order that fruitful intercourse may take place than that the semen should be introduced into the vagina. Sir Everard Home has published an interesting case of fistula in perineo, in which the celebrated John Hunter accomplished this purpose by causing the semen to be injected by means of a syringe immediately after coition. The wife afterwards proved with child, and Mr. Hunter entertained no doubt of the impregnation having been due to this cause. Spallanzani's experiments upon animals were instituted, according to Sir. E. Home, several years after this proposal of Mr. Hunter was attended with success.‖ This fact should render us cautious in giving an opinion in cases of supposed impotence; for it is possible that the semen which has been ejected from an opening remote from the penis may come into contact with the mucous membrane at the orifice of the vagina, and thus cause impregnation.

Another cause of impotence, about which less difficulty exists, is the malformation already noticed under the head of doubtful sex, viz. *epispadia*. Here the orifice of the urethra is above the penis or prostate; and as it is extremely improbable that the semen can be introduced into the vagina, such persons must be impotent, unless, as in the case just related, artificial means are resorted to. In some of these cases, the penis is entirely wanting, in others bifid, and in almost every instance unusually short.¶

In addition to the foregoing causes of impotence, may be mentioned, congenital phymosis, and a confinement of the penis to the scrotum by

* Belloc, p. 50. † Dict. des Sciences Méd. art. Hypospadias. ‡ Lancet vol. ii. N.S. p. 771. § Pp. 55-6 note. ‖ Philosophical Transactions, 1799. ¶ Ed. Med. and Surg. Journal vol i. pp. 43, 132.

a peculiar formation of the integuments. Both these malformations are curable;* they are not, therefore, *absolute* causes of impotence. Paralysis of the muscles of the penis, severe strictures, and disease of the prostate gland (the two latter of which act by preventing the expulsion of the semen) are also mentioned among the causes of impotence.

c. Defect or Disease of the Testicles.—The loss of both testicles early in life occasions impotence; where they are removed after puberty, the question may arise whether the party is necessarily rendered impotent. That sexual intercourse may take place for a considerable period after the removal of both testicles is proved by a case related by Sir Astley Cooper.† For about twelve months after the loss of the second testicle he had emissions in coitu; after that period coitus at distant intervals, but without emission: sexual intercourse became less and less frequent, till it ceased entirely at the end of ten years. Sedillot‡ cites a case on the authority of Boyer, in which, after the removal of both testicles, a man became a father; and Beck states that similar results have occurred with animals recently castrated. Otto, too, mentions one case in which he found plenty of apparently good semen in the vesicula seminalis of a man who had castrated himself a year before, in a fit of melancholy.

Much unnecessary discussion has arisen as to the possibility of a man having only one testicle being capable of fruitful intercourse, and as to the impotence of persons in whom the testicles have not yet descended. With regard to the question of impotence in cases where there is only one testicle, it is only necessary to observe, that, as impregnation cannot be supposed to depend upon the quantity of semen introduced into the vagina, we may safely affirm that one sound testicle is to the full as efficient as two. So also the mere position of the testicles cannot be reasonably supposed to alter their functions; it is therefore unnecessary to inquire whether those in whom the testicles are situated in the abdomen or in the inguinal canal are capable of procreating their species. If we can discover the testicles either in the scrotum or in the groin, and we have reason to believe that they are healthy and well-formed, we may safely decide that the parties are not impotent. If the testicles are to be found neither in the groin nor in the scrotum, our opinion must be founded on the general appearance of the body, the sound of the voice, the growth of the hair, &c.; and these cases are the only ones which can present any difficulty.

The question of impotence has sometimes been raised in cases in which the testicle is unusually small. This is not a sufficient ground for inferring impotence. Thus, though Dr. Baillie relates the case of a mid-

* Brand, by a slight incision, effected a cure in a case of this latter kind, in which the child, a boy, had been brought up as a girl. Brewster's Ed. Cycl. Art. Hermaphrodites.

† Med. Chir. Rev. vol. xviii. p. 390. ‡ Manual, p. 17.

dle aged man, in whom the size of the testicles did not exceed that of the extremity of the little finger, and there was a total absence of sexual desire, the following case, given on the authority of Mr. Wilson, shows that we are not always justified in regarding such persons as impotent. "I was some years ago consulted by a gentleman on the point of marriage, respecting the propriety of his entering into that state, as his penis and testicles very little exceeded in size those of a youth of 8 years of age. He was 26, but had never felt desire until he became acquainted with his present wife. Since that he had experienced repeated erections, with nocturnal emissions. He married, became the father of a family, and those parts, which at 26 were so small, at 28 had increased to the usual size of those of an adult man."*

Of the *diseases* which affect the testicles, some act by causing a wasting of their structure, others by entirely changing their texture. To the former class belong Elephantiasis and Cynanche parotidea. Foderé witnessed several cases of this latter kind in deserters condemned to labour on the canal at Arles. Larrey also states, that many soldiers of the army of Egypt were attacked with a similar complaint. The testes lost their sensibility, became soft, and diminished in size until they were no larger than a white French bean. No venereal disease had preceded these attacks. When both testes were affected with this atrophy, the patient became impotent—the beard grew thin, and the intellect weak. He attributes it to the use of the brandy of dates.†

Organic diseases of the testicle, such as scirrhus, medullary sarcoma, &c., will cause impotence, but we cannot safely pronounce the subject of the disease to be impotent unless the entire structure of both testicles is affected.

Allied to the diseases of the testicles are certain mechanical causes which prevent the secretion of semen by pressing on the spermatic vessels. Congenital scrotal hernia of a large size has been stated by Foderé as a possible cause of impotence; and the Medical College of Western Prussia declared a voluminous and irreducible hernia a sufficient cause of divorce.‡ Very large tumours involving the genital organs, or situated upon the lower part of the abdomen or upper part of the thighs, would of course occasion impotence by rendering sexual intercourse impossible.

d. Constitutional disease or debility.—The diseases most likely to produce impotence, are those which affect the nervous system, more especially diseases of the spine, whether arising from internal causes or from mechanical injury. With these exceptions, diseases, unless accompanied with great debility, will not prevent fruitful sexual intercourse. When extreme debility exists, we are justified in assuming that sexual intercourse is impossible. Certain medicines may be classed among the causes of impotence, such as opium, tobacco, and

* Lectures on the Urinary and Genital Organs, p. 424.
† Larrey, vol. i. p. 260. ‡ Metzger, p. 494.

spirituous liquors long taken to excess: coffee, camphor, and nitre, have been mentioned as causing impotence, but with what justice it is difficult to say. These causes are not permanent.

Onanism, or early and too frequent sexual indulgence, has sometimes proved an effectual cause of impotence. Devergie quotes the following case from Henricus ab heers.*

"A young man, brought up in a rich family, and arrived at the age of puberty, consulted that skilful physician, confessing to him that since his tenth year, he had had very frequent familiarities with young girls, *accoutumées à exercer sur lui des attouchemens lascifs*, adding that since that period he had entirely lost the power of erection. He had travelled a long time, and had taken successively the advice of several French physicians. He went to the waters of Spa, and his state was ascertained with care by the physician of whom I have just spoken. The sensibility and the weakness of the genital organs were so great, that at the least touch, and without any sort of sensation or of sexual desire, the young man discharged a fluid similar to whey ; this excretion continued day and night, every time the urine was passed, or on the slightest friction of the linen. A host of remedies had already been employed, and Henricus ab heers having wisely regarded the malady as incurable, the young man would not attend to his advice; and as he was very rich, he continued to travel in Italy, in France, in England, in Germany, in the hope of recovering the rights of virility. He did not fail, according to custom, to find several physicians, ill-informed. and very prolific of illusory promises of a complete cure. At length, after six years of travel, of vain experiments, and useless expenses, the young man went back to the skilful physician, who had spoken to him with so much frankness, and to whom he regretted not having given his confidence."

Moral or Mental Causes of Impotence.—Excessive passion, timidity, apprehension, disgust, and other workings of the imagination, have been known to occasion impotence. Such of them as are in their nature transitory, as excessive desire, are curable; but aversion has proved a permanent cause of impotence. This cause existed in the case of the Earl of Essex, who admitted his inability to know the Countess of Essex, but denied his impotence as to other females.† Devergie extracts the following case from the Gazette de Santé, 1785: "A man of 36 years was united to a female aged 26; both enjoyed perfect health; but the husband could not emit, though the erection and stiffness of the penis were complete; and he was forced to retire before the consummation of the act. This circumstance is the more remarkable, that the same man has not experienced with other persons that obstacle to the emission of semen; and that he had even had children by a former marriage."‡

* Obs. Med.

† See Hargrave's State Trials, vol. i. p. 315; or abstract by Beck, p. 54.

‡ Devergie. Cas de Nullité de Marriage.

2. IMPOTENCE IN THE FEMALE.

The causes which prevent sexual intercourse in the female are, 1. *Narrowness of the vagina*, existing in all subjects before the age of puberty; and in rare instances in the full grown adult. In the latter, this cause may be removed by the continued use of emollients, and by careful dilatation. It is therefore one of the curable causes of impotence.

2. *Adhesion of the labia*, whether the result of accidental inflammation, or, as is said to be the case in some countries, of inflammation designedly set up.

3. *Absence of the vagina*, of which instances are related by Foderé, Dr. Mott, and others.* In some of these cases the uterus is also absent, and the place of the vagina is occupied by cellular membrane, or by a substance of greater density. It is needless to state that the impotence is here incurable.

4. *Imperforate hymen.* This malformation is by no means of infrequent occurrence. As the impediment may be removed by the knife, it belongs to the class of curable causes.

5. *Tumours occupying the vagina*, as polypi, scirrhous formations, prolapsus uteri, vesicæ, &c.

In addition to these mechanical causes of impotence, there are others which, without positively preventing sexual intercourse, render it so difficult, that they may fairly be classed among the causes of impotence. These act by occasioning extreme suffering. The following are some of the more important.—Unusual shortness of the vagina; inflammatory or malignant diseases of the vagina or uterus; extreme sensibility of the parts; a fistulous communication between the vagina and rectum; internal piles. Some of these are obviously curable, others admit of no relief.

Sterility. Those permanent causes of sterility which are not at the same time causes of impotence, such as absence of the uterus, the rest of the genital organs being well-formed, closure of the Fallopian tubes, or of the neck of the uterus, &c., are for the most part of such a character as not to be discoverable during life. Besides these, there are curable causes of sterility, as of impotence, such as profuse discharges, menorrhagia and leucorrhœa, and alterations in the character of the secretions of the vagina and uterus.† There are also other causes of sterility little understood, as is proved by the possibility of females steril with one husband becoming fruitful with another. Promiscuous intercourse is one of the acknowledged causes of sterility, but of a temporary nature, as is shown by the fruitfulness of married convicts who had been previously prostitutes.

* See Beck, p. 64.

† M. Donné has shown that these secretions, in females apparently in good health, are sometimes such as instantly to destroy the seminal animalcules.

The subject of sterility is of little importance in a medico-legal point of view, as the question of sterility apart from that of impotence, is very unlikely to be mooted in a court of law.

A few directions as to the mode of conducting examinations in cases of alleged impotence will conclude this subject.

1. We should note the age, general appearance, habit of body, and state of health, of the person complained of, and ascertain what diseases he or she may have previously laboured under.

2. The sexual parts should be carefully examined; the urethra of the male should be sounded, and the state of the prostate ascertained.

3. No manipulations of a gross or indelicate kind should be practised, as they are both unnecessary and inconclusive.

4. No artificial stimulus should be employed; though the use of cantharides and other provocatives has been recommended on high authority. We are not justified in committing any offence against decency, even where the object in view is one of importance.*

Our attention, then, will be chiefly directed to the physical causes of impotence, and we shall have to determine not merely their presence or absence, but the length of time that they have existed; for in order to obtain a divorce, it must be proved that impotence existed before marriage.

RAPE.

Definition.—Physical Signs.—The Hymen.—Caution with respect to Disease.—Spots of Blood and Semen.—Characters of Semen and Seminal Spots.—Question of Consent.—Violation during Sleep.—Pregnancy following Rape.—Directions for Examination in Cases of alleged Rape.—Case in Illustration.

The legal definition of rape is "the carnal knowledge of a woman forcibly and against her will."†

Until recently, rape was a capital offence, as was also the carnal knowledge of a female under ten years of age. The carnal knowledge of a female above the age of ten years and under the age of twelve years was punished by imprisonment with or without hard labour. A late statute (4 and 5 Vict. cap. 56) substitutes for the punishment of death, that of transportation for life.

In the case of adults, the law makes no distinction between the married and the single, the chaste and the unchaste; the medical man, therefore, may have to examine persons placed under very different circumstances, which will cause the physical signs of rape to vary materially. The law, also, makes no limitation as to the period after the

* See Cummin's Lectures, Med. Gaz. vol. xix.

† Blackstone's Commentaries.

alleged commission of the offence at which an accusation may be preferred. This also tends to increase the difficulty of a medical inquiry.

Rape being defined as "the *carnal knowledge* of a woman forcibly and against her will," a question has arisen as to the meaning of the term *carnal knowledge*. Does it imply penetration and emission, or penetration only.

The statute (9 Geo. IV. cap. 34) is explicit upon this point. It runs thus: "And whereas upon trials for the crimes of buggery and rape, and of carnally abusing girls under the respective ages herein-before mentioned, offenders frequently escape by reason of the difficulty of the proof which has been required of the completion of these several crimes; for remedy thereof be it enacted, that it shall not be necessary in any of those cases to prove the actual emission of seed, in order to constitute a carnal knowledge, but that the carnal knowledge shall be deemed complete upon proof of penetration only." This law, which was passed in 1828, would seem to have settled the question of emission; but scarcely three years had elapsed, before the question was again laid open to discussion on the occasion of a trial before Mr. Justice Taunton, which took place in August, 1831. The female proved penetration, but could not prove emission. The counsel for the prosecution, therefore contended that this was a case which came under the provision of the late law. The judge, however, said that all that constitutes carnal knowledge should have happened. The jury must be satisfied from circumstances that emission took place; and although it was not necessary specifically to prove it, yet the circumstances should be such as to infer it. The prisoner was accordingly acquitted.

This decision, which was obviously at variance with the statute already cited, was in the following year overruled. In the case of Rex *v.* Cox, at the Worcester assizes, in 1832, before Justice Littledale, the jury found that there had been penetration, but no emission from the prisoner; and the judge after passing sentence on the prisoner, reserved the case for the consideration of the fifteen judges. They held the conviction to be right.

It appears, then, that emission is not necessary to constitute carnal knowledge, and that the offence is therefore complete on proof of penetration only. But here another difficulty arises, as to the meaning which attaches to the term *penetration*. Does it mean introduction of the male organ within the vagina, or merely between the labia? or if within the vagina, to what extent? Here, too, legal decisions and opinions are at variance. Chitty observes,* "it will suffice to prove the least degree of penetration, so that it is not necessary that the marks of virginity should be taken from the sufferer." The case on which this statement is founded, is that of a girl ten years of age, where two surgeons swore that the hymen was entire. "But

* Vol. ii. p. 312.

as this membrane was admitted to be in some subjects an inch, in others an inch and a half, beyond the orifice of the vagina, Ashurst J. left it to the jury whether any penetration was proved: *for if there were any, however small*, the rape was complete in law. The jury found the prisoner guilty." * But in the case Rex *v.* Gammon, tried before Mr. Baron Gurney for a rape on a child under ten years of age, when Mr. Woollett, a surgeon, deposed that he found considerable local inflammation about the parts of the child, that the hymen had been recently ruptured, and that he had no doubt that penetration had taken place, Baron Gurney observed, "I think, that if the hymen is not ruptured, there is not a sufficient penetration to constitute this offence. I know that there have been cases in which a less degree of penetration has been held to be sufficient, but I have always doubted the authority of these cases; and I have always thought and still think, that if there is not a sufficient penetration to rupture the hymen, it is not a sufficient penetration to constitute the offence." † This decision of Baron Gurney has since been overruled; for in the case of Regina *v.* M'Rue, where the prisoner was indicted for the capital offence of carnally knowing a child under the age of ten years, and the surgeon who examined the child stated that her private parts internally were very much inflamed, so much so, that he was not able to ascertain whether the hymen had been ruptured or not, Bosanquet J. (Coleridge J. and Coltman J. being present), in his summing up, inter alia, observed,—"It is not necessary, in order to complete the offence, that the hymen should be ruptured, provided it is clearly proved that there was penetration; but when that which is so very near to the entrance has not been ruptured, it is very difficult to come to the conclusion that there has been penetration so as to sustain a charge of rape." The prisoner was found guilty of an assault, and sentenced to two years' imprisonment.‡ In a still more recent case,§ the prisoner Hughes was charged with having feloniously ravished Mary Ann Wesley. The facts of the case were very clearly proved by the prosecutrix, a girl between eleven and twelve years old, and by a woman who detected the prisoner committing the offence; but with respect to the penetration a surgeon was called, who deposed to the appearances in and about the child's private parts, and stated his belief that penetration had taken place, but that the hymen, which in the prosecutrix was placed at the usual distance from the opening, had not been ruptured. Coleridge J. summed up the case to the jury, and desired them to find whether there had been penetration, and whether it had or had not proceeded to the rupture of the hymen. The jury returned a verdict of guilty, finding that there had been penetration, but that the penetration had not proceeded to the rupture of the hymen. The case was

* East's Crown Law, i. 428. Case of Rex. *v.* Russen, Oct. 1771.
† 5 Carrington and Payne's Reports, 321.
‡ 8 Carrington and Payne, Aug. 27, 1838.
§ Regina *v.* Hughes, 1841. Ib. 9.

reserved for the consideration of the judges, when Coleridge J. said, "I reserved this case from respect to my brother Gurney, on account of a dictum of his.* There is an express decision on this point by the twelve judges,† and my brother Gurney says that he does not now hold the same opinion. There is therefore nothing in the case."

It appears, then, that the least possible introduction of the male organ within the orifice of the vagina, even short of the rupture of the hymen, and without the emission of semen, constitutes a rape, provided it be done forcibly and against the will of the female.

In all accusations of rape, therefore, it is necessary to prove, 1. forcible penetration, in this sense of the term ; and, 2. in the case of females above twelve years of age, that the force was used against the will of the complainant. The subject, therefore, divides itself into two parts—the question of penetration, or in other words, the *physical signs* of rape, and the question of consent. On the first question the medical man may be required to give evidence, on the second the court will have to decide on the evidence of other witnesses.

PHYSICAL SIGNS OF RAPE.

These signs must, of course, vary with the age and condition of the sufferer, being, *cæteris paribus*, more strongly marked in those who have not had previous sexual intercourse, in the young child, and in those in whom the parts are naturally small, than in those who have had previous sexual intercourse, have borne children, or in whom the parts are naturally large. The marks of violence would also be less distinct if the offence were committed during the menstrual period, when the parts are dilated and relaxed. The period which has elapsed since the commission of the offence will also materially modify the physical signs of rape, for it is generally admitted that the effects of violence disappear after the lapse of a few days. The marks of violence and the degree of inflammation resulting from it will also be greater in the child and virgin, in whom the parts are more vascular than in those who have had frequent intercourse. All these points should be taken into consideration in estimating the degree of violence which has been used.

Though, from the explanation already given of the meaning of the term penetration, it is unnecessary to prove, in the case of those who have not had previous sexual intercourse, that the hymen has been ruptured, still, as the rupture of the hymen affords incontrovertible proof of penetration in any sense which the law is likely to attach to that term, it will be necessary to consider the value of the presence or absence of the hymen in connexion with accusations of rape.

The Hymen.—Strange as it may appear, there has been much difference of opinion among authors as to the very existence of the hymen. Devergie and Beck both give long lists of those who affirm

* In the case of Rex *v.* Gammon, see supra. † Rex *v.* Russen, see supra.

and deny its existence. Among the former are Dulaurens, Bohn, Dionis, Ambrose Paré, Palfyn, Pinæus, De Lamothe, Buffon, Fallopius, Vesalius, Columbus, and Mahon; among the latter, Zerbus, Fabricius, Riolan, Rigmore, Albinus, Ruisch, Morgagni, Winslow, Haller, Desault, Diemerbroek, Heister, Gavard, Sabatier, Cuvier, Zacchias, Brendel, Teichmeyer, Mayer, Blumenbach, Belloc, Boyer, Cloquet, Denman, Foderé, and Orfila. The latter class has the advantage both in numbers and authority.*

Orfila states that he has examined more than 200 subjects, and has never found it wanting. Gavard, who devoted much attention to this subject, found it in the fœtus, in the new-born infant, in young women from 23 to 25 years of age, and in one of 50 years old. Bennach of Marseilles saw it in a woman of 60. Devergie himself has found it invariably present in new-born infants, and has met with it in women of different ages exposed at the Morgue. Of these one was 65 and another 72 years old. The same author has twice observed the labia minora united through the whole extent of their free edge, and leaving above a small aperture corresponding to the meatus urinarius. In another case a false membrane existed internal to the labia minora, and closed the vagina, leaving above a small opening for the urine. On cutting through this false membrane, the hymen was found posterior to it quite perfect. Devergie concludes from a careful review of all his authorities, that the hymen is an almost constant formation, and that the differences of opinion which have existed in former times have arisen from the great varieties discoverable in its form and size.

The most usual form of the hymen is that of a semilunar fold, bounding the entrance of the vagina below, and of which the extremities lose themselves behind the labia minora in the circumference of the aperture of the vagina. Its convexity is behind and its concavity before. Another form of the hymen is that of a circular membrane, perforated in the centre, and adhering by its entire circumference to the opening of the vagina. In a third case the hymen fills up the entire orifice of the vagina, with the exception of a small opening above corresponding to the meatus urinarius. Lastly, the most unusual form is that of filaments of mucous membrane uniting the carunculæ myrtiformes. From all this Devergie concludes, that in 99 cases out of 100 the hymen is to be found, and recognizable by marked characters.

At birth the hymen is limited in extent; little by little, and especially during the period which precedes puberty, it grows. Its free edge then becomes relaxed and folded, so that there is reason to believe that when the rupture takes place it is chiefly in its folds or depressions, and that it is in this way that the carunculæ myrtiformes are formed. These remnants of the membrane afterwards undergo changes, become hard, are rounded after child-bearing, but rarely if ever entirely disappear.

In addition to these carunculæ myrtiformes, Boyer describes two

* Devergie, des Attentats à la Pudeur. Beck, p 89.

projections situated posterior to the hymen, which are nothing more than the projecting extremities of the anterior and posterior columns of the vagina. The pyramidal tubercles with fringed edges, three, four, five, or six in number, as they form the remains of the hymen, may be regarded as conclusive proof of the previous existence of that membrane.

From what has been stated there can be little doubt of the existence, in by far the majority of females, of the hymen, in some one of the forms already described, nor can there be any difficulty in ascertaining its existence or its recent destruction by violence. The recent destruction of the hymen would, of course, furnish conclusive evidence of the recent employment of force, and if it coexisted with other marks of violence on the parts of generation and on the person of the female, there could be no reasonable doubt of the commission of a rape, as far as that crime can be proved by physical signs.

On the other hand, the absence of the hymen, and the substitution for it of the carunculæ myrtiformes, would prove that the hymen had been destroyed at some earlier period; and supposing it to be alleged that the female previous to the accusation of rape was a virgin, this circumstance might be thought to disprove her assertion. It is scarcely necessary, however, to state that the hymen may be destroyed by other force than that employed in sexual intercourse; from within, if the aperture be small, by the first menstrual flux, or by the accumulation of other discharges; from without, in consequence of accident, or by the intentional introduction of foreign bodies for lascivious purposes. The membrane may also be destroyed by disease, or it may be originally wanting, as in a case related by Capuron. The absence of the hymen, therefore, is no proof that a female has had previous sexual intercourse.

On the other hand, the presence of the hymen must not be accounted a certain sign of chastity, inasmuch as sexual intercourse has taken place, and children have been born, and yet the hymen has remained intact. Thus Ambrose Paré tells us of a mother who applied to him to examine the membrane, and on dividing it, it was seen to be of the thickness of parchment. Ruisch relates a similar case of a female during labour, in whom he had to divide not only the hymen, but a second membrane placed farther back; and immediately after the operation the child was born. Capuron also relates a case where the expulsion of the child was powerfully impeded by the resistance of the hymen. He incised the membrane, which had naturally but a small aperture, and shortly after a pair of large and lively children were born. Bandelocque quotes the case of a woman whom he delivered, and whose hymen he was about to rupture, had not the head of the child saved him the trouble. Lastly, Tolberg quotes a case observed by the elder Meckel, and illustrated by a drawing: here a woman preserved her hymen circular and tense after having given birth to a fœtus of five months, enveloped in all its membranes.

The presence of the hymen, then, is no proof of chastity, nor is its

absence evidence of the reverse. At no time a sign of any great value, it is now become less necessary than ever to insist upon it, as proof of penetration is held to be complete even where the membrane remains intact. It is only necessary to add, by way of explaining the apparent anomaly of its existence in married and pregnant females, that there is naturally very great difference in the size of the parts of generation in different females, and that at the menstrual period and during delivery they undergo a very considerable degree of dilatation, and are so relaxed as to admit the passage of bodies of considerable size in both directions. The effect also of habitual discharges in causing a relaxed state of the parts must not be overlooked.

Besides the intact condition of the hymen, other signs of virginity have been enumerated, as the fresh colour, firmness, and elasticity of the labia, the entire state of the fourchette, the narrowness and rugose state of the vagina, and a plump and elastic condition of the breasts. The difficulty attending intercourse, the pain which the female suffers, the rupture of the hymen and the flow of blood, have also been mentioned as signs of previous virginity. All these signs are fallacious. The condition of the labia already described is not destroyed by repeated acts of intercourse, and in the state of the breasts many widows and mothers may compare with undoubted virgins. The fourchette may remain unruptured after repeated intercourse, and even after child-bearing; and the narrow and constricted state of the vagina is not only not peculiar to virgins, but it may be artificially imitated by the use of astringents, whilst the opposite state may be induced by the leucorrhœal discharge, or by profuse menstruation. It is also present, as has been already stated, during the menstrual period. As to the other supposed signs of virginity, viz. the difficulty of a first connexion, the pain alleged to attend it, and the show of blood,—these are still more fallacious, as all of them may occur from relative disproportion.

The difficulty of ascertaining whether or not a female has had previous sexual intercourse, and the possibility of the usual signs of virginity remaining after long habits of unchastity, is well illustrated by the following case, related on the authority of M. Parent Duchatelet.*

"Several years ago, two young women of genteel appearance were attacked in the public streets by some young men, who called them gross and opprobrious names, and told the passers by that they were nothing better than common prostitutes. Some good-natured persons resented this conduct, and took the girls' part. A complaint was lodged on their behalf against their defamers, and the latter were summoned to appear before a magistrate. The defendants pleaded a justification, while the females, on the contrary, stoutly insisted on their purity; they even offered to submit to a personal inspection by a medical examiner,—which the opposite party dared them to do.

* "La Prostitution dans la Ville de Paris."

A sworn inspector, a clever and conscientious man, was appointed by the magistrate, and the result of his investigation was this,—That it was totally out of his power to say anything certain in regard to one of the females; she might or she might not be a virgin; but for the other, she *probably* had had some intercourse with men, but he could not assert the fact positively. The issue of the dispute I know not; but this is certain, that it subsequently came out that these same young women had actually been for some time entered on the registers of the police, and one proof of their being anything but virgins was, that they had both been, on several occasions, affected with the venereal disease."

Devergie enters into minute details in his description of the parts of generation in the young child, in the adult virgin, and in those who have had previous intercourse. He particularly insists on a peculiarity in the parts of generation of young children, which he has verified by repeated examinations, viz. a great separation between the labia at their upper part, the reverse obtaining after puberty, and especially in those who have had repeated sexual intercourse, or borne children.*

The preliminary question as to the value of the hymen, and of other alleged marks of virginity being discussed, the next inquiry is, as to the signs of forcible defloration.

These consist in marks of violence on the organs of generation, proportioned to the force employed, the resistance offered, and the relative disproportion of the parts. If the sufferer has not previously had sexual intercourse, there may be, in addition to marks of injury on the labia, rupture of the hymen and fourchette. If the injury be recent the parts will be found lacerated, abraded, and covered with blood; if of some standing, there will be signs of recent inflammation, with increased heat and swelling of the genitals and profuse mucous discharge, at first tinged with blood. In those who have had sexual intercourse, the marks of violence will be, cæteris paribus, less distinct. These appearances will present themselves if the parts are inspected soon after the commission of the crime; but at the end of three or four days the inflammation will have subsided, the parts may be entirely healed, and nothing may remain to point out the injury which has been inflicted.

The discovery of blood on the spot where the crime was committed, or on the clothes, will strengthen the inference to be drawn from the appearance of the organs of generation, and the discovery of seminal spots on the linen will be still more decisive.

All these marks may exist, and yet no rape may have been committed, for a first intercourse, with full consent, would give rise to the same appearances; hence it will be necessary to search for further evidence of violence having been used. This will be found on the person of the sufferer in the shape of bruises, especially on the

* Devergie "Attentats à la Pudeur."

groins, thighs, and knees, and on the arms and chest. Nor, if great resistance be offered, will the person of the culprit escape without some marks of that resistance, in the shape of slight bruises or scratches. His linen may also present stains of blood or semen. Marks of injury on the persons of the culprit and sufferer will furnish the best evidence of active resistance having been offered at some period or other of the offence. The clothes may also be torn or rumpled in the struggle.

Marks of violence, then, on the external parts of generation, corroborated by bruises on other parts of the person, form the principal physical signs of rape. Now, the question is,—can these marks of injury to the parts of generation be simulated by disease or imitated by the party herself who brings the accusation of rape? Both these questions may be answered in the affirmative.

In the first place. *Appearances similar to those produced on the organs of generation by violence may be occasioned by disease.*

We owe our first knowledge of this important fact to Dr. Percival. "Jane Hampson, æt. 4, was admitted an out-patient of the Manchester Infirmary, February 11, 1791. The parts of generation were highly inflamed, sore, and painful; and it was stated by the mother, that the child had been as well as usual till the preceding day, when she complained of pain in making water. This induced the mother to examine the parts affected, when she was surprised to find the appearances above described. The child had slept two or three nights in the same bed with a boy fourteen years old, and had complained of being very much hurt by him during the night. Leeches and other external applications, together with appropriate internal remedies were prescribed; but the debility increased. and on the 20th of February the child died. A coroner's inquest was held; previous to which the body was inspected, and the abdominal and thoracic viscera found free from disease. From these circumstances Mr. Ward, the surgeon attending the case, was induced to give it as his opinion that the child's death was caused by external violence; and a verdict of murder was accordingly returned against the boy with whom she had slept. Not many weeks elapsed, however, before several similar cases occurred, in which there was no reason to suspect that external violence had been offered, and some in which it was absolutely certain that no such injury could have taken place. A few of these patients died. Mr. Ward was now convinced that he was under a mistake in attributing the death of Jane Hampson to external violence, and informed the coroner of the reasons which induced this change of opinion. Accordingly, when the boy was called to the bar at Lancaster, the judge informed the jury that the evidence adduced was not sufficient to convict; that it would give rise to much indelicate discussion if they proceeded to the trial, and that he hoped, therefore, they would acquit him without calling witnesses. With this request the jury immediately com-

plied. The disorder in these cases, says Dr. Percival, had been a typhus fever, accompanied with a mortification of the pudenda."*

Mr. Kinder Wood has described a complaint nearly resembling that observed by Dr. Percival. It is preceded by all the ordinary symptoms of fever for about three days. The patients then call the attention of parents to the seat of the disease, by complaints in voiding urine, &c. When the genital organs are examined, one or both labia are found enlarged and inflamed. The inflammation is of a dark tint, and soon extends internally over the clitoris, nymphæ, and hymen. Ulceration succeeds, and the external organs of generation are progressively destroyed. The affection has proved very fatal, and seems to constitute a peculiar kind of eruptive fever.†

Mr. Lawrence‡ describes "a peculiar kind of inflammation incidental to the external organs of children, which, in some respects is important, for it is a serious affection of itself, and, further, has been in many instances confounded with syphilitic affections, a mistake which has given rise to questions of a very serious nature. It occurs in young subjects of from four or five to eight or ten years of age ; it consists of inflammation of the labia and the external organs generally, which assume a deep dusky red colour, and in which foul ulcerations form with a tawny grey, and sometimes an actual sloughing, surface. They are very painful, attended with a thin fetid discharge, and sometimes extend so as to occupy a considerable portion of the surface of the external organs of generation, with feverishness, restlessness, great pain, and very considerable disturbance of the health of the child. These appearances have, in many instances, been supposed to be syphilitic, and hence have arisen, in some cases, suspicions that children have been ill used ; in fact, that persons have had connexion with them, and imparted to them disease ; consequently, in some cases, judicial trials of a serious nature have been the result. I had occasion myself to see a child in whom this affection had occurred (though the severity of the affection had then gone by), where it had taken place simply in conseqnence of these peculiar circumstances in the state of the health, and where, in consequence of previous professional opinions that it was the venereal disease, the child was questioned and interrogated until, I believe, from fear and apprehension, she gave into the idea that had been suggested and strongly entertained by the parents, and said that a certain youth had done something or other to her ; this proceeded so far that the suspected individual was taken to Bow-street, examined there, and, in fact, tried at the Old Bailey on a capital charge of violating this young person ; on that trial I gave evidence, and it is not the only instance in which a circumstance of this kind has taken place.

* Medical Ethics, pp. 103 and 231.

† Med. Chir. Trans. vol. viii. p. 84. See also Beck, Art. Rape, p. 96, for further references to authors.

‡ Surgical Lectures, Lancet.

"Now, I must observe, that the characters of this disease are totally dissimilar to those of syphilitic affections. There is, in the first place, an excessively deep-coloured inflammation, with great disturbance of the health of the child in the very commencement of the affection, and then the ulcerative process that takes place on the inflamed surfaces is foul and sloughing, and of a tawny colour, totally different from the characters of any primary venereal sore."

I have myself seen several such cases, and have generally found the friends suspicious of violence.

It appears, then, that *disease* may give rise to appearances on the parts of generation, which closely resemble the effects of violence. But it is important to bear in mind, that such disease attacks only young children, and hence this source of fallacy can exist only in cases of alleged violence offered to infants of tender age. In all such cases we must be on our guard not to confound the one set of appearances with the other. In doubtful cases, inquiry should be made whether or not such a disease of the genital organs as that now described is prevalent.

But, in the second place, *marks of injury on the parts of generation may be produced by other means, with a view of criminating an innocent party.*

M. Foderé relates an instructive case of this kind: "A female child between nine and ten years of age, was said to have been violated by several persons. The mother brought the charge against them, and was rather suspected to be acting with a view to extort money from the accused. M. Foderé was commissioned to investigate the affair. He found the sexual organs of the child to be perfectly uninjured; the hymen was entire, and the little finger could hardly be inserted into the orifice of the vagina. There were, however, some marks of violence about the pubes and the external labia: a red circle, about the size of a crown piece was observed on the pudenda, and it had all the appearance of having been recently made. This was, indeed, the fact; for, by waiting a little, it gradually disappeared, having evidently been produced by the indentation of a piece of money, just before the visit of the medical examiner. If the mark had been the effect of great violence, such as was stated by the mother, it would have increased in intensity with the usual effects of inflammation. It was thus discovered to be a gross fraud, and the plaintiff was driven out of court with disgrace."* It is scarcely necessary to add, that injury to the parts of generation may be produced by substances introduced into the vagina for lascivious purposes.

Spots of blood and semen have been mentioned among the physical signs of rape. On both these points some observations are necessary.

Spots of blood.—When the injury is recent we shall expect to find spots of pure blood on the clothes, spots presenting an uniform red colour throughout. When the injury has been some little time in-

* Vol. ii. p. 456.

flicted, and the first hæmorrhage has ceased, there will be a muco-sanguinolent discharge, which will stain the linen less deeply and uniformly, presenting spots of a lighter colour, reddish, or of a yellowish red, lighter in the centre, and bounded at the circumference by a circle of a deeper colour than the rest of the spot.

The co-existence of these spots of blood, or of bloody mucus, with marks of violence, would form a strong corroboration of a charge of rape; but in the absence of marks of violence we should be inclined to suspect a fraud.

It is necessary also to be on our guard against confounding marks of blood with the stains produced by the menstrual discharge. The distinction is easy, for the menstrual fluid has properties by which it may be readily distinguished from blood. 1. It is not coagulable, in consequence of containing little or no fibrine. 2. It is of a darker colour than arterial blood, and does not change colour as venous blood does by exposure to the air; and as the blood which would flow from the parts of generation in consequence of violence would be arterial in its character, the colour alone would form a sufficient distinction. Moreover, by a careful inspection of the organs of generation, and by introducing a plug into the vagina, we may be able to ascertain that the coloured fluid flows from high up in the vagina, which would at once prove it to be the menstrual fluid.

It might happen that the menses were flowing at the time of an alleged rape. In such a case blood would be mixed with the menstrual fluid. But this could give rise to no difficulty, as some of the stains would present all the characters of blood, and would correspond with marks of violence on the parts of generation.

This coincidence took place in the case of Mary Ashford, which occurred in 1817, and excited much interest at the time.

In this case, it was proved that the menses were flowing at the time of the alleged rape, and *coagulated* blood was found at the spot where connexion took place, and in the middle of the impression of a figure on the grass. The parts of generation were lacerated, and covered with coagulated blood. The shirt and pantaloons of the accused were also bloody. Abraham Thornton, the accused, confessed the connexion, but said that it was with consent. The dead body of Mary Ashford was found the next morning in a pool of water, and a question arose as to the mode and cause of death. This part of the case belongs to the subject of death by drowning.*

Semen and seminal spots.—When called upon to examine the person of a female soon after the violence has been committed, semen may sometimes be discovered at the orifice of the vagina, or on the other parts of generation. In other instances, we may find seminal spots on the garments of the female. If a fluid is found having the general appearance of semen, its real character may be determined by ex-

* See this case given at length in Cummin's Lectures, Med. Gaz. vol. xix. p. 386.

amination under the microscope; and should it contain animalcules there can be no doubt of its being semen. The animalcules were first described by Leuwenhöck, subsequently minutely examined by Spallanzani, and since proved to exist in the semen of all male animals which have reached the age of puberty. When examined by a powerful glass, they present the following appearances. Their figure, while in motion, is spherical, with filamentous tails: when at rest, or dead, the fluid about them being dried up, they appear somewhat oval, with a tapering tail.

These animalcules, of which the scientific name is *Cercaria seminis*, differ little in shape in men and in animals, and measure, according to Raspail, about $\frac{1}{3000}$ of an inch, being about $\frac{1}{30}$ of the size of the globules of the blood.

In recent semen these animalcules may be identified both by their shape and motion; but as they retain their shape when dried, they may be discovered in semen which has become dry, provided it be carefully moistened. Orfila states that he discovered animalcules in semen which had been kept for eighteen years on glass plates. The animalcules also resist putrefaction in a remarkable degree, so that Dr. John Dewy observed them in putrid semen which had been kept for 10 weeks. They may also be detected in the liquid obtained by steeping seminal stains on linen in distilled water. Dr. Dewy obtained them in this way from a seminal stain which had been kept 18 days.* M. Rattier, on moistening spots of linen with water, found the *débris* of spermatic animalculæ, and some animalculæ in a complete state.† Devergie, in a paper read before the Academy of Medicine on the signs of hanging during life, states that he found spermatic animalcules in the urethra, and also in stains on linen which had been dried 10 months.‡ M. Bayard, by taking care not to rub or injure the pieces of moistened linen, succeeded in discovering complete animalcules in semen dried for two months, a year, and even three years.§

Independently, however, of the discovery of the seminal animalcules, there are other means of identifying seminal spots. The following account of the characters of these spots is given by Orfila:

The spots are thin, of a slightly yellowish or greyish colour, which is best seen by placing the linen between the eye and the light. When pressed between the finger and thumb, the spots are found slightly stiff, as if starched. They are inodorous; but when moistened give out the well known seminal odour. Held near the fire—taking care at the same time not to scorch the linen—the spots become of a yellow fawn colour, and several small whitish spots, which were not previously perceived, make their appearance. This effect of heat on the seminal spots is characteristic; it does not take

* Ed. Med. and Surg. Journ. vol. iv. p. 15.
† Journ. du Chimie, Mars, 1838. ‡ Archiv. de Médicine, 1838.
§ An. d'Hygiène, July, 1839.

place with any other healthy or morbid discharge; neither with the vaginal mucus and the lochia; nor with the gonorrheal discharge and fluor albus.

If the linen thus discoloured by heat be placed in distilled water for some hours, it loses its colour, and the resulting liquid acquires all the properties of a solution of semen in water. If the seminal spot be placed for some hours in cold distilled water, it is moistened evenly throughout, which would not be the case if the spots contained grease, and it gives out a distinct spermatic odour. The liquid is of a milky white, and full of flakes, and on being filtered and evaporated assumes the following characters: 1. It is alkaline, as is proved by its effect on litmus paper. 2. It has the appearance and consistence of a solution of gum; it does not coagulate, though it deposits some *glutinous* flakes. 3. Evaporated to dryness, the residue is semitransparent, like dried mucilage, glistening, of a fawn colour, and on being agitated for two or three minutes in cold distilled water, divides into two parts; the one glutinous, greyish yellow, adhering to the fingers like glue, insoluble in water, but soluble in potash; the other soluble in water. 4. The watery solution is yellowish, transparent, and gives a white flocculent precipitate with chlorine, alcohol, acetate and subacetate of lead, and corrosive sublimate. *Pure and concentrated nitric acid* gives it a slight yellowish tinge, though it were colourless before, *but causes no precipitate*, whilst it constantly precipitates or whitens the various secretions mentioned above. This then is a characteristic test. The tincture and fresh infusion of galls causes an abundant greyish white precipitate.

The seminal spots placed in alcohol for 24 hours are but little affected by it, nor is any precipitate thrown down on the addition of water; but on evaporating the alcohol there is a slight residue.

Of the foregoing characters the only ones which are peculiar to semen, are the change of colour which the spot undergoes on being held near the fire, and the peculiar odour of the solution. The absence of any precipitate with nitric acid distinguishes the seminal spot from those caused by the gonorrhœal, leucorrhœal, and lochial discharges, but not from common mucous and muco-purulent discharges.*

In addition to the physical signs of rape already mentioned, it sometimes happens that there are traces of the venereal disease, and a question may arise as to the value to be attached to the presence of this disease. As the disease does not occur, in most instances, till three days after connexion, if it should be present in a female examined soon after the alleged violence, the circumstance could have no influence on the decision of the case, except in as far as it would prove the female unchaste. If on an examination at a later period, the disease should be found present, it would prove the female un-

* Orfila. Traité de Médicine Légale. Vol. i. pp. 156, et seq.

chaste if the disease were absent in the accused, but would form a strong corroboration of the charge if present. It is obviously possible to confound other discharges with that of gonorrhœa, especially the purulent or muco-purulent discharge from the vagina of children; hence it will be necessary to use great caution in forming a decision as to the nature of any existing discharge.*

According to the definition above given of rape, viz, that it is the carnal knowledge of a woman forcibly and against her will, it appears that all the physical signs just enumerated,—marks of violence on the parts of generation, and on other parts of the body, and spots of blood or semen on the person or clothes of the female,—may exist, and yet no rape may have been committed, for the violence may not have been against the will of the female. This leads to the

Question of Consent.—This is not a medical question, and may therefore be dismissed in a few words. It is obvious that the female may have resisted up to a certain point, and then consented, or that, provided there be no marks of violence on any other parts of the body except the parts of generation, that she may have consented from the first, and yet have suffered much from the act of intercourse. The question of consent then must be considered independently of the appearances discovered on the body, and must be determined by such considerations as the following—the previous character of the female, and her relations with the accused; the motives by which she may be actuated in bringing the accusation; the place and circumstances in which the offence was alleged to have been committed; the time which elapsed before complaint was made; whether, if other persons were near at hand at the time of the alleged violence, her cries were heard; whether, if they were discovered, she made resistance and cried out before the discovery; and lastly (and this is the only point with which the medical man has to do) whether there are marks of great and continued resistance on the persons of the female and the accused, and on the spot where the offence is alleged to have been committed. The question of consent has of course no place in the case of children under ten years of age, in idiots, or where the offence has been committed on a female in a state of unconsciousness, however produced.

This question of consent has sometimes been summarily answered in the case of the adult female, by alleging the utter impossibility of committing the crime on a female in full possession of her senses, and of an ordinary degree of strength. Of the difficulty of completing the offence, in the sense which was formerly attached to the term penetration, there can be little doubt, but as that term is now understood, the offence must be admitted to be possible, especially where there is great disparity of strength. The female, too, may faint from terror, or yield to threats of worse violence.

* For cases in which this question has been raised, the reader is referred to Beck, p. 115.

This suggests a new examination, viz., into the condition of the accused. It may happen that he is impotent, in which case the charge must at once fall to the ground; or he may be feeble, or ill, or of too tender or advanced an age to possess the necessary degree of strength. On the other hand, such an examination may tend to confirm the charge, especially if made soon after the alleged offence, as his own person may bear the marks of resistance, or his linen show traces of blood or semen: in rare cases, the organs of generation themselves may betray the force which has been used. In case of death following rape, a post mortem examination may be required. No particular directions are necessary in this case. The mouth should be examined, as foreign bodies are sometimes introduced with a view of stopping the cries of the female.

Two questions connected with this subject still remain to be discussed. 1. Can a female be violated during sleep without her knowledge? and, 2. Does pregnancy ever follow rape?

1. *Can a female be violated during sleep without her knowledge?* That a female may be violated during *stupor* produced by narcotics, there is no doubt; that a female, accustomed to sexual intercourse, may be violated during profound sleep, is also highly probable; but that a virgin should be violated during sleep may be held to be in the very highest degree improbable. In the absence of facts this is all that can be said on the subject; but that it may be a matter of doubt, is proved by the fact that the medical faculty of Leipsic, in 1669, answered the question in the affirmative, and the juridical faculty of Jena, in the negative. Violation is here used in the sense of sexual connexion accompanied by a certain degree of force. When discussing the question of pregnancy, cases will be cited which go to prove the possibility of sexual intercourse which has taken place during sleep being followed by pregnancy, which event has come upon the female by surprise—a proof that connexion was not accompanied by violence.*

2. *Does pregnancy ever follow rape?*—The facts just referred to prove that pregnancy may follow unconscious connexion, hence the venereal orgasm is not a *sine quâ non* of conception. It is also admitted that pregnancy may follow a first intercourse with consent; hence there is nothing in the nature of a first connexion to prevent conception. The question, therefore, becomes very simple. Is there in the aversion with which the female receives the forcible embraces any sufficient obstacle to conception? There is here not only an absence of all fact to guide us, but a preconceived notion, that pregnancy following alleged rape forms a sufficient evidence of consent, to mislead us. All that

* In the year 1840, I was consulted by a poor woman who, after mentioning other complaints of little importance, stated that she was somewhat alarmed by the fact of her sleep being so heavy that she was with difficulty aroused. She added by way of illustration that her husband had assured her, that he had frequently had connexion with her during sleep.

can be said, therefore, is, that it is in the very highest degree improbable that an event which may follow an act unconsciously performed, and which is not prevented from happening by the suffering attending a first intercourse with consent, should be prevented merely by the repugnance which a female feels to the party offering her violence.

It now only remains to give some short directions for performing medico-legal examinations in cases of alleged rape.

1. Let no time be lost in proceeding to a personal inspection of the female, and let a note be taken of the time at which the inspection is made, and of that at which the offence is stated to have been committed.

2. Observe the age, strength, and general habit of the complainant; examine carefully any injuries that may exist, or that may be alleged to exist, on her person, and see whether they correspond in appearance with the cause by which, or the manner in which, they are said to have been inflicted. Remark the state of the clothes, whether torn or rumpled.

3. Examine the organs of generation, noticing the general form and appearance of the parts, whether they are swollen, inflamed, abraded, or ulcerated; whether there is any discharge, and from what part it flows; whether the hymen and fourchette are entire or injured, and if injured, whether recently, and whether the carunculæ myrtiformes are present; ascertain the date and origin of such marks of violence as exist, and determine whether they might not have been produced by other than the alleged cause, as, for instance, by foreign bodies, purposely applied to, or introduced into, the parts. Inquire also whether the alleged violation took place during the menstrual period, or whilst the patient was labouring under any debilitating discharge.

4. Let any existing discharge be carefully observed, collected, and submitted to examination, in order to determine whether it is the result of gonorrhœa, leucorrhœa, &c. Let any spots of blood or semen on the person or clothes also be reserved for analysis.

5. If death have taken place, the body must be carefully examined, and search be made for bruises, fractures, or dislocations; and for foreign bodies thrust into the mouth. The internal viscera should also be carefully inspected.

6. Examine the spot on which the offence is stated to have been committed, with a view of comparing it with the appearances discovered on the body of the female.

Lastly. Examine the person of the accused; his bodily strength and development; the parts of generation, with a view to discover whether he be impotent, or capable of producing the existing amount of injury, whether he have the venereal disease, or any recent abrasion, or rupture of the frænum. Examine his person also, with a view to discover bruises, scratches, or other marks of resistance; and his linen for spots of blood or semen.

The discovery of these marks of resistance, if they do not convict

the man of rape, may establish his guilt on a charge of assault with intent to commit it; and it is by no means unusual, when the capital charge fails, for the judge to direct another indictment to be preferred, charging the prisoner with the misdemeanour.*

The following case will serve as an apt illustration of the signs of forcible defloration.

"We, the undersigned, went this day, at eight o'clock in the forenoon, to visit the daughter of M. G., aged 16, who was said to have been violated yesterday evening at ten o'clock.

"Upon entering the chamber, we found the girl in bed, concealing her face. We were told that on the preceding night she allowed herself to be prevailed on, under false pretences, to enter the room of M. D., aged —, who, after making her certain proposals, accomplished his purpose, having previously used violence, and ill-treated her, and threatened her with death. Upon examination, we observed that the girl was sufficiently grown and well formed for her age, but delicate and very timid: she seemed to have previously enjoyed a state of perfect health. We saw on her arms, her chest, and lower limbs, several recent ecchymoses,—some of them were close together, and on the arms indicated the pressure of fingers: on the thighs, they were larger and more apart, where it seemed they were occasioned by the closed fist and the bruises of the knees. The whole pudenda were swollen, and there was a discharge from them of a mucous fluid of a yellowish white colour: the external labia were red, and, as it were, slightly glued together; the nymphæ were tumefied, very red, and presented the appearance of laceration, still bloody, and covered with mucus.

"The hymen was ruptured—its remains were distinct and bloody: the mucous coat of the vagina, which was strongly marked with rugæ, was inflamed and contused; all the parts were painful; and various red spots diffused over the pubes and the thighs, particularly their upper and inner part, gave evidence of recent violence.

"Having requested to see the dress which Mdlle G. wore at the time of the alleged violation, it was brought to us. The chemise was stained with blood in several places; and we also noticed certain greyish spots not very thick, but sufficiently tough, making the cloth stiff, as if it was starched in those places. We moistened them, upon which they gave out a very well-marked spermatic odour; and on putting them to the fire, they assumed a distinct reddish-yellow hue. As we were desirous of leaving no doubt about the matter, we collected a small quantity of it in a watch glass. It formed flakes and cloudiness in the distilled water which held it in suspension, and which had become alkaline. We then evaporated the liquor, and the residue was of a light brown colour, and, when treated with some drops of distilled water, was dissolved but in part, leaving a yellowish-grey

* See Cummin's Lectures, Med. Gaz. vol. xix.

glutinous substance, which disappeared in a solution of caustic potash, —facts which leave not the least doubt in our minds of the presence of semen.

"We therefore hold ourselves justified in concluding—from the existence of the contusions and ecchymoses which we observed, from the above-mentioned state of the genital organs, and from the spots of blood, and of semen, detected on the clothes—that the person of Mdlle. G. has been *violated*. In which persuasion we affix our signatures to this report.—Dated Paris, 17 July, 1823."*

PREGNANCY.

Pregnancy: feigned, concealed.—Plea in Bar of Execution.—Writ de Ventre inspiciendo.—Jury of Matrons.—SIGNS OF PREGNANCY.—*Constitutional Signs.—The Breasts.—The Areola.—Secretion of Milk.—Keistein.—Enlargement of the Abdomen.—Quickening.—Suppression of the Catamenia.—Changes in the Uterus.—Ballottement.—Discoloration of the Mucous Membrane of the Vagina.—Stethoscope.—Fœtal Heart.—Uterine Murmur.—Earliest and latest Age at which Pregnancy occurs.—First and last appearance of the Menses.—Early Ovum.—Moles.—Hydatids.—False Membranes.—Examination of the Uterus and its Appendages after death.—Corpus luteum.—Can a Woman conceive whilst in a state of Unconsciousness?—Can a Woman be ignorant of her Pregnancy up to the Time of her Delivery?—Does the Presence of the Hymen rebut the Supposition of Pregnancy?—Is Superfœtation possible?*

The medical man may be required to ascertain the existence or non-existence of pregnancy, for legal purposes, not only in cases where it is truly alleged to exist, but where it is feigned or concealed.

Pregnancy may be *feigned* by the unmarried female with a view to extort money, or to induce a paramour or seducer to marry her, or she may bring an action for breach of promise of marriage, and allege pregnancy as a means of influencing the jury in the assessment of damages. It may be pretended by the married, to gratify the wishes of a husband, to produce a supposititious heir to an estate, or to delay the execution of capital punishment.

Pregnancy may be *concealed* both by the married and unmarried, to avoid disgrace, or with a view of procuring abortion or committing infanticide.

The following quotations will show the principal occasions on which the assistance of the medical man is required.

A proceeding may take place at common law, "where a widow is suspected to feign herself with child in order to produce a supposititious heir to the estate, and defraud the lawful heir. In such case the heir

* Sedillot, Manuel Complet de Méd. Lég.

presumptive may have a writ *de Ventre inspiciendo*, to examine if she be with child or not, and if she be, to keep her under proper restraint until she is delivered. But if the widow be, upon due examination, found not pregnant, the presumptive heir shall be admitted to the inheritance, though liable to lose it again on the birth of a child within forty weeks from the death of the husband."

A case of this kind, which is usually quoted in treatises on the subject of pregnancy, "occurred in the family of Sir Francis Willoughby, who died seized of a large inheritance. He left five daughters (one of whom was married to Percival Willoughby), but not any son. His widow, at the time of his death, stated that she was with child by him. This declaration was evidently one of great moment to the daughters, since if a son should be born, all the five sisters would thereby lose the inheritance descended to them. Percival Willoughby prayed for a writ *de Ventre inspiciendo*, to have the widow examined, and the sheriff of London was accordingly directed to have her examined. He returned that she was 20 weeks gone with child, and that within 20 weeks *fuit partura*." Whereupon another writ issued out of the Common Pleas, commanding the sheriff safely to keep her in such a house, and that the door should be well guarded; and that every day he should cause her to be viewed by some of the women named in the writ (wherein ten were named), and when she should be delivered, that some of them should be with her to view her birth, whether it be male or female, to the intent there should not be any falsity. And upon this writ the sheriff returned, that accordingly he had caused her to be so kept, and that on such a day she was delivered of a daughter."* A somewhat different course has been adopted in regard to these examinations in a more recent case; two medical men with two matrons were appointed to visit the female every fortnight, instead of the jury of matrons and the more frequent visits.†

Another instance in which an examination may be required, is where a woman capitally convicted pleads pregnancy. If found to be pregnant, she is respited until after her delivery.

"In case this plea be made in stay of execution, the judge must direct a jury of 12 matrons, or discreet women, to ascertain the fact; and if they bring in their verdict, *quick with child* (for barely *with child*, unless it be alive in the womb, is not sufficient), execution shall be staid generally till the next session, and so from session to session, till either she is delivered, or proves, by the course of nature, not to have been with child at all."

It is scarcely necessary to remark on the absurdity of this distinction between *with child* and *quick with child*, nor on the incompetence of the jury of matrons to decide questions which should always be submitted to men of science and experience. Illustrations of this anomaly on the

* Croke's Elizabeth, p. 566. See also references to other cases in Beck, p. 121.

† See case of Mrs. Fox, London Med. Gaz. vol. xvi. p. 697; vol. xvii. p. 191. Also, Beck, p. 121.

one hand, and of the incompetency of the female examiners, on the other, will be found in all works on Forensic Medicine.* It is of greater importance, perhaps, to show that even medical men have committed grave errors in their examinations in cases of alleged pregnancy. Thus, Riolan relates the history of a woman named Genéviève Supplice, who after being hanged for robbery, was publicly dissected by him at the school of medicine, and was found pregnant of a child of five months, contrary to the opinion of the surgeons and midwives who had examined her. Mauriceau also mentions having seen at Paris, in 1666, a miserable example of this kind in a woman who was hanged and afterwards publicly dissected: she was found to be pregnant four months, notwithstanding the report of the persons who had visited and examined her, by order of the judge, before her execution, and pronounced that she was not pregnant, being deceived by the fact of her continuing to menstruate.

Another case in which a court of law has interfered on proof of the existence of pregnancy being brought before it, is when a female in this situation is imprisoned.

Thus in the case of Elizabeth Slymbridge, "upon suggestion that she had been imprisoned for divers weeks, and was with child, and would be in danger of death if she should not be enlarged," Sir Edward Coke, the chief justice, admitted her to bail, to prevent the peril of death to her and her infant; and in giving his opinion he quotes a similar case which occurred in the 46th of Edward III. The last case is mentioned in Coke upon Littleton.

Recently, legal protection has been extended to witnesses who are pregnant.

In a recent act (1. Gul. IV. cap. 22) entitled "an act to enable courts of law to order the examination of witnesses upon interrogatories and otherwise," it is directed, among other things, that no examination or deposition shall be read in evidence, unless it shall appear to the satisfaction of the judge that the examinant or deponent is unable, from permanent sickness or other permanent infirmity, to attend the trial. In a late trial, the question arose, whether pregnancy and imminent delivery was a cause for examination under this act. It was decided that it might be; but it must be shown, by the affidavits of competent persons, that the delivery will probably happen about the time fixed for the trial of the cause.

As the subject of pregnancy is one which involves a great number of details, the several parts of which it consists will be examined in the following order. 1. The signs and symptoms of pregnancy during life; including questions raised by the expulsion of various substances from the womb. 2. Examination of the uterus and its appendages after death, with a view to the discovery of proofs of an existing or previous pregnancy; and 3. Questions of a medico-legal nature connected with pregnancy.

* See Beck, p. 122.

SIGNS OF PREGNANCY.

It is usual in works on Forensic Medicine to treat at some length the Signs of Pregnancy. All that is intended in the present work is to give a short abstract of the principal signs, without entering into minute detail. For more accurate information, and for the opinions of authors, the reader is referred to works on midwifery, or to monographs treating expressly on this subject.*

The best division of the signs of pregnancy is into the general or constitutional, and the local signs, the local signs being subdivided into those which affect the *breasts* and those which affect the *uterus*.

1. *Constitutional Signs or Symptoms of Pregnancy.* Unusual irritability and capriciousness of temper, melancholy, languor, a worn and dejected expression of countenance, and emaciation; derangement of the functions of the stomach and bowels, consisting of nausea, heartburn, loathing of food, a capricious, variable, or depraved appetite; vomiting, especially in the morning; the bowels usually costive. The functions of circulation and secretion are affected, and there is feverishness, determination of blood to the head, with eruptions on the face, and occasionally salivation. Wandering pains of the face and teeth also sometimes occur.

These general symptoms, taken separately, have little or no value; they furnish but a low probability, which of course increases as a greater number of them combine, but which in any case falls far short of certainty.

2. *The Breasts.* The changes which take place in the breasts in consequence of pregnancy consist, (*a*) in increased size and firmness; (*b*) in the formation of a dark circle or areola around the nipple, which areola is studded with mucous follicles; and (*c*) in the secretion of lymph (a mixture of milk and serum), which flows from the nipple.

a. Increased Size and Firmness. This, where it exists, does not always occur in the early months of pregnancy, though it generally shows itself towards the end of the second month. The amount of enlargement, too, differs greatly in those who are pregnant; and in women of weak and delicate constitutions little or no change takes place till pregnancy is far advanced. Gardien and Mahon both observe, that the swelling of the breasts is not observable in women who menstruate during the early months of pregnancy. Occasionally the breasts do not enlarge until after delivery. Enlargement of the breasts, therefore, is not *constantly* present in those who *are* pregnant.

On the other hand, enlargement of the breasts may take place in those who *are not* pregnant, for it may arise from marriage and the change of habits which it brings, or from suppression or retention of the menses, or from any cause distending the uterus; it also occurs at the

* Consult Montgomery, Cycl. of Pract. Med. art. Pregnancy, and his work on the Signs of Pregnancy.

change of life. The breasts are also naturally large in some and small in others.

Mere enlargement of the breasts, therefore, must not be looked upon as a certain sign of pregnancy, as it does not always occur in those who *are* pregnant, and is often absent during the early months of gestation, when we most stand in need of such a sign. On the other hand, swelling of the breasts is often present in those who *are not* pregnant, and commonly exists in those cases which are most likely to be confounded with pregnancy, viz. where the uterus is mechanically distended by the retained catamenia or in any other way.

In any case it is not the absolute size of the breast that is to be considered as a sign of pregnancy, but a marked increase from an ascertained or reported smaller size, and even this affords but a doubtful indication.

b. The Areola.—The earliest period at which any change can be discovered in and about the nipple is probably about the end of the second month. This change consists in a slight deepening of the natural colour, turgescence of the nipple, and development of the follicles. At the end of four months these changes are generally complete, when the part presents the following characters:—"A circle around the nipple, whose colour varies in intensity according to the peculiar complexion of the individual, being generally much darker in persons with black hair, dark eyes, and sallow skins, than in those of fair hair, light-coloured eyes, and delicate complexions. The extent of this circle varies from a diameter of an inch to an inch and a half, and increases in some as pregnancy advances, as does also the depth of colour. In the centre of this circle the nipple is observed partaking of the altered colour of the part, and appearing turgid and prominent; and the part of the areola more immediately around the base of the nipple has its surface rendered unequal by the prominence of the glandular follicles, which, varying in number from 12 to 20, project from the $\frac{1}{16}$th to the $\frac{1}{8}$th of an inch; and lastly, the integument covering the part is observed to be softer and more moist than that which surrounds it, and the breasts themselves are, at the same time, observed to be full and firm, at least more so than was natural to the person previously. Such we believe to be the essential characters of the true areola, the result of pregnancy, and that, when found possessing those distinctive marks, it ought to be looked on as the result of that condition alone, no other cause being capable of producing it."*

This is an accurate description of the well-developed areola; but how far such an areola, where it exists, may be regarded as a sign of pregnancy, and how far the absence of it may be taken as evidence that a woman is not pregnant, is a question on which there is considerable difference of opinion among accoucheurs. There can be no doubt, however, that when the areola is present in a marked form, and especially in a female who has not previously borne children, it

* Montgomery, Encyc. Pr. Med. art. Pregnancy.

gives a strong probability of pregnancy. But it would not be safe to trust to this sign alone, for instances are on record of a well-marked areola occurring in persons who are not pregnant, as well as of an entire absence of areola in those who are.

The two following cases in illustration are related by Dr. James Reid, who has given much attention to the signs of pregnancy in general, and to this subject in particular:—"In a remarkable case of an unmarried lady, æt. 38, who was suffering from chronic tumour of the left breast, follicles might be seen, though the patient certainly was not pregnant. It is only about three months since she first consulted me, and on examining the nipple and surrounding parts, I must confess I was a little startled at observing not only the prominence of the follicles, but the identical emphysematous and moist appearance about them so well described by Montgomery." "On the other hand, I last week had occasion to examine, in our lying-in ward, the breast of a woman whose labour was just commencing (and who was afterwards delivered of a *living* child); here the mamma was quite flaccid, and although the patient was of a moderately dark complexion, there was a very light shrivelled areola (she had previously borne children), and it was only by distending this with the finger, that I was enabled to perceive the very indistinct, *dry*, and flattened follicles." Dr. Reid adds, "there are numerous cases in which they will be found absent where pregnancy exists, and a smaller number in which they will be discovered in women who are not *enceinte*."*

c. Secretion of Milk or Milky Serum.—This is one of the most fallacious signs, for it may be secreted by girls before puberty, by middle aged adults, who are not pregnant, and even by females advanced in life. It is not even peculiar to females, for well-authenticated instances have been related by Humboldt, Captain Franklin, and the Bishop of Cork, of males giving suck to young infants. Moreover, milk may be retained in the breasts for a considerable period; or it may be produced by morbid causes affecting the uterus, as hydrometra and physometra.

To sum up the signs of pregnancy furnished by the breasts, it may be stated that there is no one sign which taken alone can be entirely depended on, and that it is *possible*, though highly improbable, that all the signs might coincide, and yet the female not be pregnant.

In connexion with the secretion of milk or milky serum by the breasts, the formation in the urine of a substance containing some of the elements of milk may be mentioned. This substance has received the name of *Keistein*. The urine of a pregnant woman after standing during one or two days is found to become turbid, and numerous fatty

* Observations on the Fallacy of the Individual Signs and Symptoms of Pregnancy. By J. Reid, M. D. Lancet, Dec. 22, 1838. Some time since, Dr. Reid showed me one case of enlarged mammæ, with distinct areolæ and mucous follicles, in a female who had never been, and was not at that time, pregnant.

globules rise to the surface and form a pellicle closely resembling that left on the surface of mutton-broth on cooling. This crust remains swimming on the surface for three or four days, but breaks up and disappears with the advancing putrefaction of the urine. The secretion remains faintly acid till the moment of the breaking-up of the crust, which disappears with the development of ammonia. This fatty pellicle cannot be mistaken for the crust of earthy phosphate which forms on the surface of urine after long repose, for the former is destroyed and the latter developed by putrefaction. Dr. Golding Bird found the caseous pellicle absent in only 3 out of about 30 cases, at various periods of pregnancy from the third to the ninth month.* It is, therefore, a valuable sign of pregnancy, though, like most other individual signs, occasionally absent. It is probable that *keistein* would be found in the urine in those rare cases in which the breasts secrete milk in women not pregnant. The subject is still under examination. According to Dr. Stark the pellicle which floats on the urine—the *keistein*—results from the decomposition of a "natural sediment," to which he has given the name of *gravidine*. This sediment bears a close resemblance to the milk-globule in recent milk. It differs from albumen in being soluble by heat, from caseum in being soluble in sulphuric and nitric acid, from gelatine in being precipitated from its solution in water on cooling, and in its precipitate with tannin being soluble in boiling water.†

3. *Signs referable to the Uterus.*—These are, *a.* changes in the size and shape of the abdomen; *b.* quickening; *c.* suppression of the catamenia; *d.* changes in the neck and orifice of the uterus; *e.* increased size of the uterus; *f.* ballottement; *g.* discoloration of the mucous membrane of the vagina; *h.* sounds heard on the application of the stethoscope to the abdomen.

a. Changes in the Size and Shape of the Abdomen.—These consist in an enlargement of the abdomen, first perceptible about the end of the third month, and progressively increasing up to the period of delivery, with certain changes in the umbilicus. Previous to the third month the abdomen often appears unusually flat, in consequence of the uterus sinking lower into the pelvis, and at the same time the umbilicus is drawn in and depressed, so as to furnish a sign of pregnancy on which some authors have placed much reliance. In the fifth month the depressed condition of the umbilicus begins to diminish; by the end of the sixth month it is generally raised to a level with the surrounding integument, and, in many persons, it afterwards projects beyond the surface. These changes in the umbilicus would of course accompany all uniform enlargements of the abdomen, beginning in the uterus or in the contents of the pelvis. The enlargement, with the changes in the umbilicus which accompany it, is not to be relied upon as a certain sign of pregnancy; for in rare instances it may be nearly absent,

* Guy's Hospital Reports, April, 1840, pp. 16—20.
† Ed. Med. and Surg. Journal, Jan. 1, 1842.

or scarcely perceptible, even in advanced periods of pregnancy ; on the other hand, the enlargement, where it exists, may not be due to increased size of the uterus, or if it be, the enlargement of the uterus itself may arise from causes other than pregnancy. Among the causes of enlargement of the abdomen which are external to the uterus may be instanced, diseases of the liver, spleen, &c., ovarian tumours, ascites, and tympanites; and among those due to increased size of the womb itself, hydrometra, physometra, retention of the menstrual discharge, and various morbid growths. The former will generally be distinguished by careful examination of the abdomen, and by the history of the case ; the latter by examination per vaginam, joined to the previous history. Enlargement from causes dilating the womb itself will of course present the greatest difficulty, as it is generally progressive, and often accompanied by changes in the breasts and in the functions of the uterus resembling those caused by pregnancy.

b. Quickening.—This, which is generally attributed to a sudden change in the position of the uterus, takes place, for the most part, between the 14th and 18th weeks, but sometimes as early as the 12th week. It is vulgarly attributed to certain movements of the child. This is an extremely fallacious sign ; for not only are these movements often absent during the whole period of pregnancy, but when present and distinctly felt by the medical man they are often not perceived by the female herself. Moreover, it is easy for those who have not previously borne children, and even for those who have, to mistake the motions of flatus within the abdomen, or other internal movements, for those of the fœtus. The medical man must be on his guard, too, against movements of the abdominal muscles, which have sometimes so exactly imitated the motions of a fœtus as to deceive even experienced men.

c. Suppression of the Catamenia.—This, too, is a most fallacious sign, for the menses may be suppressed for long periods, from other causes, without injury to health ; or they may be present for one or two periods after conception, or even during the whole course of pregnancy ; or again, they may be absent at all other times, and make their appearance only after conception. Moreover, the sign is altogether wanting in those rare instances in which pregnancy has occurred in females who have never menstruated. There is one source of fallacy connected with this sign which it is very difficult to guard against. A female who is really pregnant may conceal the fact from her friends, by pretending that she is regular and imitating the catamenia by blood. A case of this kind is related by Dr. Montgomery.*

d. Changes in the Neck and Orifice of the Uterus.—In the unimpregnated state, the mouth and lower part of the neck of the uterus project into the cavity of the vagina from a quarter to half an inch. The part so projecting feels remarkably firm, is of about the size of

* Montgomery, Enc. Pr. Med. p. 471. art. Pregnancy,

the end of a man's thumb, and terminates in a transverse opening with firm and well-defined margins or lips. Into this opening the point of the finger may be introduced to the depth of an eighth of an inch, sometimes a little more, sometimes less. When conception has taken place these characters change. With the first increase of size which follows the influx of blood into the vessels, the cervix becomes fuller, rounder, softer, and more elastic; the margins, or lips, lose their well-defined edge, and become swollen, softer, and less distinct; and the orifice, instead of being transverse, becomes circular, and admits the point of the finger more readily, and to a greater depth. These changes become more marked as pregnancy advances. Other changes take place in the neck of the uterus. One of these consists in shortening, which is perceptible during the sixth month, and becomes gradually more and more marked, till at length, towards the close of gestation, the neck is no longer to be felt, but the uterus forms one globular tumour. Another change is in position. During the greater part of the first three months it is lower in the vagina than in the unimpregnated state, and often projects a little forwards; but when the uterus leaves the cavity of the pelvis, and begins to rise into the abdomen, which it does by the fifth month at farthest, sometimes a month earlier, the fundus is directed forwards, and the os uteri backwards. The uterus, continuing to enlarge and to ascend, the neck is situated still higher, and turned still more backwards.

These changes in the uterus, as ascertained by examination per vaginam, though they afford a strong probability of pregnancy, must not be too implicitly relied on. Thus, the near approach of menstruation, and the accompanying irritation of the uterus, may cause the orifice to undergo changes of form and texture similar to those due to recent impregnation. Again, any increase of the substance of the uterus, or distention of its cavity by fluid, or diseased growth, will cause those parts to assume the characters of the more advanced periods of pregnancy. In some women, moreover, and especially in those who have borne children, the os uteri is permanently in a condition similar to that described.

e. Increased Size of the Uterus.—During the first three months, the uterus not having yet risen out of the pelvis, no increase of size can be discovered, either by external examination or by examination per vaginam. At the end of the fourth month, the uterus, in thin persons, may be felt above the pubes; during the fifth, it rises half-way between the pubes and umbilicus, and may now be felt by the finger introduced into the vagina, and passed between the anterior part of the cervix and the pubes; in the sixth month, the uterus rises to the umbilicus, which is protruded so as to be on a level with the integuments; in the seventh month, the fundus may be felt half-way between the umbilicus and the end of the sternum; by the end of the eighth month it has risen to the ensiform cartilage; and, in the ninth month, the uterus still continues to enlarge; but the abdomen is not

proportionably increased in size in consequence of the uterus falling lower in the pelvis as the period of delivery approaches.

This enlargement of the uterus, and with it of the abdomen, may be due to any cause gradually distending the cavity of the uterus. Taken alone, therefore, it is a sign not to be relied on: but combined with other signs of pregnancy it has great weight.

Ballottement.—This name has been given to the sensation produced by the fall of the fœtus after it has been jerked upwards by a brisk movement of the finger. It is not available till after the end of the fourth month, and rarely much beyond the completion of the sixth. Its application, therefore, is limited, and in resorting to it much practice and some precautions are required. In practised hands it is a sign of great value.

g. Discoloration of the Mucous Membrane of the Vagina.—This test was proposed by M. Jacquemin, who states that during pregnancy the entire mucous membrane of the vagina has a deep violet tint, like that of lees of wine, and that this sign never failed him. This statement has been confirmed by more than one competent observer. The test is one admitting of very rare application, especially in this country.

h. Application of the Stethoscope.—Two sounds may be heard on applying the stethoscope over the region of the uterus in a pregnant female; the pulsations of the fœtal heart, and the uterine murmur.

The pulsations of the fœtal heart vary from 120 to 160 in a minute, and bear no relation to the pulse of the mother. Each pulse is double, and resembles the tick of a watch heard through a pillow. It is rarely heard till the fifth month, when it is very indistinct, and not easily heard without practice and attention. It is not always heard in the same position, but most generally on one or other side, at a point nearly midway between the umbilicus and the anterior superior spine of the ilium. It is also occasionally inaudible. Once heard, it is of course a sure sign, not only of pregnancy, but also that the fœtus is alive. It fails in the case of a dead fœtus, and it is also inapplicable at an early period of utero-gestation.

The Uterine Murmur.—This is a low murmuring, or cooing sound, resembling that made by blowing gently over the lip of a wide-mouthed phial.* It is synchronous with the pulse of the mother, and its relative situation remains the same during the whole period of gestation. It may generally be detected in the lateral or anterior parts of the uterus, and is first distinctly audible about the end of the fourth month.† This, like the former sign, requires for its detection much care, and a practised ear. Like the former, too, it is, when distinctly heard, a sign of considerable value.

From the foregoing brief account of the signs of pregnancy, it appears that there are few signs which, when taken alone, can be safely relied on; and that in this, as in other cases, it is from the combination

* Montgomery, Signs of Pregnancy. † Ibid.

of many signs that we must form our opinion. Most of the signs can be rightly appreciated only by experienced persons. Many of them are extremely fallacious, and the natural difficulties by which they are surrounded are increased to the utmost in medico-legal inquiries, in which the parties submitted to examination have an interest in misleading us either in one way or the other.

The difficulties naturally attendant upon the question of pregnancy will be much increased in cases where disease is present. Some diseases, as, for instance, ascites and ovarian dropsy, render the signs of pregnancy, connected with enlargement of the abdomen, obscure; others, on the other hand, tend to interfere with the conclusions drawn from an examination per vaginam. On this subject it is impossible to lay down any general rules; suffice it then to observe, that disease, whether external to the uterus or within that organ and its appendages, does not negative the supposition of pregnancy; for cases are recorded of pregnancy occurring in females affected with dropsy, in those affected with polypus and prolapsus uteri, with cancerous disease of the womb itself, and even with extensive disease of one or both ovaries.* Such cases as these require on the part of the medical man both the most practised skill and the greatest care. Without these the most serious and fatal errors may be committed, of which examples may be met with in most works on Midwifery.

Other signs of pregnancy have been enumerated, as the sizy condition of the blood, and the increased pulsation of the arteries at the orifice of the vagina. These are much too trivial to require any lengthened discussion. But, in addition to the positive signs already enumerated, there are certain circumstances which serve to negative the supposition of pregnancy. Of these the principal are, too tender or too mature an age, and the existence of the physical causes of sterility, enumerated under the head of impotence. Some authors would add to these the presence of the hymen; but this has been already shown to be no evidence of the non-existence of pregnancy.

Age.—The limits of child-bearing in women are commonly the first and last menstruation; but, in rare instances, conception has been known to take place before or after this occurrence. Cases of premature fruitfulness are related by high authorities. Thus, Montgomery delivered a female of twins before the completion of her 15th year; La Motte and Sir E. Home give instances of pregnancy in the 13th year; the last-named author another in the 12th; and Bruce, in Abyssinia, and Dunlop, in Bengal, met with mothers of 11 years. In this country the limit may be probably stated at 12 years, and pregnancy at an earlier period must be looked upon as highly improbable.

On the other hand, cases are recorded of pregnancy at very advanced periods of life. Bartholomew Mosse mentions four cases of

* Montgomery, loc. cit. p. 491.

women pregnant in their 51st year, and Dr. Labatt of Dublin one; Knebel and La Motte each one in the 52nd year; Bartholomew Mosse and Knebel each one in the 54th year; a case of pregnancy at the same age (that of Mrs. Ashley), is also related in the Edinburgh Annual Register for 1816. In a French case, in which the succession to an estate was disputed on the ground of the mother being 58 years old when the child was born, a decision was given in favour of the fact. Pliny, Valescus de Tarenta, and Marra of Venice, record cases of pregnancy at 60; Capuron states that a woman of 63 was generally believed in Paris to have given birth to a daughter; and, lastly, Beck quotes a case from the Boston Medical and Surgical Journal of a woman at Whitehall (State of New York) becoming a mother at 64.*

Mr. Roberton† states that out of 10,000 pregnant females registered at the Manchester Lying-in Hospital, 436 were upwards of 46 years of age. Of these there were—

397	from	40 to	46
13	in their	47th	year
8	„	48th	„
6	„	49th	„
9	„	50th	„
1	„	52nd	„
1	„	53rd	„
1	„	54th	„

In all questions of this kind, the safest rule to adopt would be not to regard any case as worthy of implicit belief unless supported by one or more cases of the same kind; where a case stands quite alone, we are justified in viewing it with distrust, and in giving full force to all the objections that may be urged against it. If we adopt this rule in the question now under consideration, we shall be constrained to consider the age of 54 as the probable limit of fruitfulness, though we shall not be justified in denying the possibility of pregnancy occurring at a more advanced age. Legal decisions may, in all these cases, be safely rejected, and the narratives of authors, unless they are very circumstantial, and contain some better evidence of age than the statements of women, may be received with scepticism.

As the first and last appearance of menstruation are usually supposed to fix the limits of possible fruitfulness, the following tables are added, showing the ages at which menstruation has been found to commence and to cease.

* Beck, Med. Jur. Title Pregnancy.
† Ed. Med. and Surgl. Journal, vol. xxxviii.

Table showing the Ages at which the Menses have appeared in different Countries.

Age.	England.*	France.†	Germany.‡	Total.
5	0	1	0	1
6	0	0	0	0
7	0	1	0	1
8	0	2	0	2
9	4	11	0	15
10	14	34	0	48
11	147	116	0	263
12	207	155	6	368
13	338	198	18	554
14	520	271	48	839
15	525	336	65	926
16	451	235	65	751
17	340	195	39	574
18	205	135	39	379
19	88	64	21	173
20	49	42	20	111
21	11	13	5	29
22	4	8	2	14
23	2	5	3	10
24	0	3	1	4
Total	2905	1825	332	5062

* This column includes 1100 cases on the authority of Dr. Robert Lee (Med. Gaz. 1842); 450 cases on the authority of Mr. Roberton (Ed. Med. and Surg. Journ, vol. xxxviii.); 934 cases communicated to me by my friend Dr. James Reid, and 421 observations of my own.

† This column comprises 68 observations made at Marseilles and Toulon by M. Marc D'Espine, 432 made at Lyons by Bouchacourt and Pétrequin, 85 made at Paris by M. Marc D'Espine, and 1200 made in the same city by M. Meniers. (See the work of M. Brierre de Boismont on Menstruation.)

‡ This column embraces 137 observations made at Göttingen by Osiander, and 195 observations made at Halle by Hohl.

Table showing the Ages at which the Menses have ceased.*

Age.	Age.	Age.	Age.
34 — 1	43 — 4	52 — 17	61 — 4
35 — 3	44 — 14	53 — 11	62 — 5
36 — 3	45 — 35	54 — 13	63 — 6
37 — 4	46 — 21	55 — 7	64 — 7
38 — 7	47 — 30	56 — 7	65 — 2
39 — 11	48 — 49	57 — 3	66 — 3
40 — 29	49 — 30	58 — 7	67 — 2
41 — 13	50 — 47	59 — 0	68 — 1
42 — 18	51 — 10	60 — 14	69 — 5

There are still other points connected with pregnancy which require examination. It may happen that substances are expelled from the uterus which occasion suspicion as to the previous existence of pregnancy ; and it is important to be able to state whether or not they are to be regarded as products of conception.

The chief of these substances are, 1. An early ovum. 2. Moles. 3. Hydatids. 4. False membranes.

1. *An Early Ovum.*—We may recognise an early ovum either by the characters of the contained fœtus, or by that of the surrounding membranes. It is unnecessary to enlarge upon the appearances presented by the fœtus itself during the early stages of its development ; suffice it to observe, that as parts of its structure may have degenerated we may have to identify it by some small portion retaining its normal character. In other cases we may be able to identify an ovum by the membranes which enter into its formation. Thus we may discover the decidua, characterised by its soft, rich, pulpy appearance and strong red colour, with its rough external surface perforated by small foramina, and its internal surface smooth, covering, either partially or completely, the substance under examination. Within this again, and immediately investing the membranes of the ovum, we may

* This Table is formed from 337 observations, collected and kindly communicated to me by Dr. James Reid, and 106 by myself. The earliest age in my own observations was 35, and the latest 56. With reference to the last column it is necessary to state, that Dr. Reid took much pains to ascertain whether all these were *bona fide* cases of menstruation, and that he has reason to believe that many of them were examples of the recurrence of the menses at regular intervals after they had ceased for a certain period.

The earliest and latest periods at which menstruation occurs, though not of immediate importance in medico-legal inquiries, may serve to furnish an argument in favour of the possibility of pregnancy at an early and at an advanced age.

discover the inner decidua, with its smooth outer surface and its internal one covered with filaments which receive the arborescent villi from the surface of the chorion.* When we find these characters in the substances expelled from the uterus, we may be as sure of the existence of an ovum, and consequently of the previous existence of pregnancy, as if we had the fœtus itself perfect in all its parts ; for these appearances are never assumed by any product of disease. Great care is necessary in these examinations. The blood with which the ovum is found clotted must be removed by previous maceration and washing, and the examination must then be conducted with much delicacy.

2. *Moles.*—This term is very loosely defined, and, as a natural consequence, there has been much difference of opinion about Moles, some authors regarding them as products of conception, and some as occurring independent of sexual intercourse. If we define a Mole as a solid substance expelled from the uterus, it must be either a product of conception or not. If a product of conception, it will be identified as such by the discovery of some parts belonging unequivocally to an ovum, but if we can discover no such parts, then we are bound not to assume that the substance under examination was due to impregnation. On such a question there must needs be much difference of opinion, and the benefit of the doubt ought to belong to the suspected female.

3. *Hydatids.*—There is a decided balance of opinion in favour of Hydatids being in all cases the product of conception ; hence they form an exception to the rule just laid down with regard to moles, and it is not necessary to discover traces of an ovum in order to form a decided opinion. It must be recollected, however, that Hydatids may spring from portions of the membranes retained in the uterus after the expulsion of an ovum. They must not, therefore, be regarded as proof of impregnation having taken place within a period less than that of utero-gestation. The importance of this caution may be shown by a very supposible case : "A woman loses her husband by death or departure when she is, perhaps, in the third or fourth month of pregnancy ; shortly afterwards she miscarries, and the placenta or some other portion of the ovum is retained, and gives rise to the production of hydatids. This new product may be retained for many months, and being then expelled, might very unjustly excite suspicion against a perfectly chaste person ; for although the result of impregnation in such a case, they might obviously be no proof of a pregnancy occurring subsequently to the absence of the husband."†

4. *False Membranes.*—False Membranes are often expelled in dysmenorrhœa ; and a superficial and careless observer might pronounce them to be the product of conception. The general rule already laid

* Montgomery, loc. cit.

† Ibid. p. 488. Consult the same for the opinions of authors on this point.

down, when speaking of moles, viz. that no substances expelled from the uterus should be regarded as products of conception, unless they contain well-marked traces of some part or other of an ovum, must be observed also in this case. Those who are accustomed to the use of the microscope will have no difficulty in distinguishing these false membranes from true ones.

Examination of the Uterus and its Appendages after Death.

The examination of the uterus and ovaries after death may become necessary, with a view of determining the existence or previous occurrence of pregnancy ; a question of much importance in certain medico-legal cases.

The *uterus* itself, by presenting the small size of the virgin state, may at once negative the supposition of pregnancy. In other cases it may be found enlarged but empty, and marked by some of the changes which accompany gestation. Should this be the case, we cannot assert that pregnancy has existed, because those appearances may be due to any tumour which had distended the organ, and at the same time formed a vascular connexion with its internal surface. If, instead of being empty, the womb should be found to contain any substance, it must be examined with all the care and precaution insisted on in speaking of substances expelled from the uterus. If traces of an ovum should be discovered, the fact of previous impregnation is made out ; but nothing short of this, with the exception of hydatids, can justify us in affirming the fact.

The examination of the *ovary* will lead to results of a much more satisfactory nature. The peculiar appearance on which so much stress has been laid as an evidence of previous impregnation, and which has received the name of *corpus luteum*, demands a minute description.

Corpus luteum. — The ovary of a female who has recently conceived is larger and more vascular than in the virgin state, and fuller and softer to the touch. This increase of size is not general, but due to an enlargement affecting one part only, and distinctly visible on its surface. The increased vascularity, too, is nearly confined to this spot, which is distinguished from the surrounding structure by its dull reddish-yellow colour. The external covering of this projecting part is also marked by a distinct cicatrix, resembling a rent imperfectly united.

On making a section of this projecting spot, we find it presenting the following characters : Its *form* is almost always oval, its long axis varying from four to five-eights of an inch, its short axis from three to four-eights, and the breadth exceeding the thickness. Its *texture* is strikingly glandular, resembling a section of the human kidney. It is very *vascular*, and its vessels may be often seen by the naked eye. Its *colour* is a dull yellow, similar to that of the buffy coat of the blood, but has, when recently exposed, a slightly reddish tinge.

In its centre there is either a cavity or a radiated white cicatrix. For the first three or four months after conception a cavity may be frequently found, large enough to contain a grain of wheat. This cavity is surrounded by a strong white cyst, the opposite sides of which, as gestation proceeds, approximate and at length unite, leaving, when the union is complete, a white radiated cicatrix. This cicatrix is visible as long as any distinct trace of the corpus luteum exists, and effectually distinguishes this body from every other.

After the contents of the uterus have been expelled, whether the expulsion takes place prematurely or at full term, the characters of the corpus luteum rapidly fade, until at length it is no longer to be found in the ovary. The time of its complete disappearance is not known, but Dr. Montgomery has found it distinctly visible at the end of five months after delivery at full term.

In cases of twins there are two, and in that of triplets three, corpora lutea, one corresponding to each conception. In no case is there more than one *corpus luteum* to a conception ; but where abortions rapidly follow each other, more than one of these bodies may be found in the ovary at the same time. Such is the description of the corpus luteum, taken from one of the highest living authorities, Dr. Montgomery, who has enjoyed ample opportunities of investigating the subject, and has spared no pains in forming a correct opinion. The value of the corpus luteum as a sign of actual or pre-existing conception has been a subject of dispute ; but the balance of authority and the weight of the greatest names is decidedly in its favour.* The concluding observations of our author, comprising the statement of his own extensive opportunities of experience, and the strong conviction of his own mind, are well worth attention.

After citing the high authority of De Graaf, Haller, Haighton, Cruikshank, William Hunter, and Dr. Baillie, Dr. Montgomery adds the result of his own observations, " which have been now continued through a period of more than six years, during which time we never omitted a single opportunity within our reach for examining the bodies of women of all ages, and under all the varying circumstances of virginity, after intercourse, during gestation, and subsequent to delivery at different periods from conception ; these opportunities having been afforded by more than one large hospital, as well as in private practice. We have also dissected hundreds of the inferior animals with reference to this point, and have in our museum preparations of ovaries, exhibiting the corpus luteum in different conditions in the human female, and also in cows, mares, sheep, sows, goats, bitches, cats, hares, rabbits ; and our firm conviction is of the truth of both Haller's propositions, viz. that ' *conception never happens with-*

* For a very learned and able exposition of the opinions of authors, and a judicious commentary on the same, see Montgomery, Cyc. Pract. Med. vol. iii. pp. 499, et seq.

out the production of a corpus luteum,' *and that* '*the corpus luteum is never found in virgin animals, but is the effect of impregnation.*' And we think that those who have supposed or asserted that they may exist without impregnation, and of course be found in the virgin ovary, have been led into the error by confounding appearances and structures essentially different, and in fact having only one character in common, which is their colour, altogether forgetting that '*every yellow substance in the ovary is not a corpus luteum.*' It is allowed by those writers that '*the corpora lutea of virgins may in general be distinguished by their smaller size, and by the less extensive vascularity of the contiguous parts of the ovarium.*' Now we have seen several of these virgin corpora lutea, as they are unhappily called, and have preserved several specimens of them, and according to our experience they differ from those of impregnation in all the following particulars:—1. There is no prominence or enlargement of the ovary over them; 2. the external cicatrix is wanting; 3. there are often several of them in both ovaries, especially in patients who have died of tubercular diseases; 4. they are not vascular, and cannot be injected; 5. their texture is sometimes so infirm, that they seem to consist merely of the remains of a coagulum, and at others appear fibro-cellular, and resembling that of the internal structure of the ovary; but in no instance did we ever see them presenting the soft, rich, and regularly granular appearance which Hunter meant to express when he described them as '*tender and friable like glandular flesh;*' 6. they have neither the central cavity, nor the radiated cicatrix which results from its closure."

Dr. Paterson of Leith, who has discussed the value of the corpora lutea in two able papers,* comes to the following conclusions respecting them: "False corpora lutea in the human female arise, 1. from the bursting and subsequent filling of a vesicle with blood, as in menstruation. 2. From partial effusion of blood into a vesicle, either with or without rupture of it. 3. By re-absorption of the fluid of a morbidly enlarged Graafian vesicle, giving rise to a puckered cyst. 4. From effusion of blood into the tissue of the ovary—the apoplexy of the organ. 5. Tubercular deposits. 6. Cysts filled with yellow fatty matter. These are to be distinguished from the true corpus luteum by the following marks:—They in general have an irregular form. They want the central cavity lined with a distinct membrane, or the central puckered cicatrix. They have no concentric radii. They are frequently numerous in both ovaries."

On the trial of Mr. Angus of Liverpool for the murder of Miss Burns, the discovery of a corpus luteum in the ovary of Miss Burns served to prove the fact of recent pregnancy in the face of much difference of opinion as to the conclusions to be drawn from the appearance of the uterus itself.†

* Ed. Med. and Surg. Journal, Jan. and Oct. 1840.

† See this case at length, Beck, p. 181.

Questions of a Medico-legal Nature connected with Pregnancy.

These questions are 1. Can a woman conceive while in a state of unconsciousness? 2. Can a woman remain ignorant of her pregnancy up to the time of delivery? 3. Does the presence of the hymen rebut the supposition of pregnancy? And 4. Is superfœtation possible?

1. Can a woman conceive while in a state of unconsciousness? The answer to this question must be in the affirmative, for there is no doubt that a participation on the part of the female in the act of sexual intercourse is not necessary to conception, and as little doubt that intercourse may take place and the female remain quite unconscious of what has happened. Capuron says, "It is a fact which experience has more than once confirmed, that a woman may become with child while in a state of hysteria, under the influence of narcotics, during asphyxia, drunkenness, or *deep sleep*, and consequently without being conscious of it, or sharing the enjoyment of the man who dishonours her." To prove the possibility of intercourse and consequent conception under the use of narcotics, the following cases may be cited: Capuron gives the case of a young woman who conceived during a deep sleep produced by punch given her by her paramour, and who became aware of her condition for the first time when she felt the motions of the child in the fourth month. Another case of the same kind is mentioned by M. Desgranges in a letter to Foderé.* He says, "I am certain that it is possible for a female to conceive during sleep, by the fact of a young person who, in the midst of our revolutionary miseries (at Lyons) became the victim of the wickedness of a young man and one of his relations. He enjoyed her during the effect of a strong dose of opium, and she became pregnant without knowing it, and with the assurance that she had never exposed herself to the risk of it." The following case is cited by Beck:†—"A pregnant female in her last moments solemnly declared that to her knowledge she never had connexion, but that a person in the family some time previous had given her some wine to drink, after which she fell into a profound sleep. She was not, however, conscious of anything having occurred during that state, but mentioned the circumstance as probably explaining her situation."

As examples of conception taking place from intercourse during profound sleep, the following cases may be cited: "A maid at an inn, who was always thought to be virtuous, and bore a good character, began to enlarge in a way which excited suspicions of pregnancy; she solemnly declared that she never had connexion with any man. At length she was delivered, and was afterwards brought before a magistrate to swear to the father; but she repeated her former declaration.

* Foderé, vol. i. p. 497. † Page 169.

Not long afterwards, a post-boy related the following circumstance: that one night he came late to this inn, put his horses into the stable, and went into the house; he found all gone to bed except this girl, who was lying asleep on the hearth-rug, and without waking her he contrived to gratify his desires."* Dr. Montgomery relates an analogous case, on the authority of Dr. Cusack: "A servant woman, at an hotel in Neuagh, proved pregnant, and solemnly declared that she was not conscious of having had intercourse with any man. Suspicion, however, fell upon an ostler in the establishment, who subsequently acknowledged that he believed he was the father of the child; that having found the woman in a deep sleep from fatigue, caused by long continued exertion, and being kept out of bed two or three nights in succession, he had connexion with her, and as he believed, totally without her knowledge, as she did not evince the slightest consciousness of the act at the time, or recollection of its occurrence afterwards: the parties were married with mutual consent."†

The possibility of conception taking place in consequence of unconscious connexion during asphyxia or apparent death, is proved by the following case: "A young friar being on a journey, arrived at a house where they were about to bury a young girl, whom they believed to be dead. He proposed to pass the night in the chamber with the coffin and watch the body. In the course of the night, while examining the body, his passions were so excited by the beauty still remaining, that he determined on satisfying them even under such circumstances. He departed early next morning, and in the course of the day, the apparently dead revived, proved to be pregnant, and at the end of nine months brought forth a child, to the great amazement of her friends as well as her own. The friar returned to the place about this time, confessed himself the father of the child, and married the mother, having procured absolution from his vows, which he had taken against his will."‡

It appears then that there are various states of system accompanied by insensibility, during which connexion may take place followed by conception, the female being quite unconscious of what has happened. In the cases just quoted, it seems highly improbable that the act of intercourse was accompanied by violence, for had it been so, the females could scarcely have failed to suspect the real cause of the injury which they had sustained. This leads to the second question.

2. *Can a Woman remain ignorant of her Pregnancy up to the time of Delivery?*—It is obvious that in the case first quoted this is quite possible. A woman who is not conscious of having exposed herself to the risk of becoming a mother, would naturally attribute her enlarge-

* Gooch, Compendium of Midwifery, pp. 81-2.

† Montgomery. Art. Pregnancy, Cyc. Pr. Med. vol. iii. p. 494.

‡ This case is quoted by several authors from the *Causes Celebres*, and may be found in Foderé, vol. i. p. 500.

ment, and all the symptoms of pregnancy accompanying it, to any cause but the true one. There is another case in which such ignorance is possible; and that is where the female has yielded to the solicitations of a lover in consequence of solemn assurances that under certain circumstances, connexion may take place without danger. Thus Foderé cites a case on the authority of M. Desgranges, in which a young girl, after resisting the repeated solicitations of her lover, yielded to his desires in a bath, under the assurance that in that situation she could not conceive. She became a mother, however, but appeared to remain ignorant of her situation till the last. M. Desgranges states that she always affirmed to him that the circumstance of the connexion having taken place in the water had removed all idea of pregnancy.* There is also an opinion prevailing that a single act of intercourse is unattended with danger; and another popular prejudice, that provided the act of intercourse is incomplete, and the hymen remains uninjured, impregnation is impossible. Foderé states that many cases have occurred of females asserting that they were not pregnant up to the last, on the strength of the precautions which they had taken.

Now in all such cases it is obviously possible that the female may attribute the symptoms of pregnancy to disease, and really believe what she so much desires should be true. But it is in the highest degree improbable that a woman who has had connexion under any circumstances should not have serious misgivings as to the real cause of her altered state, and as to the infallibility of the popular belief on which she had acted. In this, as in other things, the wish is father to the thought, and as the married woman, anxious for offspring, construes every unusual sensation into a sign of pregnancy, and makes serious preparations for the important event which is to crown her wishes, so the single woman, whose wishes all tend the other way, may sincerely attribute to any cause but the true one, every symptom of an event which threatens her with shame.

3. *Does the presence of the Hymen rebut the supposition of Pregnancy?* This question is easily answered, for it has already been shewn (p. 54) that the hymen may exist in spite of repeated intercourse, and that it may not be destroyed even by delivery. Its presence, therefore, does not negative the supposition of pregnancy.

4. *Is Superfœtation possible?*—As this question has an important bearing upon legitimacy, it demands a careful examination. Superfœtation is defined as the conception of a second embryo during the gestation of the first, the products of the two distinct conceptions being born either at the same or at different times. Some light is thrown

* Foderé, vol. i. pp. 496-7. Beck quotes this case as an illustration of the position, that ignorance of pregnancy may exist "when the female is an idiot." This case does not appear to me to be in point, for though M. Desgranges describes the girl as "assez niaise," there seems no good reason to regard her as an idiot.

upon this question by more than one well-authenticated case in which a woman has been delivered of twins of different colours, and both of them fully formed. The two following are taken from many similar ones quoted or referred to by Beck:* "A female at Charleston, in South Carolina, was delivered in 1714 of twins, within a very short time of each other. One was found to be black, and the other white. This variety of colour led to an investigation; and the female confessed that on a particular day, immediately after her husband had left his bed, a negro entered her room, and by threatening to murder her if she did not consent, had connexion with her." This case is related on the authority of Buffon. The following case is mentioned by Dr. Moseley as occurring within his time at Shortwood estate, in the island of Jamaica.: "A negro woman brought forth two children at a birth, both of a size; *one of which was a negro, and the other a mulatto.* On being interrogated upon the occasion of their dissimilitude, she said she perfectly well knew the cause of it; which was, that a white man belonging to the estate came to her hut one morning before she was up, and she suffered his embraces almost instantly after her black husband had quitted her."† A case still more remarkable than either of the foregoing is quoted from the Rev. Dr. Walsh's Notices of Brazil.‡ "It was communicated to me," says Dr. Walsh, "by the Sargenté Mor of the San José gold district (Brazil). A Creole woman with whom he was acquainted in the neighbourhood had three children at a birth, of three different colours, white, brown, and black, with all the features of the respective classes." In the first two cases there is nothing very remarkable. It is easy to imagine conception taking place in the same ovary or in different ovaries, from the nearly simultaneous application of semen, whether of the same man or of different men.

Now these are cases in which the two children are of the full size, and differ in nothing but colour from children of one father and one conception. There is another class of cases equally easy to believe and to understand, in which the birth of two children is separated by a short interval, or by an interval closely corresponding to their respective size and degree of development, on the supposition of their being twins. Of the former class of cases the following, taken from the *Consilia* of Zacchias, is an example:—"J. N. Sobrejus lost his life in a quarrel, leaving his wife pregnant. Eight months after his death she was delivered of a deformed child, which died in the birth. Her abdomen remained large, and it was suspected that a second infant was contained in it, but all efforts to procure its delivery proved fruitless. One month and a day thereafter, the widow was again taken in labour, and brought forth a per-

* Page 160.
† Moseley on Tropical Diseases, &c. p. 111.
‡ Vol. ii. p. 90.

fect living child. The relations of the husband contested its legitimacy, on the ground that it was the fruit of a superfœtation, and Zacchias was consulted on the subject. He agreed that the two infants could not have been the product of one conception, since the interval between their birth was so great: but advanced it as his opinion, that the *first* was the product of a superfœtation, and conceived a month after the other. This he strengthened by the fact that the husband died suddenly while in a state of perfect health. His opinion preserved the character of the mother, and also gave her those legal rights to which her situation entitled her." Zacchias seems, in this case, to have chosen the most improbable of two suppositions. It is certainly more easy to suppose that the birth of twins, the product of the same conception, may take place at two different times, than that they should be the products of two different conceptions; and it is by no means easy to understand on what data Zacchias could found his opinion that the child first born was the last conceived. In a question of so much difficulty, the wisest course seems to be to prefer that interpretation which involves the least difficulty, and which is most consistent with experience. Now the expulsion of twins at different times is allowed to be a common event, of which examples are to be found in most works on midwifery. The most feasible opinion, then, seems to be, that this was a case of twins conceived at the same time, but of which one was discharged before the other.

But there are cases on record which do not admit of so easy an explanation, and which certainly countenance the theory of a double conception.

"The wife of Raymond Villard, of Lyons, married at the age of twenty-two, and became pregnant five years thereafter, but had an abortion at the seventh month, on the 20th of May 1779. She conceived again within a month; and on the 20th of January 1780, eight months after her delivery, and seven months from her second conception, she brought forth a living child. This delivery was not, however, accompanied with the usual symptoms—no milk appeared, the lochia were wanting, and the abdomen did not diminish in size. It was accordingly found necessary to procure a nurse for the child.

"Two surgeons visited the female, and were at a loss with respect to her situation. They called Dr. Desgranges in consultation, who declared that she had a second child in the womb. Although this was strongly doubted, yet, three weeks after her delivery she felt the motions of the fœtus; and on the 6th of July 1780, (five months and sixteen days after the first birth), she was again delivered of a living daughter. The milk now appeared, and she was enabled to nurse her offspring."

It is not possible, adds Dr. Desgranges, that this second child could have been conceived after the delivery of the first, for no sexual inter-

course took place between the husband and wife till twenty days after, which would have made the age of the second child only four months twenty-seven days.

The narrative of this case was accompanied by a legal attestation of it under the oath of the mother; and on the 19th of January 1782, both children were still living *

Assuming that the facts of this case are correctly stated, it must be admitted to be nearly conclusive as to the possibility of superfœtation; for if we deny this, and assume both children to have been the product of a simultaneous conception, and the last child to have been at full term, the first child, which, be it remembered, in common with the other survived its birth between one and two years at the least, must have been born alive at three months and a half; or, if the first child be admitted to be seven months old, the second must have been born alive at six weeks, which is obviously absurd. The only other possible supposition is also in the highest degree improbable, viz. that the second child was the fruit of sexual intercourse taking place subsequent to the delivery of the first. If such were the fact, a child born at about the end of the fifth month was reared! As no allusion is made to any peculiar difficulty in rearing the child, this supposition must be regarded as inadmissible."

Dr. Maton has also related a well-authenticated case, in which two male children (both of which were "born perfect") were brought forth at an interval of nearly three calendar months. If this had been a case of simultaneous conception the one would have been six months or less, the other nine months or less.†

Additional cases are referred to by Beck, in three of which there was an interval of one month, in two an interval of two months, and in one an interval of four months.

In deciding this question, those cases only must be admitted to have any weight in which the interval between the births is considerable; for, where the interval is short, if we suppose the child last born to be mature, the first may have been eight or seven months old, which is quite reconcileable with the supposition of its being reared. When, however, the interval is one of four months, if we assume, as before, that the child last born is mature, the first cannot be more than five months old, an age at which it is in the highest degree improbable that a child could be reared.

In any cases that may hereafter occur, it will be important to observe the size and degree of development of the children, as this must always be an essential element of the inquiry. But it must not be forgotten that even the products of the same conception may differ greatly in size, and yet both be healthy children.

This fact is well illustrated by a case brought under my notice

* Foderé, vol. i. pp. 484-6. † Beck, pp. 181-2.

by Mr. Streeter, in which female twins, five and a quarter months old, were born enveloped in a common chorion. The one was more than twice the size of the other, but the smaller fœtus alone had made successful efforts to respire.*

If the single case of the wife of Raymond Villard be allowed to be correctly stated, the doctrine of superfœtation must be admitted to be highly probable ; but, as there may still be room for doubt, it may be useful to subjoin the chief arguments employed by the advocates and opponents of that doctrine.

The opponents of superfœtation allege that the occurrence is impossible, because 1. shortly after conception the os tincæ, as well as the internal apertures of the Fallopian tubes, are closed by a thick tenacious mucus. 2. The membrana decidua, which is also formed soon after conception, lines the uterus, and aids in obliterating the openings into its cavity. 3. That when the uterus is impregnated, the Fallopian tubes, instead of running horizontally to the ovaria, lie parallel to the sides, so that if a second embryo were formed within the ovarium, the tubes could not embrace it in order to convey it to the uterus. And 4. that the arrival of a new embryo in the uterus would prove destructive to the first.

The last objection is founded upon a bare assumption, and may therefore be summarily dismissed. The third objection, if valid, must prove fatal to the doctrine of superfœtation ; but though this obstacle may exist in the fully developed uterus, the ovary and Fallopian tubes are not more prevented from coming into contact with each other in the early stage of utero-gestation, at which alone superfœtation is alleged to take place, than in the unimpregnated state. The answer to the first two objections is an obvious one. Neither the tenacious mucus nor the newly-formed decidua, though in contact with the orifices and cells of the uterus, adheres so firmly to it as not to admit the passage of the aura seminis, or even of the semen itself. The fact of menstruation in numerous cases occurring during a part or the whole of pregnancy seems to prove, that the adhesion of this tenacious mucus and of the decidua is by no means so firm as to forbid the passage of fluid ; and this argument is strengthened by the frequent occurrence of hæmorrhage in the advanced stages of pregnancy in consequence of partial detachment of the placenta. The arguments advanced against the doctrine of superfœtation are certainly not of weight sufficient to set aside such cases as those already adduced ; and until those cases can be shown to be untrustworthy, we have no alternative but to admit the truth of the doctrine.

If, then, we admit the possibility of superfœtation, the question arises, Can we explain this occurrence in such a manner as to avoid the objections of its opponents? The existence of double uteri, and

* Ed. Med. and Surg. Journal, No. 150.

more rarely of double vaginæ also, suggests the required explanation; and as the recorded cases of this malformation are much more numerous than those of superfœtation, it is quite possible that some of the latter may be explained by the malformation in question.*

That this malformation does really explain some cases of superfœtation is proved by a case related by Scheider of a woman who, six weeks after marriage, bore a four months's child, and forty weeks after marriage mature twins. On examination, the uterus and vagina were both found double, and each vagina had a separate orifice.† It must be recollected, however, that this is a solitary case of the co-existence of superfœtation and a double uterus. Though some other cases may possibly have depended on the same malformation, there is no reason to believe that this was the case in all.

As the subject is one of considerable importance, it is to be hoped that those who may meet with cases bearing upon it will publish them with every detail which can throw light upon the question.

Delivery.

Delivery, concealed and pretended.—Cases of pretended Delivery.—Signs of Recent Delivery in the Living.—Their rapid Disappearance.—In the Dead.—Signs of Delivery at a former and more remote Period.—Unconscious Delivery.

Delivery, like pregnancy, may be either concealed or pretended;—concealed, with a view either of hiding shame, or of effecting the destruction of the child; and pretended, in order to produce a supposititious heir to an estate, to influence the feelings of a paramour with a view to marriage, or to satisfy the wishes or appease the anger of a husband.

The following are cases of pretended delivery:—

"A young woman having granted her favours to a lover who had seduced her, under the promise of wedlock, feigned pregnancy, in the hope of hastening the celebration of her marriage; but the lover refused to ratify the solemn engagement into which he had entered, and she therefore determined to carry on the imposition, with a view to conciliate his affections, and to secure his future protection and support. For this purpose, after a proper interval had elapsed, she confined herself for several days to her bed-chamber, and having stained her linen and bed with bullock's blood, she openly declared that she had been

* Dr. Cassan (Récherches sur les cas d'Utérus double. et de Superfœtation,) has collected forty-one cases, in three of which both uterus and vagina were double; and Beck has added eleven others, in three of which the vagina was double.

† Müller's Archives 1836; and London Med. Gaz. vol. xx. p. 408.

delivered, and that the infant had been committed to the care of a nurse. The young man, however, notwithstanding this supposed new pledge of affection, remained obdurate, and persisted in his refusal to complete his engagement; in consequence of which all intercourse between the parties ceased, until after the lapse of two years, when the alleged father claimed his child. In answer to this application, the young woman confessed the deception which she had been induced to practise; but the criminal department of the Seine, before whom she was summoned, hesitated to give credence to her tale: upon which a personal inspection was instituted by Capuron, Maygrier, and Loyer Villermay, in order to decide whether the woman in question had ever been delivered; and as the result of this inspection enabled the professors to decide in the negative, the prisoner was immediately discharged."

"A similar instance of pretended delivery occurred at Sirakoso, in the circle of Posen. A young woman, anxious to fulfil the violent desire of her husband to have an heir, pretended to have been suddenly and unexpectedly delivered, and stole an infant in order to support the fiction. The case was rendered more atrocious from the real mother having, in consequence of the theft, been subjected to the accusation of infanticide. The fact was, however, happily discovered, and the culprit has been delivered to the punishment due to her crime."

Dr. Male relates a case of pretended delivery which occurred in his own town. "A surgeon was called to a pretended labour, when a dead child was presented to him, but there was no placenta. He therefore proceeded immediately to examine the woman, when he found the *os tincæ* in its natural state, nearly closed, and the vagina so much contracted as not to admit the hand. Astonished at this circumstance, he went to consult a medical friend; but before any further steps were taken, it was discovered that he had been imposed upon; the woman, in fact, had never been pregnant, and the dead child was the borrowed offspring of another. It appears that she was induced to practise the artifice to appease the wrath of her husband, who frequently reproached her for her sterility."*

The medical man, then, may be called upon for medico-legal purposes to ascertain the existence of delivery in concealed cases, and its non-existence in pretended cases. The latter class of cases is comparatively rare, but the former is of frequent occurrence; especially in accusations of infanticide, when having discovered that a child has been destroyed, we are called upon to examine the suspected mother with a view to determine whether she has been recently delivered. The subject of delivery, therefore, becomes one of considerable importance.

In treating this subject the following order will be adopted: 1. The signs of recent Delivery in the Living. 2. The signs of recent Deli-

* These cases are quoted by Paris and Fonblanque, vol. i. p. 250.

very in the Dead. 3. The signs of Delivery at a more remote period. 4. Medico-legal questions connected with Delivery.

1. *Signs of recent Delivery in the Living.*—When an examination is made within a few days after delivery, the following appearances are present:—

1. The *countenance* is pale, resembling that of a person recovering from a slight illness, and the eye is sunken and surrounded by a brownish circle. The pulse is increased in frequency, and the skin is soft and warm, and moistened with a perspiration of a peculiar and unpleasant odour.

2. The *breasts*, especially if examined on the third or fourth day after delivery, are found full, tense, and knotty, and when pressed or drawn yield a milky fluid. The nipples are turgid, and the areola dark, and presenting the appearances already described under the head of Pregnancy.

3. The *abdomen* is distended, its integuments relaxed and thrown into folds, and its lower part from the pubes to the umbilicus marked by light-coloured broken streaks or cracks. On pressing the hand firmly over the pubic region, we feel the tumour produced by the imperfectly contracted uterus, about the size of the head of a new-born child, rising three or four inches above the brim of the pelvis, and inclining more to one side than the other.

4. The *external parts of generation* bear distinct marks of the distension and injury which they have recently undergone. They are swollen and relaxed, and not uncommonly bruised and torn, especially after a first labour. In first deliveries, also, the fourchette is often ruptured, and the injury sometimes extends deep into the perineum.

5. On examination per vaginam we discover the *uterus* enlarged, and corresponding with the external tumour, the os uteri gaping, so as to admit two or three fingers, and its margins relaxed and flabby, and seeming as if divided by several small fissures. If the examination is made within a few hours after delivery, the orifice is so open that its margins cannot be distinguished, and it seems to be a continuation of the vagina. The vagina itself is also relaxed and dilated, and its internal surface is smooth from the obliteration of the rugæ.

6. The *lochia*. From the time of delivery and for the first two or three days, but in some instances much longer, a sanguineous discharge flows from the genitals. It then becomes nearly colourless, or acquires a light brown or dirty greenish hue, whence the vulgar name "green waters." This discharge has a peculiar, sour smell, resembling that of fish-oil, and one which it is impossible to destroy.*

The value of these signs of recent delivery entirely depends upon their being found in combination; for, when taken separately, they are not conclusive; and in some cases one or more may be absent, or

* Beck.

but slightly developed. The uterus and vagina may be enlarged, and the external parts injured by a tumour of any kind recently expelled, and this may be followed by a discharge from the genitals. The breasts, moreover, may enlarge and secrete milk, from sympathy with the distended uterus, and the abdomen may display all the marks of recent distension. It is, therefore, by taking all the signs in combination, and even then only when the more certain of them are strongly marked, that we can decide on the fact of recent delivery.

It is of the first importance that the examination should be made without delay ; for even in cases in which the signs of delivery are most strongly marked, they may disappear before the tenth day ; and as a general rule it may be stated, that after that date no satisfactory results are to be expected. In many cases, it will be difficult to give a decided opinion even before this period has elapsed. Much depends on the relative size of the fœtus, and on the constitution of the mother. In cases of abortion occurring in the early months, the appearances would be slight and evanescent, and before the end of the second month it is generally admitted that no evidence of recent abortion would be discoverable. All these circumstances must be taken into account in forming our decision.

The case of Aimée Perdriat may be cited in this place, to show how completely the signs of delivery may have disappeared after the lapse of a few weeks. On the 11th of June, early in the morning, Aimée Perdriat left her master's house, and went to that of a friend named Rosina, living in the fifth story of the house, begging permission to lie down, as she was unwell with colic. In about an hour afterwards, a person living on the third story heard an extraordinary noise in the water-pipe, as if a heavy body was falling through it. Aimée was not visited by any one, except Rosina and another young girl, who came to ask if she wanted anything. About five hours afterwards, Rosina observed blood on the stairs and on the floor of the room, and Aimée remarked, that her menses were flowing very profusely. Suspicion was excited, and on the 17th the privy was opened, when a child, placenta, and two bloody cloths were found. Two surgeons examined the body, and reported that there were no marks of violence present, except that the umbilical cord was *torn* off ; that it was a full-grown child, and in their opinion had breathed after birth, and had fallen alive into the place from whence it was taken. Aimée was arrested on suspicion of being the mother of this child, and the suspicion was increased by her refusing to submit to the examination of a midwife, and having absconded from Paris. She was brought back ; and on the 15th, 17th, and 27th of July, being more than a month after the supposed delivery, she was examined by Bandeloque, Dubois, Ané, Dupuytren, and Lafarge, who declared that they could not discover any sign indicative of delivery having taken place at the time in question. In consequence of this, she was acquitted, the

judges leaning to the side of mercy; but the circumstances of the case impress us with a moral conviction of the woman's guilt.*

2. *Signs of recent Delivery in the Dead.*—The external parts will, of course, present the same appearance in the dead as in the living. On opening the cavity of the abdomen, we find the uterus presenting different appearances, according to the time which has elapsed between delivery and death. If death has taken place immediately after parturition, the uterus will be found flat and flabby, from 9 to 12 inches long, the os uteri wide open, its cavity containing large coagula of blood, and the internal surface lined by the soft and pulpy remains of the decidua. The attachment of the placenta is distinctly visible, characterised by its darker colour, the small number of flocculi, and the semilunar openings upon its surface.

The size of the uterus at periods more remote from delivery varies with the degree of contraction which has taken place. In the first two or three days after delivery of a mature child, it may be stated to be about seven inches long by four broad; its external surface is vascular, and marked by purple patches; when divided it is found to be from an inch to an inch and a half in thickness, of the colour and consistence of firm muscular fibre. Its internal surface retains the appearances just described. At the end of a week, the length of the uterus is between five and six inches. It is now about an inch in thickness; less vascular, but more firm in texture. The inner surface is still bloody, and partially covered by decidua. At the end of a fortnight the length of the uterus does not exceed five inches, and after the lapse of a month it has resumed its original size, but the os uteri never closes so completely as in the virgin state.

The Fallopian tubes and one or both of the ovaries are found turgid and vascular, and presenting the characters already enumerated (p. 82).

When the appearances now described are well marked, it will be quite impossible to hesitate as to the cause of them.

3. *Signs of Delivery at a former and more remote period.*—The signs of a former delivery are by no means of so marked a character as to be decisive. The external marks consist of silvery lines, or "shining broken streaks, like the remains of cracks," on the skin of the breasts and abdomen. These are often absent, and when present they furnish proof merely of great previous distention from whatever cause, followed by sudden subsidence. The marks on the abdomen are, for obvious reasons, the most fallacious; but those on the breasts are extremely unlikely to be caused by any other form of distention. When these two are found in combination, they furnish strong evidence either of a former delivery, or of some distention of the uterus producing sympathetic enlargement of the breasts. An experienced hand will detect in the os uteri a peculiar, jagged condition, on which much stress has been

* Foderé, tome ii. p. 18.

laid as evidence of a former delivery. The marks of a previous rupture of the fourchette or perineum will also tend to confirm the evidence derived from the external examination of the abdomen and breasts. On the other hand, we may find negative evidence of a still more satisfactory character; as, for instance, an entire hymen, which must disprove the delivery of a mature child, or such a state of imperforation or narrowness of the parts as is quite inconsistent with the idea either of pregnancy or delivery. The following case will serve to illustrate the difficulty which in many cases exists of proving the fact of a previous delivery:—"We very lately examined a patient who had borne five children, and nursed three of them, the youngest being now five years old; the breasts were small, but neither flaccid nor pendulous; the nipples short, with not the least shade of brown colour in the areolæ, which exhibited only the delicate rose colour so often observed on that part of the virgin breast; there were neither lines nor spots of any kind on the abdomen; the os uteri was small and natural; the vagina contracted, and the fourchette perfectly entire. It should be mentioned that this lady never carried her children beyond the end of the eighth month."*

4. *Medico-legal Questions connected with Delivery.*—There are two questions of this kind connected with the subject of delivery; the one is, can a woman be delivered, and be unconscious of it? the other, can a woman, if alone and without assistance, prevent her child from perishing after delivery? The first of these questions alone will be examined in this place; the second belongs more properly to the subject of Infanticide.

Can a woman be delivered and be unconscious of it? This question can be answered in the affirmative. The event may happen under the following circumstances:—

a. Under the influence of narcotics or ardent spirits. This happened in a case quoted by Foderé from the *Causes Célèbres.*† It was that of the Countess de Saint Géran, who, in the year 1641, was delivered of a boy whilst stupefied by narcotics. In the morning she awoke, and found herself bathed in blood, and the infant gone. Her relations had suborned individuals to remove it. These individuals were afterwards discovered, and the child was restored to its rights.

b. During coma, delirium, or puerperal convulsions; one case of this kind is mentioned by Hippocrates. The female was delivered during coma attendant upon typhoid fever. Dr. Cheyne‡ also relates a case of a female delivered of a living child during an attack of apoplexy.

c. During sleep. Dr. Montgomery cites two cases of this kind; one on the authority of Dr. Douglas, and the other from the London Practice of Midwifery.§ The last case is as follows: "A lady of great respectability, the wife of a peer of the realm, was actually deli-

* Montgomery, Cyc. Pract. Med. vol. iv. p. 504.
† Foderé, vol. ii. p. 10. ‡ Essay on Apoplexy.
§ Fifth edition, p. 87.

vered once in her sleep: she immediately awaked her husband, being a little alarmed at finding one more in bed than was before."

d. During suspended animation, or even after death. This fact rests on high authority.* Thus Dr. Hoyer of Mulhausen gives an account of a female dying in labour, who was laid out for interment, and in this situation an infant was suddenly born.† Cases of unconscious delivery are of rare occurrence, but especially during sleep, and it is highly improbable that this should happen in a female pregnant for the first time. In women, however, who have borne many children, and who have naturally easy deliveries, such an event must be admitted to be possible.

The subject of delivery is best brought to a close by the following summary by Dr. Montgomery: ‡

1. The signs of delivery are most distinct after the birth of a full-grown child; and least so when the uterine contents have been expelled at an early period of pregnancy.

2. The proofs are more distinct in proportion to the recency of the delivery, and any examination made after the lapse of ten days from the time of the delivery is not likely to afford satisfactory information, the most decisive signs in general disappearing within a week.

3. The third or fourth day generally presents the results of delivery very distinctly, the condition of the breasts being then most remarkable from the active secretion of milk.

4. A first delivery is more easily detected than subsequent ones.

5. We cannot safely rely on any of the signs of delivery, viewed separately, but must consider them collectively, and their mutual relation and correspondence with each other, and with the other collateral circumstances of the woman's case and history.

6. The chief points of attention ought to be the state of the external parts and of the breasts.

7. There are certain physical signs which, when present, are sufficient to establish a negative decision; such are, for instance, a perfect hymen,§ or an imperforate state of the parts.

8. But, on the other hand, a woman may have borne children, and no one mark remain by which the fact of delivery could be proved after the lapse of even a few weeks.

9. A woman may be delivered while in a state of insensibility, or even during deep natural sleep; so that the child may perish merely from want of attention, and without any moral delinquency on her part.

* Montgomery refers to cases from Foderé, Buffon, Leroux, Levret, Baudelocque, Bichat, Hartemann, &c.

† Foderé, vol. ii. p. 11. ‡ Cyc. Pract. Med. vol. iii. p. 509.

§ For exceptions to this statement see p. 54.

CHAPTER IV.

FŒTICIDE, INFANTICIDE, LEGITIMACY.

NEITHER of these subjects can be understood without a preliminary knowledge of the growth and development of the Embryo and Fœtus. This subject therefore, will be treated separately.

ON THE GROWTH AND DEVELOPMENT OF THE FŒTUS.

It is commonly asserted that no distinct ovum containing a defined embryo can be discovered in the uterus before the 20th or 22nd day. Much of this interval is consumed before the ovum reaches the uterus. In rabbits three days elapse, and in the bitch from six to eight, whilst the ovum is being conveyed through the Fallopian tube to the uterus ; and it is probable that at least the same period is occupied by the transit of the human embryo.

The period here assigned for the first appearance of the embryo is not the earliest at which it is distinctly visible, for Velpeau, one of the best authorities on the subject of the embryo, tells us that on three occasions he has had an opportunity of examining the ovum when it could not have exceeded twelve days from conception.* Sir E. Home also relates a case in which he found an ovum of a very minute size in the uterus only eight days after impregnation.†

At 14 days the embryo measures about one-twelfth of an inch, at three weeks about one-tenth, and at 30 days from 3 to 5 lines. At this latter period it has been compared in size to a large ant, a barley-corn, a house-fly, or the malleus of the tympanum. Commencing with this period of a month, I shall describe the size, weight, and general appearance of the fœtus for the several periods of utero-gestation, and in doing so shall avail myself chiefly of the description of Devergie.‡

Embryo, Three to Four Weeks.—Length, 3 to 5 lines. *Weight*, about 20 grains. *Form*, that of a serpent, the head indicated by a swelling, the caudal extremity slender, and terminating in the umbilical cord ; the mouth indicated by a cleft ; the eyes by two black points ; the members beginning to appear as nipple-like protuberances ; the liver occupying the whole abdomen; the bladder large. The chorion villous; but the villosities uniformly diffused over the surface.

Embryo of Six Weeks.—Length, from 7 to 10 lines. *Weight*, from 40 to 75 grains. The face distinct from the cranium ; the apertures

* Embryologie, p. 50. † Gooch's Midwifery, p 88.
‡ Médicine Légale, vol. i. art. Infanticide.

of the nose, mouth, eyes, and ears perceptible ; the head distinct from the thorax ; the hands and forearms in the middle of the length, and the fingers distinct ; the legs and feet situated near the anus ; there is a distinct umbilicus for the attachment of the cord, which consists of the omphalo-mesenteric vessels, of a portion of the urachus, of a part of the intestinal tube, and of filaments which represent the umbilical vessels. The placenta begins to be formed ; the chorion and amnion are still separated ; the umbilical vesicle very large. *Points of ossification* in the clavicle and maxillary bone.

Embryo of Two Months.—Length, from 16 to 18 lines (Devergie), 4 inches (Maygrier). *Weight*, 2 to 4 drachms (Devergie), 5 drachms (Maygrier). Rudiments of the nose and lips ; palpebral circle beginning to appear ; the arms and legs detached from the trunk ; clitoris or penis apparent ; anus marked by a dark spot ; rudiments of lungs, spleen, and supra-renal capsules ; cœcum placed behind the umbilicus ; digestive canal withdrawn into the abdomen ; urachus visible ; chorion beginning to touch the amnion at the point opposite the insertion of the placenta ; placenta beginning to assume its regular form ; umbilical vessels becoming twisted. *Points of ossification* in the frontal bone and in the ribs.

Embryo of Three Months.—Length, 2 to 2½ inches (Devergie), 3 inches (Hamilton and Burns), 6 inches (Maygrier). *Weight*, 1 oz. to 1½ oz. (Devergie), 2 ounces (Burns), 2½ ounces (Maygrier). The head voluminous ; the free margins of the eyelids in contact ; membrana pupillaris visible ; mouth closed ; fingers completely separated ; inferior extremities of greater length than the rudimentary tail ; clitoris or penis very long ; thymus as well as supra-renal capsules present ; cœcum placed below the umbilicus ; cerebrum 5 lines, cerebellum 4 lines, medulla oblongata 1½ line, and the medulla spinalis ¾ of a line, in diameter ; the two ventricles of the heart distinct. The decidua uterina and decidua reflexa in contact ; the funis containing umbilical vessels and a little of the gelatine of Warthon ; placenta completely isolated ; the umbilical vesicle, allantois, and omphalo-mesenteric vessels have disappeared.

Fœtus of Four Months.—Length, 4 inches (Gardien), 5 inches (Burns, Hamilton, Ramsbotham), 5 to 6 inches (Devergie, Velpeau, Capuron), 6 to 7 inches (Orfila), 8 inches (Maygrier). *Weight*, 2½ to 3 ounces (Devergie), 4 to 6 oz. (Capuron), 5 to 7 oz. (Orfila), 7 to 8 oz. (Maygrier). Skin rosy and tolerably dense ; mouth very large and open ; membrana pupillaris very evident ; nails beginning to appear ; genital organs and sex distinct ; cœcum placed near the right kidney ; gall-bladder appearing ; meconium in duodenum ; cœcal valve visible ; umbilicus placed near the pubes. Complete contact of chorion and amnion ; membrane forming at point of attachment of the placenta to the uterus. *Points of ossification* in the inferior part of the sacrum ; ossicula auditoria ossified.

Fœtus of Five Months.—Length, 6 to 7 inches (Devergie, Burns,

Hamilton, Dewees), 9½ inches (Lécieux), 10 inches (Maygrier, Soemmering). *Weight*, 5 to 7 ounces (Devergie). The volume of the head still comparatively great ; nails very distinct ; hair beginning to appear ; skin without sebaceous covering ; white substance in cerebellum ; heart and kidneys very voluminous ; cœcum situated at inferior part of right kidney ; gall-bladder distinct ; meconium of a yellowish-green tint occupying commencement of large intestines. *Points of ossification* in pubes and os calcis ; germs of the permanent teeth.

Fœtus of Six Months.—Length, 8 or 9 inches (Burns, Hamilton), 9 to 10 inches (Devergie), 12 inches (Maygrier, Lécieux). *Weight*, 1 lb. (Burns, Hamilton, Devergie), 2 pounds (Maygrier). Skin presents some appearance of fibrous structure ; eyelids still agglutinated ; membrana pupillaris still existing ; sacculi begin to appear in the colon ; the funis inserted a little above the pubes ; face of a purplish red ; hair white or silvery ; sebaceous covering beginning to appear ; meconium in the upper part of the large intestines ; liver of dark red colour ; gall-bladder contains insipid serous fluid ; testes near kidneys. *Points of ossification* in the four divisions of the sternum. Middle point of the body at the lower end of the sternum.

Fœtus of Seven Months.—Length, 11 to 12 inches (Hamilton, Devergie), 12 inches (Granville), 14 inches (Maygrier, Lécieux). *Weight*, 2 to 3 lbs. (Maygrier), 2 to 4 lbs. (Granville), 3 to 4 lbs. (Devergie). Skin of rosy hue, thick and fibrous, and covered with sebaceous matter ; nails not reaching to the ends of the fingers ; eyelids no longer adhering ; membrana pupillaris disappearing ; meconium occupying nearly the whole of the large intestine ; valvulæ conniventes beginning to appear ; cœcum placed in the right iliac fossa ; left lobe of liver almost as large as the right ; gall-bladder containing bile ; brain firmer ; testicles more distant from kidneys. *Point of ossification* in the astragalus. Middle point of the body a little below the end of the sternum.

Fœtus of Eight Months.—Length, 13 to 15 inches (Devergie), 14 to 15 inches (Hamilton), 16 inches (Maygrier, Lécieux), 17 inches (Granville). *Weight*, 4 lbs. (Maygrier), 4 to 5 lbs. (Granville, Devergie). Skin paler, covered with fine short hairs, and with a well-marked sebaceous envelope ; nails reaching to the extremities of the fingers ; membrana pupillaris disappears ; brain showing indications of convolutions ; testicles descend into the internal ring. *A point of ossification* in the last vertebra of the sacrum. The middle point of the body nearer the umbilicus than the sternum.

Fœtus at Nine Months, or Full Term.—Length, 16 to 18 inches (Devergie), 18 inches (Lécieux). *Weight*, 6¼ lbs. (Devergie). The head covered with hair from ¾ inch to 1 inch long ; skin covered with sebaceous matter ; membrana pupillaris absent : white and grey substances of the brain distinct ; liver descends to umbilicus ; testes have passed inguinal ring, and are frequently found in scrotum ; meconium at termination of large intestine. *Point of ossification* in the centre of

the cartilage at the lower end of the femur; os hyoides not yet ossified; four portions of occipital bone remain distinct; external auditory meatus still cartilaginous.

The most precise of the foregoing data for determining the age of the fœtus are the weight and length; and these, as it has been seen, are variously stated, by different authorities. As such standards of comparison are of frequent application in questions connected with the present chapter, the following tables, exhibiting at a glance the length and weight of the fœtus according to different authorities, are subjoined. That they may be more useful to the English reader, the French weights and measures are in this table converted into English.

Table showing the Weight of the Fœtus at different Ages, according to the Estimates of Authors.

Name.	Two months.	Three months.	Four months.	Five months.	Six months	Seven months.	Eight months.	Nine months.
Hamilton	. .	. .	. .	. .	more than 1lb.			
Burns	. .	2 oz.	. .	. .	abt. 1lb.	. .	4 to 5lbs.	7 lbs.
Capuron	. .	3 oz.	4 to 6 oz.	. .	. .	. .	. .	6 — 7
Maygrier	5 dr.	2½ oz.	7 to 8 oz.	1lb. 1oz.	2lbs. 2oz.	2lbs. 2oz. to 3lbs. 3oz.	4lbs. 4oz.	
*Orfila	2 to 4 dr.	1 to 1½ oz.	2½ to 3 oz.	5 to 7 oz.	1lb. abt.	2lbs 2oz.	3lbs. 4oz. to 4lb. 5oz.	4lbs. 5oz. to 5lbs. 7oz.
Devergie	2 to 4 dr.	1 to 1½ oz.	2½ to 3 oz.	5 to 7 oz.	1lb. 1oz.	3lbs. 4oz. to 4lbs. 5oz.	4lbs. 5oz. to 5lbs. 7oz.	6¾ lbs.
Velpeau	5 dr.	2½ oz.	7 to 8 oz.	1lb. 1oz.	2lbs. 2oz.	2lbs. 2oz. to 3lbs. 3oz.	4lbs. 5oz.	6½ — 7½

* 2nd month, 3rd month, &c.

Table showing the Length of the Fœtus at different Ages, according to the Estimates of Authors.

	Two months.	Three months.	Four months.	Five months.	Six months.	Seven months.	Eight months.	Nine months.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Hamilton	..	3	5	..	8 to 9	11 to 12	14 to 15	..
Burns	..	3	5	6 to 7	8 to 9	11 to 12	15	..
Ramsbotham	..	..	5	..	..	..	..	..
Capuron	2	3½	4¾	8	11	13¾	15 to 16	19¼
Chaussier	..	..	7½	10	13⅓	16	18	20¼
Maygrier	4¼	6⅓	8½	10½	12⅔	15	17	..
*Orfila	1½ to 1¾	3	4½ to 5⅓	6½ to 7⅔	9½ to 10½	11½ to 12¾	13¾ to 14¾	16 to 17
Devergie	1⅓ to 1½	2 to 2½	5⅓ to 6⅓	6⅓ to 7½	9½ to 10½	11½ to 12½	15 to 16	17 to 19¼
Gardien	..	..	4¼	..	..	..	..	..
Velpeau	..	..	5⅓ to 6¼	7½ to 8½	9½ to 10⅔	12¾	16	19¼
Foderé	..	..	6½	9¼ to 12¾	..	16 to 16¼	..	19¼ to 20⅓

* Second month, third month, &c.

To the foregoing tables of the weight and length of the fœtus, the following measurements by Bélard of the fœtal skeleton at different ages may be usefully subjoined. The numbers in the table represent the results of the examination of about fifty fœtuses at each of the periods indicated.

Age.	Length of the Skeleton.
2 months	4¼ inches.
3	6
4½	9
6	12
7½	15
9	18

Extremes 16 and 20 inches.

As the questions which are involved in a knowledge of the growth and development of the fœtus are of great importance, and the estimates given in the foregoing tables are obviously too general to be of much use in the decision of medico-legal questions, I have prepared two tables founded upon the accurate observations of different authors, and presenting not only the average weights and measures but the two extremes. It is obvious that the extreme values which have hitherto been so much neglected in all numerical investigations are precisely those which are most required. These are stated in the following tables, of which the first* presents the ascertained weight of the fœtus at the several ages specified, and the second the ascertained length, and in both cases the still-born are distinguished from those born alive: amongst the latter those only being included who had survived their birth one week or less. The foreign weights and measures have been carefully reduced to the English standard. The number of observations has been stated, in order that the value of the several results may be better appreciated, and that fresh observations may at any time be added.

The tables commence with the sixth month of utero-gestation, because previous to that age but a very small number of cases are on record. This is much to be regretted, as the fifth month is a period of peculiar importance in its bearing on certain questions connected with legitimacy.

Weight of the Fœtus.—For the period of five months the following facts are on record:—*Still-born*, one male, on the authority of Schmitt, 12·877 grains, or about 1 lb. 13½ oz.; and a female twin of five months and a quarter at the most, weighed by myself, 9406 grains, or about 1 lb. 5¾ oz. The other twin, also a female, which had breathed, weighed 4594 grains, or about 11 oz.

The weight of the fœtus at full term has been made the subject of many investigations, and as this point is of importance in itself, and interesting as throwing light upon the probable limits of variation at earlier periods of utero-gestation, a table, which exhibits at a glance the weight, according to different observers, is subjoined.† The foreign weights are reduced to the standard of the English pound avoirdupois.

* See page 105. † See page 106.

Table showing the Greatest, Least, and Average Weights of the Fœtus of both Sexes at different Periods of Utero-gestation.*

SEX.		Six Months.			Seven Months.			Eight Months.			Nine Months.		
		Still-born.	Born alive.	Both.	Still-born.	Born alive.	Both.	Still-born.	Born alive.	Both.	Still-born.	Born alive.	Both.
		4, 8, 12, obs.	7, 11, 18, obs.	11, 19, 30, obs.	15, 19, 36. obs.	20, 19, 43, obs.	35, 38, 79, obs.	20, 18, 43, obs.	31, 22, 57, obs.	51, 40, 100, obs.	70, 58, 143, obs	135, 88, 248, obs.	205, 146, 391, obs.
		lbs. oz.	lbs. oz	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Male	max.	2 14½	2 9¾ (5 1½)†	2 9¾	4 12½	6 2¼	6 2¼	7 4¾	7 15	7 15	13 10¾	11 15	13 10¾
	min.	1 9½	– 13¾	– 13¾	2 –	1 9	1 9	2 13¼	2 2½	2 2½	2 6½	2 8½	2 6½
	mean.	2 5¼	2 1½	2 2½	3 9⅔	3 7½	3 8	4 11	4 2	4 5½	7 4¾	6 –	6 7¾
Female	max.	3 12¾	2 15¾	3 12¾	5 4	5 5	5 5	6 4½	7 7⅓	7 7⅓	12 7⅓	14 –	14 –
	min.	– 14¼	1 4	– 14¼	1 5½	2 4½	1 5½	2 2¼	1 15	1 15	3 15	2 12	2 12
	mean.	2 1	2 3	2 2	3 6½	3 9½	3 8	4 3	4 6½	4 5	7 6	5 7¾	6 3¾
Male and Female	max.	3 12¾	2 15¾	3 12¾	5 4	6 2¼	6 2¼	7 4¾	7 15	7 15	13 14	14 –	14 –
	min.	– 14¼	– 13¾	– 13¾	1 5½	1 9	1 5½	2 2¼	1 15	1 15	2 6½	2 8½	2 6½
	mean.	2 1½	2 2½	2 2¼	3 8	3 7	3 8	4 6¾	4 4½	4 5¼	7 5	6 1½	6 8½

* This Table is founded upon 293 observations by Lécieux, 93 by Schmitt, 74 made under the direction of Bernt, 17 by Orfila, 16 by Devergie, 19 by Haartmann, 11 by Joerg, 20 by Mr. Alfred Taylor (of which a large proportion are contributed by Dr. Geogehan of Dublin), and 17 by myself. Smaller numbers of facts have been borrowed from Jäger, Mörrike, Dr. Brady, and others. For exact references to the authors see Ed. Med. and Surg. Journal, Nos. 140 and 150.

† This number is obviously too high, and must be considered as originating in an error or misprint.

Table showing the Average and Extreme Weights of the Fœtus at full Term, according to different Authorities.

	MAX.		MIN.		MEAN.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.
Quetelet of Brussels, 119 Observations.* §	9	14	2	8	6	11
Camus, 1541 Observ.	9	9	3	3	6	$10\frac{1}{4}$
Lécieux, 20,000 Observ.†	11	2	3	3	6	$10\frac{1}{4}$
Baudelocque‡ . .	13	13	3	$15\frac{3}{4}$	—	—
Dr. Macauley, British Lying-in Hospital.§ §	11	—	4	—	5 to 8	—
Dr. Clark, Dublin .	11	—	4	—	—	—
Observations in the preceding table. §	14	—	2	$6\frac{1}{2}$	6	$8\frac{1}{2}$

Many instances of weights greatly exceeding the average have been put on record by authors. Ramsbotham and Dr. W. Moore, of New York, give cases of 12 lbs., Ramsbotham and Baudelocque of $12\frac{3}{4}$ lbs., Baudelocque one of 13 lbs. 13 oz., Ramsbotham one of 14 lbs., Dr. Merriman one exceeding 14 lbs., Sir Richard Croft one, and Dewees two, of 15 lbs., Dr. Ramsbotham senior, and Dr. Moore, of New York, instances of $16\frac{1}{2}$ lbs. Greater weights than these are on record, and one of no less than 25 lbs.!

It is only necessary to add that still-born children are heavier than those born alive, males than females, single children, cæteris paribus, than twins, and twins than triplets, &c.

Length of the Fœtus.—The subjoined table arranged in the same way as that which presents the weights of the fœtus at different ages, has been, in like manner compiled from the facts stated by authors, the foreign measures being converted into English inches and twelfths of an inch. The measurements for the 5th month are few in number, and are as follows—Still-born, male, 13 inches, female, $12\frac{1}{2}$ inches; the first on the authority of Schmitt, the second a twin measured by myself. born alive, male $9\frac{1}{3}$ inches on the authority of Devergie, female 10 inches measured by myself.

The numbers for the 6th month are small, and it is probable that the maximum of 17 inches 1 line, given on the authority of Bernt, belonged to a fœtus nearer to maturity. Among the observations of the 7th month one is enclosed in a bracket as being very small, and probably belonging to a fœtus of the 5th month. With the two exceptions now pointed out, it is probable that the table presents a fair approximation to the average and extreme lengths for the different periods.

* Sur l'Homme moyen. † Considérations sur l'Infanticide, p. 9.
‡ Midwifery, vol. i. p. 256.
§ Quoted by Dr. Hunter. Anatomy of the Gravid Uterus, p. 68.

Table showing the Greatest, Least, and Average Lengths of the Fœtus of both Sexes at different periods of Utero-Gestation.*

SEX.		Six Months.						Seven Months.						Eight Months.						Nine Months.					
		Still born.		Born alive.		Both.		Still born.		Born alive.		Both.		Still born.		Born alive.		Both.		Still born.		Born alive.		Both.	
		3, 2, 5, obs.		2, 2, 4, obs.		5, 4, 9, obs.		7, 9, 16, obs.		10, 9, 22, obs.		17, 18, 38, obs.		10, 6, 17, obs.		13, 8, 26, obs.		23, 14, 43, obs.		47, 33, 82, obs.		57, 32, 99, obs.		104, 65, 181, obs.	
		in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.	in.	lin.
Male	max.	14	6	14	0 [17 1]	14	0	16	7	17	3	17	3	19	0	19	9 *t*	19	9	22	11	23	6	23	6
	min.	10	6	14	0	10	6	11	11	12	6	11	11	16	0	14	9	14	9	16	7	17	1	16	7
	mean.	12	11	15	6	14	0	14	7	15	5	15	1	17	7	17	0	17	3	20	0	19	6	19	9
Female	max.	16	1	14	6	16	1	16	7	16	6	16	7	18	8	17	10	18	8	22	4	24	0	24	0
	min.	12	10	14	0	12	10	13	0	12 [9	6 10]	12	6	16	7	15	6	15	6	17	0	16	6	16	6
	mean.	14	5	14	3	14	4	15	1	14	2	14	7	18	1	16	7	17	2	19	9	19	5	19	7
Male and Female	max.	16	1	14	6	16	1	16	7	17	3	17	3	19	0	19	9	19	9	22	11	24	0	24	0
	min.	10	6	14	0	10	6	11	11	12	6	11	11	16	0	14	9	14	9	16	7	16	6	16	6
	mean.	13	7	14	11	14	2	14	10	14	11	14	11	17	8	16	11	17	2	19	11	19	4	19	7

* This Table is founded upon 271 observations, of which 98 were by Schmitt, 70 were made under the superintendence of Bernt, 26 by Dervergie, 17 by Billard, 21 by Mr. Alfred Taylor (including those contributed by Dr. Geogehan), and 24 by myself. A few scattered measurements made by Orfila, Madame La Chapelle, &c., complete the number.

The following table corresponds to the one already given for the weight of the fœtus at full term.

Table showing the average and extreme lengths, in English inches, of the Fœtus at full term, according to different observers.

	MAX.	MIN.	MEAN.
	inches.	inches.	inches.
Hutchinson . .	26	17	19 to 22
Foderé and Capuron	24½	17	—
Petit . . .	—	—	22⅓
Quetelet . . .	22	17¼	19¼
Billard . . .	—	—	17 to 18

Cases are recorded in which the length has greatly exceeded any of the maxima in the table, and Dewees met with one instance in which the length was 27 inches.

The length, like the weight, is greater in males than in females, in still-born than in those born alive, and in single children than in twins, triplets, &c.

The signs of maturity or immaturity will be gleaned from the history of the development of the fœtus; and they will be stated more at length under the head of legitimacy, on which question they have an important bearing.

FŒTICIDE, OR CRIMINAL ABORTION.

Legal Relations.—Examination of Substances expelled from the Womb.—Causes of Abortion.—Natural.—Intentional.—By Medicines and Instruments.—Difficulty of effecting it.—Cases.—Examination of the Female.—Circumstances which justify the Medical Man in procuring Abortion.

The attempt to procure abortion is punished as felony. The following is the law as it now stands:—

"And be it enacted, that whosoever, with intent to procure the miscarriage of any woman, 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 transported beyond the seas for the term of his or her natural life, or for any term not less than 15 years, or to be imprisoned for any term not exceeding 3 years."*

According to this statute the absurd distinction formerly made

* 1 Vict. cap. 85.

between women *quick* and *not quick* with child is done away with, and the subject is materially simplified.

In trials for abortion, the first duty of the medical man will be to establish the fact of abortion by an examination of any substances which may have been discharged from the womb. Having ascertained that the substances submitted to his inspection are the products of conception, he may be required to determine whether the abortion was due to natural causes, to the use of drugs, or to violence. For this purpose he will have to form an opinion as to the sufficiency of any means which may have been used to procure the miscarriage. In rare instances, also, he may have to examine the female to whom the *corpus delicti* is stated to belong, in order to determine whether or not she has been recently delivered. Three different examinations therefore may be required.

1. An examination of substances expelled from the womb.
2. An inquiry into the cause of the abortion : and
3. An examination of the female supposed to have miscarried.

Examination of Substances expelled from the Womb.—It is only in the early periods of gestation that this examination will offer any difficulty. When the embryo has attained a certain degree of development, it will be impossible to confound it with any other substance expelled from the uterus. The rule already laid down in speaking of moles and false membranes as signs of pregnancy, must be observed in cases of alleged abortion, viz. to admit no substance to be the product of conception in which distant traces of an ovum cannot be recognized. To this rule there is only one exception in the case of hydatids.

Having ascertained that the substance submitted to our inspection is really a product of conception, we must next determine its age ; and this will be done by comparing it with the description already given of the growth and development of the embryo and fœtus, pp. 99 & seq.

CAUSES OF ABORTION.

It is necessary to premise that abortion from natural causes is of frequent occurrence. Out of 21,960 pregnancies, Madame La Chapelle met with only 116 abortions, being one abortion in every 188 pregnancies : but M. Deubel states the proportion of abortions to deliveries at full term as 35 to 420, or 1 in 12.* It is probable that the small proportion observed by Madame La Chapelle is due to the fact, that the females who came under her observation at La Maternité were in the latter months of their pregnancy, when abortions are comparatively rare. In the early months, abortion from natural causes is of frequent occurrence, and more frequent as the period of utero-gestation is earlier. It is important to bear in mind this tendency of abortion to occur in the earlier periods of pregnancy, as we shall be hereby better prepared to decide whether abortion in any parti-

* Quoted by Velpeau, Art des Accouchemens, *art.* Avortement.

cular case was due to natural causes, or to criminal means alleged to have been resorted to.

The causes of abortion are two-fold, *natural* and *artificial*. In all cases which may be submitted to the medical jurist, he will be required to ascertain whether the abortion might not have been due to natural causes, and whether the alleged causes were sufficient to produce it. It is important therefore that the medical jurist should understand both the natural and the artificial causes of abortion.

Natural Causes of Abortion.—These may be divided into predisposing and exciting. The predisposing causes may affect either the female herself or the ovum. The females most liable to abortion are the plethoric, the irritable, the nervous, the lymphatic, the feeble, and the ailing. Excessive or irregular menstruation and leucorrhœa are also among the predisposing causes. Females attacked by syphilis, scurvy, asthma, and dropsy, and those affected with malignant diseases, are peculiarly liable to miscarry, Malformations of the pelvis, the small size of the pelvis in those who marry very early, tight lacing, and all diseases of the uterus or its appendages, which tend to prevent the complete development of the organ, may be mentioned among the predisposing causes of abortion. To these may be added, a rigidity of the womb, as in those who are pregnant for the first time at a comparatively advanced age, and a relaxed condition of the neck of that organ. Occasionally, abortion has been epidemic, depending upon some peculiar condition of atmosphere.*

Among the predisposing causes of abortion, the most important to bear in mind is habit; and the fact of a female having had previous abortions would go far to render it probable that abortion in any given instance was due to natural causes. Heberden relates the case of a woman who miscarried five and thirty times.† The predisposing causes of abortion dependent upon the condition of the ovum are very numerous, especially in the early months. Velpeau states that of upwards of 200 embryos expelled before the end of the third month, at least one half were diseased.‡ The disease may exist in any part of the ovum—in the membranes, in the placenta, or in the fœtus itself. The different forms of disease which may attack these several parts are too numerous to specify in this place; suffice it to observe, that where we can discover any marked disease of the fœtus, or its annexes, we are justified in regarding such disease as affording a strong probability in favour of the abortion having been due to natural causes.

The *occasional*, or *exciting* causes of abortion, are not less numerous than the predisposing. Among them may be mentioned all strong and sudden actions of the muscles of the abdomen, in the stronger efforts of expiration, as in coughing, straining efforts to void the

* See references to these epidemics in Velpeau's Art des Accouchemens, *art.* Avortement.

† Commentaries, p. 15. ‡ Loc. cit.

urine or fæces, &c.; violent exercise, as dancing; profuse discharges from the bowels or from the womb itself; all undue excitement of the genital organs, as excessive venery, blows, and various forms of mechanical injury.

All these occasional or exciting causes of abortion will fail in producing it where the ovum is sound, and the female healthy; while, on the other hand, the most careful abstinence from all the exciting causes will not prevent abortion when the predisposition is strong.

The *intentional causes of abortion*, in other words, the *criminal means resorted to with a view of destroying the fœtus*, are best divided into two classes, *general* and *local;* the first acting through the constitution of the mother; the second by immediate application to the abdomen or uterus.

1. *Constitutional Means. Venæsection.*—The confidence placed by the vulgar in this remedy comes, like many other popular fallacies, from high medical authority—that of Hippocrates. But it is merely a *vulgar error.* It is a notorious fact that pregnant women bear blood-letting well, and, it is often by far the best means of averting a threatened abortion. There is no dearth, moreover, of positive experiments and facts which decide the question. Thus, Mauriceau tells us, that the wife of one of his colleagues was delivered at the full period of a well-developed infant, after having been bled 80 times during her pregnancy. Jamot states that his own wife bore a living infant at full term after being bled 48 times; and De La Motte states, that a female was bled 87 times in the last five months of her pregnancy.* Dr. Rush, in speaking of the effects of bleeding in the yellow fever of 1793, asserts that not one pregnant woman to whom he prescribed it, died, or suffered abortion.† He also gives us an account of one woman whom he bled 11 times in 7 days during her pregnancy; of another who was bled 13 times, and of a third who was bled 16 times while in the same condition. All these women recovered, and were delivered of living and healthy children.

Another popular error connected with the subject of blood-letting with a view of procuring abortion, attributes extraordinary efficacy to the abstraction of blood from the foot. Mauriceau refutes this error by stating the case of a woman bled 10 times from the foot during pregnancy, without any bad effect.

Another mode of abstracting blood has been thought very effectual in producing abortion, viz. by *leeches* applied to the *anus* or *vulva.* This practice is much less frequently resorted to in this country, either for the treatment of disease, or with the view of procuring abortion, than in France, where it is frequently used for both purposes. Though a powerful remedy in diseases of the pelvic viscera, it has little or no

* Velpeau, Art des Accouchemens.

† Medical Observations and Inquiries, vol. iii. p. 309.

effect on the fœtus, and is by no means a sure mode of procuring abortion.

Emetics.—There does not seem any good ground for regarding the vomiting produced by emetics as a sufficient cause of abortion. It is well known that during the early months of pregnancy, and even in some instances throughout the entire duration of it, severe and distressing vomiting occurs, but without producing abortion. Beck, indeed, endeavours to draw a distinction between the vomiting of pregnancy and that produced by emetics, and thinks the latter a likely means of procuring abortion. In support of this view he cites the opinion of Burns, and in opposition to it a case related by Velpeau in which fifteen grains of tartar emetic given with a view of procuring abortion, and productive of violent vomiting, did not arrest the progress of the pregnancy.* On the whole, then, we cannot attribute any great efficacy to *emetics* in producing abortion.

Cathartics.—These remedies, too, may be given to a considerable extent, and in very large doses, without producing abortion. For this statement we have the authority of Dr. Rush, who tells us that, in the yellow fever of 1793, he gave large and repeated purges of calomel and jalap to many women in every stage of pregnancy, and that in no case did any injury ensue to the child; and he adds that, out of a great number of pregnant women whom he attended in this fever, he did not lose one to whom he gave this medicine, nor did any of them suffer an *abortion.*† De La Motte, states that he has seen the most energetic evacuants produce gastritis, peritonitis, and death itself, without abortion following as a consequence.‡ The authority of Dr. Rush and De La Motte may be deemed decisive as to the safety of tolerably active purging in the pregnant; but it is not to be doubted that hypercatharsis, but especially that resulting from remedies acting chiefly on the rectum, would not be without danger to the life of the fœtus, in cases of predisposition to abortion.

Diuretics, are stated to exercise an injurious effect on the fœtus; but there is a total absence of proof to that effect, and we may, therefore, pass them over in silence.

One remedy classed by Beck among diuretics—viz. *nitre*, which should be rather termed an irritant poison, taken in a very large dose (a handful) produced *abortion* in less than half an hour.§

Another irritant poison,—which from its powerful effects on the urinary organs might be supposed amongst the most effectual means of procuring abortion—*cantharides*—has been taken in very large doses with a view of procuring abortion, but without accomplishing the desired effect. A case of this sort is quoted by Beck on the authority of Mr. Lucas, one of the surgeons of the General Infirmary at Leeds.

* Beck, p. 255.
† Med. Observations and Inquiries, vol. iii. p. 249.
‡ Quoted by Velpeau, loc. cit.
§ Paris and Fonblanque, vol. iii. p. 94.

"He was called to a patient who had taken about a drachm of powdered cantharides in order to induce abortion, and which brought on frequent vomiting, violent spurious pains, tenesmus and immoderate diuresis, succeeded by an acute fever, which reduced her to extreme weakness, yet no signs of miscarriage appeared, and about five months afterwards she was delivered of a healthy child."* Though this active drug has in other instances produced abortion, and is perhaps of all drugs the most likely to effect it, still the fact of its failing in this instance, not merely proves that it is itself not to be relied upon; but renders the efficacy of other less powerful remedies extremely doubtful. In this case there was the combined effect of a violent emetic, a strong purgative, a most effective diuretic, and a drug acting violently on the organs in the immediate neighbourhood of the uterus, viz. the bladder and the rectum—and all this followed by intense fever, and subsequent debility, and yet no abortion.

The next class of medicines which either have, or are supposed to have, power to procure abortion, are the so-called *emmenagogues;* a name under which a vast number of active and inert remedies are classed, by far the majority of which have as little effect on the uterine system as they have on other parts of the body.

The medicines which Beck notices under this head are *savin*, *mercury*, *polygala seneka*, and *pennyroyal*.

As to snake-root and pennyroyal, nothing more need be said of them than that they have been given with a view of procuring abortion, but it does not appear that they are very efficacious.

The *Juniperus Sabina*, however, has some pretensions to be considered a dangerous drug; for it has undoubtedly procured abortion in more than one instance, though it has failed in others, and in others again has sacrificed the life both of mother and child. A case from Foderé will show that it is not always effectual.†

"In 1790, a poor imbecile and cachectic girl, in the duchy of Aoust, in the seventh month of her pregnancy, took from the hands of her seducer, a glass of wine, in which there was mixed a large dose of powdered savin. She became so ill that report of it was made to the magistrate, who ordered Foderé to visit her. The patient stated to him, that on taking the drug, she had felt a burning heat, accompanied with hiccup and vomiting. This was followed by a violent fever which continued for fifteen days. By the proper use of refrigerants, however, she recovered, and at the end of two months was safely delivered of a healthy child."

Closely allied to the so-called *emmenagogues* is the *secale cornutum* or ergot of rye, a medicine which possesses the remarkable property of exciting the muscular fibres of the uterus to contraction, and is in frequent—much too frequent—use for that purpose. Concerning the efficacy of this remedy, much difference of opinion exists, but there

* Memoirs of the Medical Society of London, vol. ii. p. 208.
† Vol. iv. p. 431.

can be no reasonable doubt that though it sometimes fails of exciting the uterus to contraction, it very often succeeds in producing that effect.

Some authors have supposed that the power of the ergot is limited to the period of delivery, and to the state of full expansion and development of the uterus. This opinion seems highly improbable, and cases are certainly recorded in which this active agent produced abortion at an earlier period of gestation. Thus Beck quotes a case on the authority of Dr. Chatard, in which abortion was produced at the fourth month of pregnancy by twelve grains of the *ergot*,* and experiments on animals have shown that it is capable of producing abortion at any period. On the other hand, instances are on record, in which considerable doses of the ergot, often repeated, have failed of producing abortion. Thus Dr. Condie, an American, states that instances have come to his knowledge, in which the ergot was employed to the extent of several drachms a-day, for the express purpose of inducing abortion, but without exerting the least effect upon the uterus. In all these cases, gestation continued to the full period, and the females were delivered of living children. He also states that he has known the ergot to be given, in large and repeated doses, by ignorant midwives, where pains resembling those of parturition have occurred toward the termination of utero-gestation, in order to quicken the labour; but so far from doing this, the pains have actually ceased under its use, and labour did not occur for several weeks subsequently. Beck himself met with the case of a female who had had several children, and who took, of her own accord, three drachms of ergot to produce an abortion, without any effect.†

The root of a plant called the *actea ramosa* has the reputation of being nearly as active as the ergot; but, as it is not in common use, it may be dismissed with a passing notice.

There are two other remedies which have the credit of producing abortion, viz. *Mercury* and *Digitalis*.

Formerly crude mercury was supposed to possess great power in this way, but it is not necessary to inquire into the grounds of the belief. With regard to preparations of mercury, (of which *calomel* is most frequently used with a view of producing abortion,) the same observations apply as to the remedies already noticed. Although the authority of Burns may be quoted in favour of the opinion that salivation should be avoided in pregnancy, there are so many high authorities on the other side, that we may safely conclude that it is by no means a certain or even likely means of producing abortion. The names of Bartholin, Mauriceau, Benjamin Bell, Rush, and Campbell may be mentioned as authorizing the employment of mercury during pregnancy, even to the extent of producing severe salivation.

Digitalis is put down among the substances capable of producing

* Page 260. † Ib.

abortion, on the authority of a single case related by Dr. Campbell; but as the power of a remedy can never be deduced from one case, it would be but waste of time to enlarge upon it. In this instance the digitalis was given for dropsy; the child was still-born, and the mother died soon after.*

The result of all these observations on the power of medicines to produce abortion, is simply this:—That there is no one medicine which can be depended on as a means of procuring abortion; that, if given in doses short of those which would destroy the life of the mother, they would almost certainly fail of accomplishing the purpose; that, where they do succeed, they place the life of the mother in jeopardy, and often sacrifice it; and that, for every case in which the mother escapes, there is probably one at least in which the mother and her offspring both fall a sacrifice, and one in which the mother dies, the child remaining uninjured in the womb.

The fact is, that none but *poisons*, or medicines administered in poisonous doses, can be expected to produce abortion in any case unless the predisposition to abortion is already very strong; when such predisposition does not exist, the mother is much more likely to fall a sacrifice, whilst the child remains intact in the womb, or is even born alive, than the child to be expelled and the mother to survive; in other cases both the mother and the offspring will perish.

Mechanical means.—These consist either of *external violence applied to the abdomen or loins*, or of *instruments introduced into the uterus.*

External violence applied to the abdomen or loins would appear a sufficient cause of abortion, and cases enough are on record to prove that it is so. The fact is so obvious that it can scarcely be necessary to cite examples. Here, too, it is important to bear in mind, that unless the degree of violence is such as to endanger the life of the mother, it is not likely to occasion abortion. The two following instances will show that the life of both parties is put in jeopardy. The first is related by Dr. Smith: "In 1811 a man was executed at Stafford for the murder of his wife. She was in the pregnant state, and he had attempted to induce abortion in the most violent manner, as by elbowing her in bed, rolling over her, &c., in which he succeeded—not only procuring abortion, but along with it the death of the unfortunate woman."† The other case is by Dr. Campbell: "A female in the last month of her pregnancy was struck on the abdomen by her husband. An extensive detachment of the placenta caused the immediate death of the fœtus, and that of the mother in fifty-one hours afterwards."‡

Madame La Chapelle mentions the case of a young midwife, who was pregnant and had a narrow pelvis; and who, with a view to produce abortion and avoid the Cæsarian section, threw herself from a height. She died in consequence of her wounds, but she did not miscarry.

* Introduction to the Study and Practice of Midwifery, p. 141.
† Forensic Medicine, p. 305. ‡ Op. cit. p. 131.

Mauriceau also gives the case of a pregnant female seven months gone, who to escape from a fire in her room slid down from the third story, but losing her hold from fright, fell upon the stones and fractured her forearm ; but there was no abortion.*

Precisely the same remarks apply to the *introduction of instruments into the womb*, as to the causes of abortion which have been already mentioned. In some instances abortion has been produced ; in others, though considerable injury has been inflicted, the child has been born alive ; and in all of them the mother's life has been endangered or sacrificed. When the object has been to puncture the membranes, considerable difficulty has occurred, especially at the early periods of gestation, and in such cases the uterus has generally been seriously, and often fatally, injured. As to the difficulty of puncturing the membranes during the early months of pregnancy Dr. William Hunter's experience is conclusive. He attempted to puncture the membranes in a young woman in the third month of pregnancy, but unfortunately injured the neck of the uterus so much as to destroy the life of the mother.†

In most of the instances on record, mechanical violence has been applied to the exterior of the abdomen as well as to the uterus, and frequently after medicines have entirely failed.

One case of this sort, which occurred in the practice of Dr. Wagner of Berlin, shows very strikingly how much violence may be employed without producing abortion.

"A young woman, seven months with child, had employed savin and other drugs with a view to produce miscarriage. As these had not the desired effect, a strong leathern strap (the thong of a skate) was tightly bound round her body. This too availing nothing, her paramour (according to his own confession) knelt upon her, and compressed the abdomen with all his strength : yet neither did this effect the desired object. The man now trampled on the girl's person while she lay on her back ; and, as this also failed, he took a sharp-pointed pair of scissors, and proceeded to perforate the uterus through the vagina. Much pain and hæmorrhage ensued, but did not last long. The woman's health did not suffer in the least ; and, pretty much about the regular time, a living child was brought into the world without any marks of external injury upon it."

Sulphuric acid, in one extraordinary case, has been injected into the vagina with a view of producing abortion. The result was the most violent inflammation of the parts, and adhesion of the os tincæ, with the formation of a dense membrane over it. After attempting delivery by incisions into the neck of the uterus, it was found necessary to perform the Cæsarian operation—and both the mother and the child died.‡

* Quoted by Velpeau, op. cit. † This case is quoted by Gooch.

‡ This case is given in the report of M. Guerin to the Académie Nationale of Paris, and is cited in the Lancet, vol. viii. p. 38.

It appears, then, that to mechanical violence applied externally to the abdomen or internally to the uterus, very nearly the same observations apply as to the more active remedies ; often failing, and where they succeed, always endangering the life of the mother.

Where slight external violence has been used, it will of course be necessary to ascertain whether the female (in case abortion should take place) was predisposed to it, or whether the placenta was diseased or misplaced in such a manner as to render abortion probable without the application of force.

Examination of the Female.—In cases of abortion we may be required to examine the person of the suspected female. We should be guided in such an examination by the signs already laid down in speaking of delivery, bearing in mind that these signs will of course be less strongly developed in the early than in the later months. Before two months little dependence can be placed on these signs.

If the female dies, we may be required to examine the body, when we should be guided by the same signs which exist in delivery at the full period, but less distinct as the period of utero-gestation is earlier. For more minute particulars concerning the size of the uterus, &c. at different periods of utero-gestation, the reader is referred to works on Midwifery.

The following is a summary of the chief points to be attended to in cases of *abortion :* The supposed product of conception must be submitted to minute and careful examination. Having made out that a fœtus has been expelled, its age must be determined by the rules already laid down. The reputed mother, whether alive or dead, must then be examined ;—if alive, we must endeavour to ascertain whether there was or was not such a predisposition to *abortion* as to account for its having taken place, without attributing any great efficacy to the means employed. With a view of determining whether or not such a predisposition exists, we must inquire into the general state of health of the mother before the abortion took place, and especially whether she has had previous abortions—and if so, whether they occurred at or about the same period of gestation. If the female died from the means employed, we must use the same care in examining the state of the uterus as well as of other organs.

The circumstantial evidence of abortion does not require the interference of a skilled witness ; it need not, therefore, be noticed in this place.

Some questions of medical ethics mix themselves up with the question of abortion, as

Under what circumstances, and by what means, is it morally and legally proper to induce premature delivery ? What circumstances will justify the Cæsarian operation ? &c.

Such questions as these are easily answered. The medical man is clearly justified in resorting to any measures which promise to preserve the life of mother and child when both are threatened ; and

where one only can by any possibility be preserved, the female herself may use her right of self-preservation, and choose whether her own life or that of her child shall fall a sacrifice to the means recommended to be used.

INFANTICIDE.

Legal Relations.—Questions relating to the Child.—*Degree of Maturity.*—Was the Child born alive?—*Evidence* before Respiration, *Affirmative and Negative.*—*Intra-uterine Maceration.*—*Severe Injuries inflicted while the Blood is still circulating*—after Respiration.—*Developed Air-cells—their Characters—how Distinguished from the Effects of Putrefaction.*—Lung Tests.—Static Tests.—*Ploucquet's Test.*—Hydrostatic Test (as originally applied). *Objections*—to the Sinking of the Lungs as a Proof of Still-Birth.—1. *Disease.*—2. *Imperfect Respiration*—to the Floating of the Lungs as a Proof of Respiration.—1. *Putrefaction* (including Emphysema which is incipient putrefaction).—2. *Inflation*—(as now applied). *Objections*—to the Sinking of the Lungs as a Proof of Still-Birth.—1. Disease.—2. Imperfect Respiration—to the Floating of the Lungs as a Proof of Respiration.—*Inflation, Value of Pressure as distinguishing Respiration from Inflation.*—Other Tests.—*Summary.*—*Directions for examining the Lungs.*—*To what Extent can the Lungs be Inflated?*—*Circumstantial Evidence.*—If Respiration has taken place, was the child born alive?—*Respiration before Birth.*—*State of the Abdominal Viscera.*—If born alive, how long has the child lived?—*Progressive changes in the Skin, Umbilical Cord, and Circulation.*—How long has the Child been dead?—*Effects of Putrefaction.*—*Caution with regard to Intra-uterine Maceration.*—Cause of Death—*Death from Natural Causes.*—*Diseases of the Heart and Arteries—of the Lungs—of the Brain and Spinal Marrow—of the Alimentary Canal.*—*Protracted Labour.*—*Immaturity.*—*Statistics of Still-Birth.*—*Death from Violence.*—*Accidental or Intentional?*—*Suffocation.*—*Strangulation.*—*Drowning.*—*Cold.*—*Starvation.*—*Fractures of Skull.*—*Fracture and Luxation of Cervical Vertebræ.*—*Wounds.*—*Contusions.*—*Poisoning.*—*Infanticide by Omission.*—Examination of the supposed Mother.—*Signs of Recent Delivery.*—*State of the Mind.*

There is no crime which meets with so much public sympathy as Infanticide, and this feeling has been largely shared by members both of the medical and legal profession. The medical man has consequently been led to take the part of an advocate where he should have been merely the man of science; while the lawyer has equally for-

saken his proper sphere by setting himself up as a judge of matters with which he was totally unacquainted.*

This misplaced humanity, added to learning equally misplaced, has encumbered with objections, and overlaid with refined subtilties, a subject of necessity unusually complicated.

The public sympathy for the child-murderer arose out of the extreme harshness and cruelty of a former statute,† which virtually visited the concealment of shame with the punishment of murder. Dr. Hunter wrote, under the influence of that injustice, in 1783, since which time (1803) an act has been passed which decrees that "women tried for the murder of bastard-children, are to be tried by the same rules of evidence and presumption as by law are allowed to take place in other trials of murder; if acquitted, and it shall appear on evidence that the prisoner was delivered of a child, which by law would, if born alive, be bastard, and that she did, by secret burying or otherwise, endeavour to conceal the birth thereof, thereupon it shall be lawful for such court, before which such prisoner shall have been tried, to adjudge, that such person shall be committed to the common gaol, or house of correction, for any term not exceeding two years."

This statute has been modified by an act passed in June 1828,‡ which runs thus: "And be it enacted that if any woman shall be delivered of a child, and shall, by secret burying or otherwise disposing of the dead body of the said child, endeavour to conceal the birth thereof, every such offender shall be guilty of a misdemeanour, and being convicted thereof, shall be liable to be imprisoned, with or without hard labour, in the common gaol or house of correction, for any term not exceeding two years; and it shall not be necessary to prove whether the child died before, at, or after its birth. Provided always, that if any woman tried for the murder of her child shall be acquitted

* This remark points on the one hand to Dr. William Hunter, whose Essay "On the Uncertainty of the Signs of Murder in the Case of Bastard Children," still exercises an injurious influence on the decision of cases of infanticide; and on the other to a learned judge, Baron Garrow, who, in the case of Mary Baker, tried at the Dorchester Assizes, interrupted Mr. Bellamy, the medical witness, by reminding him that the hydrostatic test had been "long exploded," and had been demonstrated to be "a vulgar error;" his lordship's authority being the essay of Dr. Hunter. That the sentiments of Dr. Hunter have been shared by other members of his profession, the following extract from Mr. Abernethy's Lectures will show: "It is your duty, I think, to try to weaken the effect of your testimony upon this point."—Lancet, vol. xii. p. 227.

† 21 Jac. i. cap. 27. This statute enacts, that "if any woman be delivered of any issue of her body, which being born alive should by the laws of this realm be a bastard; and that she endeavour privately, either by drowning or secret burying thereof, or in any other way, either by herself or the procuring of others, so to conceal the death thereof, as that it may not come to light whether it were born alive or not, but be concealed: in every such case, the said mother so offending shall suffer death as in the case of murder, except she can prove by one witness, at the least, that the child whose death was by her so intended to be concealed was born dead."

‡ 9 Geo. iv. cap. 31.

thereof, it shall be lawful for the jury, by whose verdict she shall be acquitted, to find, in case it shall so appear in evidence, that she was delivered of a child, and that she did, by secret burying or otherwise disposing of the dead body of such child, endeavour to conceal the birth thereof, and thereupon the court may pass such sentence as if she had been convicted upon an indictment for the concealment of the birth."

Questions of infanticide are necessarily more complicated than those of homicide in general ; for, previous to the inquiry into the means by which a child has come by its death, it is necessary to show that it has been born alive. The medical man may, moreover, be required to examine the female suspected of being the mother of the child, in order to determine whether or not she has been recently delivered.

Two classes of questions, then, may be raised in cases of infanticide ; the one relating to the child ; the other to the mother.

QUESTIONS RELATING TO THE CHILD.

These are the following :—

1. What is the degree of maturity of the child ?
2. Was the child born alive ?
3. If the child was born alive, how long did it survive its birth ?
4. How long has the child been dead ?
5. What was the cause of death ?

These questions require to be examined separately.

1. What is the degree of maturity of the child ?

This question will be answered by employing the data contained in the introduction to this Chapter, viz. the length and weight, the position of the centre of the body, the proportional development of the several parts, the growth of the hair and nails, the condition of the skin, the presence or absence of the membrana pupillaris ; in the male, the descent or non-descent of the testicles, &c.*

2. Was the child born alive ?

This question involves a great number of details, and depends on the determination of many difficult and delicate points.

First, as to the legal meaning of the term *born alive*. It has been decided in more than one case, that to constitute live-birth the child must be alive after the whole body has been brought into the world ;† and that it must have an independent circulation.‡ It appears, how-

* See ante, pp. 99 and seq.

† R. *v.* Poulton, 5 Carrington and Payne's Reports, 329. R. *v.* Crutchley, 7 C. and P., 814. R. *v.* Sellis, ib., 850.

‡ R. *v.* Enoch, 5 C. and P., 539. Reg. *v.* Wright, 9 C. and P., 154.

ever, that it is not necessary that the umbilical cord should be separated, for the child may still be connected with its mother by the cord, and yet the killing of it will constitute murder.*

Such is the meaning of the term *born alive.* In examining a child with a view to determine whether or not it was born alive, the chief point to be attended to is the condition of the lungs. If by examining these organs we can discover signs of respiration, we have gone far towards the proof of live-birth ; but if no signs of respiration are present, there is an equally strong probability that the child was still-born. But in the absence of all signs of respiration there may still be sufficient proof that a child has or has not been born alive. Hence the present inquiry consists of two parts. 1. The evidence of live-birth, independent of, and prior to, respiration. 2. The evidence of live-birth deduced from, and subsequent to, respiration.

The evidence of live-birth prior to respiration is either negative or positive,—negative when we discover signs of previous death within the womb ; and positive when we find marks of violence inflicted while the blood was still circulating, and when that violence is of such a kind as not to have been inflicted *during* the birth.

We can state with certainty that a child has not been born alive when we find upon it the signs of intra-uterine maceration.

The appearances presented by the body of a child which has died in the womb, and which has there undergone maceration, are the following :—The body is shrunken and flaccid in every part, the chest and abdomen flattened, the ribs distinctly visible through the skin, the ilia prominent, the extremities small and attenuated. The head is soft and yielding, so that it falls flat in whatever position it may be placed. The epidermis is more or less extensively detached, and is everywhere easily separated from the dermis. On the hands and feet the cuticle is white, thickened, and wrinkled, as if from the application of a poultice. The cutis itself is more or less extensively discoloured. The abdomen, which is the first part to exhibit the change of colour, presents a mottled appearance, blending a rose and ash colour. Elsewhere the skin assumes a brownish red, without any admixture of green. The parts of generation have a deep red colour, as have also, in a less degree, the head and face. The umbilical cord is straight and flaccid. The entire surface of the skin is covered with a soapy fluid, so that the body, when handled, slips from the grasp. On cutting into the cellular membrane it is found to be infiltrated with a reddish serosity, and to contain in parts, especially in the scalp, a substance which Orfila has aptly compared to gooseberry jelly. The periosteum is easily detached from the bones of the cranium, which are found loosely united, and moving easily the one upon the other. The several cavities are filled with an abundant sero-sanguinolent fluid, and the viscera are tinged throughout of a

* R. *v.* Crutchley, 7 C. and P. 814. Reg. *v.* Reeves, 9 C. and P. 25.

reddish brown colour, at the same time that their minute structure is very distinctly displayed.

The appearances now described are more or less strongly marked, as the child has lain a longer or shorter time dead within the womb. They are quite distinct from the effects of putrefaction, whether in air or water, and the odour of putrefaction is entirely wanting. When developed in a marked degree it is impossible to mistake these appearances for those due to any other cause; but if the death of the child took place only a short time before its expulsion from the womb these appearances would not be present. In such a case the absence of all traces of respiration on the one hand, and of marks of violence accompanied with copious effusion of blood, on the other, would prove that the child was still-born.

The conclusion drawn from the appearance of the child would be corroborated, should it appear in evidence that the mother for some days before her confinement had ceased to feel the movements of the child; that her abdomen seemed heavier, and her gait became more difficult; that she lost her appetite and felt ill; that towards evening she experienced shiverings, agitation, and fever,—the symptoms, in fact, which precede the delivery of a dead child. These symptoms, however, are not likely to be adduced in evidence, nor can they become necessary. With regard then to intra-uterine maceration, if it exist, the charge of infanticide falls to the ground.

The single case in which we may state that a child has been born alive anterior to, and independent of, the establishment of respiration is when we find marks of violence on the body so severe as not to be possibly inflicted during the birth, and attended with proofs that the blood was still circulating whilst the injuries were inflicted.

It is well known that a child may live after its birth, and without breathing, long enough to perish by neglect or by violence. It may be born in a state of asphyxia, and may die from the want of proper care, or it may be murdered. The mother has sufficient time whilst the infant is yet alive, but before it has breathed, to dash its head against the wall, to compress the larynx, or to fix a string round its neck. Now, have we any means of determining that such a child has been born alive? It is obvious that the child, though no longer in the womb, is in the same state, as far as its circulation is concerned, as if it were unborn. The circulation of blood still goes on as in the fœtus, although very languidly, and fluid blood is still contained in the several parts and organs of the body. Supposing the child to have received no wound or external injury of any kind, we have clearly no means of determining whether it was born alive or not; but, if a wound or bruise has been inflicted, we may determine whether or not such wound or bruise was inflicted whilst the blood was still fluid and circulating, or after it had ceased to circulate; and our decision will be guided by the same rules as in

the case of the adult.* Devergie relates a case of infanticide in an infant that had not respired, proved by the existence of extensive wounds and marks of great violence on the head, with copious effusion of blood.†

There are two cases, then, in which, independently of, and anterior to, respiration, we may decide the question, 'was the child born alive?' in the one negatively when we discover the marks of intra-uterine maceration, in the other affirmatively, when we discover injuries inflicted whilst the blood was still circulating, and which, from their extent and severity, must have been inflicted after the birth of the child.

Cases in which we are required to furnish evidence of live-birth before respiration must be extremely rare, as few children in whom the blood is still circulating are born without respiring, at least imperfectly.

The great question then on which the proof of live-birth depends is,—has the child respired? respiration being one essential part of the proof that the child was born alive.

The evidence of live-birth after respiration involves two questions 1. Has respiration taken place? and, 2nd. Did respiration take place before, during, or after the birth? It is not sufficient, in order to prove that the child has been *born alive*, to show that it has breathed, for it may have breathed during the birth and yet have perished before its complete delivery.

HAS RESPIRATION TAKEN PLACE?

Judging from the number of tests which have been proposed for the solution of this question, it would appear to be one of extraordinary difficulty. Such, however, is by no means the case. The best evidence of respiration is the change which it produces in the external appearance of the lungs; and, were it not that inflation gives rise to the same change, a mere inspection of the lungs would supersede all other tests. As it is, it serves to establish the alternative of respiration or inflation when all other means fail.

Lungs which have neither respired nor been inflated, are of a uniform texture throughout, and resemble both in colour and consistence the adult liver. The only marks which they have upon their surface are produced by slight furrows, which obscurely mark the division of the lobules. When the lungs are full of blood, these slight furrows are scarcely, if at all, visible; but when those organs are comparatively empty, the furrows are more distinct, and are still more strongly marked in the lungs of the fœtus which has undergone intra-uterine maceration.

The effect of respiration or inflation varies according to the degree of either. The smallest quantity of air serves to develope some of the air-cells on the surface of the lungs; and these developed

* These rules will be laid down under the head of Wounds.

† Annales d'Hygiène, May 1837.

air-cells form the best proof of the admission of air in one of the two ways just mentioned. The right lung, and especially the edges and concave surface of its upper lobe, admit the air most readily: it is here, therefore, that the first effects of inflation or respiration must be looked for.

The air-cells thus developed present an appearance not to be confounded with any other. If the lungs are fresh and filled with blood, the position of these developed cells is marked by brilliant vermilion spots; if the lungs contain less blood, the spots are of a lighter colour; and if they are examined some days after the death of the child, they will be found to have lost their bright vermilion hue, and to have assumed a light rose colour. In the lungs of children who have survived their birth some days, the air-cells have very nearly the colour of the healthy adult lung.

The cells themselves are found in irregular groups; they are angular in form, not perceptibly raised above the surface, and obviously situated in the substance of the lung. Occasionally, as Devergie has observed, they will be found in groups of four, arranged in a perfectly regular and symmetrical manner: but more commonly the patches are irregular in shape.

Another appearance which I have seen the air-cells present, is that of a group of small globules, like millet seeds, arranged closely side by side, and on the same level.

The only appearances on the surface of the lungs with which these developed air-cells might by possibility be confounded, are, 1. small ecchymoses, which I have occasionally met with; and, 2. air the product of putrefaction. The small ecchymoses may be at once distinguished by their perfect roundness, their very slight deviation in colour from that of the surrounding portions of lung, and the entire absence of any thing resembling a developed texture. These spots, therefore, can occasion no difficulty.

Air, the product of putrefaction, collects on the surface, and between the lobes of the lungs, in the form either of distinct globules, the size of peas, rising above the level of the surrounding lung, or in that of a fine mercurial injection beneath tissue paper. The air is situated in the cellular membrane connecting the pleura with the surface of the lung, and its true situation is often pointed out by a small globule seated upon a larger one. If these appearances are not sufficient to distinguish air, the product of putrefaction, from air contained within the air-cells, all that is necessary is, to pass the finger over the surface of the lung, when the appearance will vanish; and a little stronger pressure will destroy the larger globules. No amount of pressure so applied will force the air out of the air-cells, or in any way alter their appearance.

The so-called emphysema of the fœtal lungs is merely an incipient process of putrefaction, and the appearance which it occasions may be distinguished in the same way from that of the developed cells.

It is scarcely necessary to caution the reader against confounding with the developed air-cells the change of colour which takes place on the surface of the lungs from the contact of air. The change of colour is the same in both cases, but the mere contact of air with the surface of the lungs does not change the texture of the organ in any way.

The appearance of developed air-cells on the surface of the lungs is, therefore, quite characteristic, and furnishes undeniable proof either of respiration or of artificial inflation.

The simple sign of respiration or inflation now insisted on, is as delicate as it is simple, for it detects the smallest possible quantity of air introduced into the lungs, a quantity much too small to have any appreciable effect on the specific gravity either of the entire lung, or of the portion of the lung into which it has been introduced. I have repeatedly detected at a glance the existence, in the superficial air-cells, of a quantity of air which was insufficient to render the smallest fragment of the lung buoyant. I may add, that I have never found these signs of respiration absent in any case in which a child was stated to have breathed, though for the shortest space of time; and in a child that was reported to have given only three distinct gasps, the effect of respiration was obvious, at the first glance, in the bright vermilion-coloured groups of developed air-cells scattered over the surface of the right lung. This sign, therefore, succeeds where the hydrostatic test fails.

If a different appearance were produced in the air-cells by respiration and inflation respectively, and we could infallibly distinguish the one from the other, there would be no need of any other lung-test; and if it could be made to appear that all the tests which have been proposed fail in effecting this most desirable object, then all those tests would cease to have any claims upon our attention.

Devergie,* after stating correctly enough, that an attentive examination of several infants which he has inspected at the Maternité during nearly nine months, has enabled him to distinguish, *à priori*, and without any other research, lungs belonging to a still-born infant from those of an infant which had breathed; and also to determine whether the air has dilated all parts of the lungs, or merely certain portions of those organs, adds, that "in *many* cases he could determine whether the distention of the lungs with air has been the effect of respiration or of insufflation." In the case of air introduced by respiration, Devergie states that there is a minute injection of capillary vessels on the surface of the air-cells, which injection does not take place in the case of inflation. This distinction may be well founded, but it deals with parts so extremely minute, and, according to the author's own statement, is to be relied on only in *many*, but not in *all*, cases, that it may be fairly set down as unfit for the use of those who have not taken the pains to examine the lungs carefully and minutely for themselves. I have not myself ob-

* Méd. Légale vol. i. *art.* Infanticide.

served such a difference between the effects of inflation and respiration as to pretend to be able in this way to distinguish the one from the other.

There is one case, indeed, in which the distinction laid down by Devergie would entirely fail; and that is, where the lungs which have respired contain but a very small quantity of blood: in such a case, the capillary vessels would, in all probability, present no strong signs of injection.

Developed air-cells, then, form the best, and the only necessary proof, of the admission of air into the lungs, and they are to be found in every case of respiration or inflation, however limited, or however slight.*

The development of the air-cells is not merely a proof of respiration or inflation, but the degree to which they are developed is a measure of the extent to which these processes have been carried. When respiration is complete, the lungs present the spongy, crepitant character of adult lungs, and differ from them only in having a more rosy colour.

Before proceeding to the consideration of the other signs or tests of respiration, it is necessary to premise that respiration is not a sudden, but a gradual process; that it is rarely, perhaps never, completed in a few respirations, and very often remains incomplete and partial after many hours, days, or even weeks. In by far the majority of cases of infanticide, therefore, we shall have to deal with lungs in which the process of respiration has been very incompletely set up. This fact increases the importance of a sign which stands us in stead where, as will be presently shown, every other test may fail.

The admission of air into the air-cells of the lungs is not the only effect of respiration. It may be stated, as a general rule, that this change is accompanied by an increased afflux of blood. The consequence of this is an increase of weight in the lungs themselves, and an increase in their weight as compared with that of the body. This increase of weight in the lungs themselves, and the altered proportion which the lungs bear to the body, have been made the basis of two lung tests.

The absolute Weight of the Lungs.—This was used as a test by Ploucquet, who, however, preferred the ratio of the weight of the lungs to that of the body, which latter test accordingly goes by his name. The supposed value of the weight of the lungs as a test of respiration rests upon the erroneous supposition that "the arteries and veins of the lungs of a fœtus which have not respired, are empty, and in a state of collapse,"† whilst after respiration they become more or less filled with blood. This erroneous statement has been corrected by Orfila‡ and Devergie.§ That it is a gross mistake is proved by

* It is strange that this simple sign of respiration should have been so often overlooked. Cruveilhier, in his Morbid Anatomy, depicts the bright vermilion air-cells as a disease of the fœtal lungs.

† Foderé, Méd. Lég. tom. iv. p, 481, 2nd edit.

‡ Leçons de Médicine Légale, p. 341. § Tome i. *art.* Infanticide.

my own repeated observations: for I have, on the one hand, examined lungs which have breathed, and found them almost destitute of blood; and, on the other, have met repeatedly with lungs which have never admitted air, but yet were gorged with blood in every part. In other instances, I have inspected lungs which presented only a few groups of developed air-cells, and found them full of blood. This test, then, is founded on an erroneous assumption.

The weight of the lungs of mature children before respiration is commonly stated at one ounce, or 480 grains, and after respiration at two ounces, or 960 grains. The averages of upwards of 400 observations on mature children are as follow:—Still-born, 874 grains; children who had survived their birth one month or less, 1072 grains. The observed weight, therefore, in still-born children is nearly double the rude estimate of authors, and the increase, instead of being equal to the original weight, is only about one-fourth. These are averages. But as in a court of law we shall have to deal, not with probabilities, but with possibilities, we must compare the extreme and not the average weights.

This comparison is made in the following table, in which English observations alone are employed—*

Before Respiration.	After Respiration.	Before Respiration.	After Respiration.
510	510	694	—
520	—	703	—
550	546	713	726
—	562	744	746
586	590	—	774
630 (two)	—	—	861
632	—	—	920
640	—	1054	1000
647	—	—	1173
658	—	—	1189
666	—	—	1203
683	675	1480	—
687	—	1950†	—

	Before Respiration.	After Respiration.
Maximum .	1950	1203
Minimum .	510	510
Mean .	769	820

* For the particulars of these observations see Lancet for October 1, 1842.

† This case has been added to those published in the Lancet. It is on the authority of Mr. A. Taylor. See Med. and Phys. Journal, vol. lxxx.

This table shows in a striking manner the limited application of the absolute weight of the lungs as a test; for, out of 34 cases, there is not a single one in which we could have stated, by means of this test alone, that respiration had, or had not, taken place; while, in two instances, the great weight of the lungs would have led us to infer respiration, though the children were still-born.

In the foregoing table no regard is had to the duration of respiration; as, however, in by far the majority of cases of infanticide respiration is extremely imperfect, it is important to determine the effect of imperfect respiration in increasing the weight of the lungs. The average result of a considerable number of facts is the following—

Still-born . . .	874 grains.
Imperfect respiration .	988 grains.
Perfect respiration .	1195 grains.

The effect of imperfect respiration, then, is to increase the weight of the lungs by about 100 grains, or rather more than $\frac{1}{8}$ of their original weight. The mean weight after different durations of respiration is as follows:—

Still-born . . .	874 grains.
Less than one hour .	918 grains.
Twelve hours . .	853 grains.
One day . . .	1000 grains.
One month and less .	1072 grains.

Hence the duration of respiration for one hour adds less than 50 grains to the weight of the lungs, which is increased by only 126 grains when respiration has lasted one day. The slight difference between the results of the observations on the weight of the lungs in the still-born, and in those who have survived their birth twelve hours, may be due to the small number of facts. If additional evidence were required of the uselessness of this test, it might be found in a comparison of the weight of the lungs in two children born alive in whom the weight of the body was the same. In the one case the lungs weighed 1544 grains, and in the other 494, the one being more than three times as great as the other.

From what has been said it appears that the difference between the absolute weight of the lungs before and after respiration, and especially after imperfect respiration, or respiration lasting only for a short time, is much too slight to be used as a test; and that, if we make use of the extremes, there are very few instances in which they can be applied with any confidence.

This test, moreover, is rendered unnecessary by the mere inspection of the lungs, and it is obvious that it can be of service only provided that it assists us in distinguishing respiration from inflation. This it does not do, though it has been recommended for that purpose; for if, as has been just shown, it fails in distinguishing the lungs of the still-born from those which have respired, it must equally fail in

distinguishing lungs which have breathed from those which have been inflated, for inflated lungs are, as to the blood which they contain, in the condition of the fœtal lungs.

Ploucquet's Test, or *the ratio of the weight of the lungs to that of the body.* Before entering upon the examination of this test it is necessary to premise, that the average weight of the body of still-born children exceeds that of children who have lived one day or less, by about one-third; that the body of the male is heavier than that of the female; that the proportion which the weight of the lungs bears to that of the body decreases as the weight of the body increases; and that the weight of the lungs is subject to much greater variation than that of the body. These things affect the value of the test.

This test is a good example of the futility of all conclusions drawn from a small number of facts. Ploucquet himself making use of three facts, only two of which were strictly comparable, obtained the proportion before respiration, of 1 to 70; after respiration, of 1 to 35. The more numerous facts collected by subsequent observers have greatly modified these proportions, and the following statements will, it may be hoped, serve to consign the test to oblivion. The averages of more than 400 observations on mature children are as follow: Still-born 1:57, instead of 1:70; children who have lived one month or less 1:38 instead of 1:35. The extremes, which, as has been before observed, are the values really required for practical purposes, are shown in the following table.

Before Respiration.	After Respiration.	Before Respiration.	After Respiration.
1:91	—	1:54	1:55
1:82	—	1:51 (two)	1:52
1:74	—	1:49	1:49
1:71 (two)	—	—	1:48
1:70	—	—	1:46
1:67	1:65	1:45	1:45
1:61	1:61	—	1:44 (two)
1:60	—	—	1:41
1:59	1:59	—	1:39
1:57 (three)	1:56	1:21*	

	Before Respiration.	After Respiration.
Maximum .	1:21	1:39
Minimum .	1:91	1:65
Mean . .	1:60	1:50

The results of this table differ somewhat from those already obtained in the case of the absolute weight of the lungs. In 7 cases out of 33 we might have asserted, with some degree of confidence, that a

* This proportion corresponds with the highest weight of lungs contained in the last table.

child had not breathed, while in one case we should have asserted that a still-born child had breathed. The value of our conclusion must depend, as in the case of the absolute weight of the lungs, upon an assumption that we have found the true limits both before and after respiration.

The mean proportions after different durations of respiration are as follow :—

Still-born	1:57
Less than one hour . .	1:51
12 hours	1:53
1 day	1:48
1 month or less . . .	1:38

The difference between the several proportions is here extremely small; certainly much too small to justify the employment of the test in the only case where such a test can be required, namely, where respiration has been imperfectly established.

If further proof were required of the futility of this test, it might be found by comparing the ratio of the lungs to the body in two cases in which the weight of the body was precisely the same. Thus, to take only one instance; the weight of the body being in each of two children born alive 32,436 grains, the lungs bore to the body in the one case the proportion of 1 to 21, in the other of 1 to 66; the one ratio being more than three times as great as the other. Precisely the same remarks apply to this test as to the absolute weight of the lungs. The simple inspection of the lungs would render it superfluous even if it were useful, and there are the same objections to its being used as a means of distinguishing inflation from respiration which lie against the absolute weight of the lungs.

The static lung tests therefore may be dismissed as alike unsafe and unnecessary.

The Hydrostatic Test.—This is without exception the most interesting and important test ever proposed for the determination of a medico-legal question; interesting from the many controversies to which it has given rise, and important on account of the purpose to which it is applied, and the high value usually assigned to it.

That the true value of this test may be understood, it must be premised, that it is merely a test of respiration; the question, "when or where did respiration take place," being consequent on the determination of the fact of respiration. By thus clearly stating the object of this test, the objections to it will be more easily understood, and some of the confusion arising from the multitude of objections will be avoided.

The discussion will be still further simplified by dividing it into two parts corresponding to the two forms which the test has assumed. In the first part, I shall examine the test, as it was originally, and till a comparatively recent period, performed; that is to say, by placing the lungs, with or without the heart attached, entire or divided into several portions, in a vessel of pure water of the temperature of about

60°; and in the second part I shall endeavour to determine the real value of the more modern test, which consists in adding to the former the effect of pressure. This division is rendered necessary by the fact, that the objections which will have to be considered apply chiefly to the test as originally performed; and that the additional test of pressure removes more than one objection, though it leaves others in full force, and opens an important inquiry as to the distinction between the effects of respiration and inflation.

I proceed, then, to consider, in the first place, the value of the hydrostatic test as originally performed, including the addition subsequently made of dividing the lungs into several portions, but without submitting them to pressure. Placing myself in the position of a supporter of the hydrostatic test, I assert on its behalf, that, if the lungs, both entire and divided into several portions, when placed in a vessel of sufficient size, filled with pure water of the temperature of about 60°, sink to the bottom of the vessel, respiration has not taken place.

To this assertion there are two objections. 1. That respiration may have taken place, and yet the entire lungs, as well as the several parts into which they have been divided, may sink in consequence of disease. 2. That respiration may have taken place, but to so limited an extent, or in so imperfect a manner, that neither the entire lungs nor any portion of them, though perfectly healthy, containing only the usual quantity of blood, and presenting no unusual appearance, shall float.

In examining the first objection, it must be borne in mind that disease may either exist before respiration or supervene after it. If a disease existing before birth affect the whole of both lungs, it is obvious that respiration cannot take place; but if it affect only certain parts of the lungs, there is nothing to prevent the healthy portions from receiving air, and those portions of the lungs would float, provided the quantity of air admitted into them were sufficient to render them buoyant. If, on the other hand, the disease supervene after respiration, it is not probable that it would proceed to such an extent as to consolidate the whole of both lungs. Hence some portions would be found to float. On either of the foregoing suppositions, that is to say, whether the disease occurred before respiration or supervened upon it, the cases must be extremely rare in which the objection on the score of disease would be valid. Disease affecting the entire lungs before birth, as it would preclude the possibility of respiration, could not fall within the scope of the objection; and partial disease could form a valid objection only where respiration in the healthy portions was so imperfect as not to render those portions buoyant. In like manner, disease occurring after respiration can form a valid objection only where the disease affects the entire lungs, and renders every part of them heavier than water; or where, though it do not affect every portion of the lungs, the sound parts of those organs have received in the process of respiration so small a quantity of air as not to be thereby made buoyant.

Without having recourse to authorities it may be safely stated, that disease occurring after respiration rarely, if ever, affects the whole of both lungs ; hence certain portions of the lungs will remain free from disease, and, provided respiration has been completely performed in those portions, they will, by their buoyancy, at once remove the objection. It will not, perhaps, be safe to deny the possibility of the lungs being so extensively affected by pneumonia as that no part of them shall remain buoyant ; but the event must be of extremely rare occurrence, and the objection will almost never find place. When the disease is partial, whether it occur before birth or after respiration, the objection, as has been stated, can hold good only in those cases in which respiration has been so imperfectly established in the healthy portions of the lung as not to render any one of those portions buoyant. In such cases the first objection merges in the second ; for if lungs healthy in all their parts may respire without becoming buoyant, it follows that lungs which have only certain parts of their structure in a sound state may receive air into those parts in a quantity too small to cause them to float. The first objection then, becomes identical with the second, except in those cases, acknowledged to be so rare, in which disease supervening after respiration affects the entire texture of both lungs. If it can be shown that lungs healthy in all their parts may, in spite of respiration, sink when placed in water, it will follow that lungs which are only partially healthy may also sink, though respiration have taken place. This leads to the second objection, viz.

That respiration may have taken place, but to so limited an extent, or in so imperfect a manner, that neither the entire lungs, nor any portion of them, though perfectly healthy, containing only the usual quantity of blood, and presenting no unusual appearance, shall float. A single case, reported by Mr. Alfred Taylor,* will suffice to prove the validity of this objection. The child was a twin, of the female sex, weighing nearly five pounds and probably nearly mature. "The substance of the lungs was healthy, of a deep Modena-red colour, with here and there patches of a somewhat lighter hue. There was no crepitation under the knife, nor was there any mark of congestion; for no more blood followed the incisions than is ordinarily witnessed in dividing the lungs of a fœtus." "The lungs were separately placed in water ; but they both sank with equal rapidity. Each lung was then cut into fifteen pieces." "The pieces of the two lungs having been kept apart, were placed in water separately ; and it was remarked that every portion sank rapidly to the bottom ; and on compression below the surface of water, no bubbles of air escaped." This child had survived its birth twenty-four hours.

This single case renders the entire objection just stated valid; but it is by no means unique, for similar instances have been reported by

* Guy's Hospital Reports, No. v. case 4.

Bernt, Remer, Orfila, Daniel, Schenk, and Osiander, which cases are quoted in Mr. Taylor's Essay already referred to. Billard, from meeting with some cases of this sort, has been led into the strange error of supposing, that children may survive their birth for hours, and even days, without breathing.* I have myself repeatedly examined lungs in which the process of respiration had been very imperfectly set up in several portions of one or both lungs, and yet only one or two of the several parts into which the lungs were divided floated when placed in water; but I have not met with any instance in which every portion of both lungs sank.

The objection, then, to the statement that the sinking of the lungs, whether entire or divided into several portions, is a proof that respiration has not taken place, is a sound and valid objection to the hydrostatic test, in the sense which is here attached to it, and the objection of course applies equally to lungs healthy in all their parts, and to those which have only some portions of their structure free from disease.

Let us now suppose that the entire lungs, or any one of the several portions into which they have been divided, float when placed in water. This buoyancy of the whole lung, or of its parts, is asserted to be a proof that respiration has taken place. Now to this assertion there are three distinct objections. The buoyancy may be due 1. To Emphysema; 2. to Putrefaction; or, 3. to Inflation. The first objection, viz. that the lungs may float in consequence of emphysema is easily disposed of. If emphysema do exist the air must be introduced either from the air-tubes in the process of respiration, or by inflation, or it must be formed by some peculiar action of the tissues themselves. On the supposition that the air is introduced during respiration, it will expand the air-cells of the lungs so as to furnish, independent of the emphysema itself, distinct proof that the child has breathed. On the other hand, if the emphysema has been caused by inflation, the first objection will become identical with the third. Emphysema then can form a valid objection only on the supposition that it is produced by some peculiar action of the tissues. Such is the prevailing theory, as will appear from the following quotation from Dr. Cummin's treatise :† "It sometimes happens that infants suffer violence in the birth ; the labour, perhaps, being tedious, and the mother malformed. The sides of the chest may be so pressed against the substance of the lungs as to do those organs injury ; they become inflamed and puffy, containing air in large vesicles on their surface, and this is what some authors call emphysema." So also Lécieux: "Thus, when I have been obliged to extract an infant by the feet, especially if the pelvis is narrow, I have often found that a part of the lungs floated, though the child had certainly not breathed, and even died in the course of the delivery. I could not attribute this acci-

* Maladies des Enfans, title Viabilité.

† The Proofs of Infanticide considered. By William Cummin, M.D., p. 61.

dental buoyancy of the lungs to putrefaction, because the infant did not present the characters of putrefaction, and I examined the body a short time after the extraction; but as we sometimes see a wound or a bruise, especially on the head, accompanied by an emphysematous swelling, it has appeared to me that in this case, during the extraction of the fœtus, the lungs have suffered a sort of contusion; that an effusion of blood has taken place into their tissue, which by undergoing a change had given rise to the formation of some bubbles of air, and in this way produced the buoyancy of a part of the lungs. This explanation appeared to me the more probable, inasmuch as the lungs had a brownish violet tint." *

Though I am by no means inclined to believe, with Cummin, that the lungs ever undergo such an amount of injury during parturition as to give rise to inflammation, and the consequent effusion of gas, nor with Lécieux that the lungs ever suffer "a sort of contusion," there is no room to doubt the occasional formation of gas in the cellular tissue of lungs free from the usual signs of putrefaction.

A remarkable instance of this sort occurred in my own experience. During the winter of 1840, I examined the body of a mature still-born fœtus, within forty-eight hours after its extraction by instruments. There was not the slightest trace of putrefaction in the lungs or in any other part of the body; there was no change of colour, no softening of tissues, no putrefactive odour, and, with the exception of a vesicle the size of a pea on the surface of one of the lungs, no formation of gas. The lungs, which were gorged with blood, were extracted, put into a gallipot, and carried in my pocket about two hours; at the end of which time the entire surface of the lungs was found studded with vesicles, some of them as large as a pea, and others smaller than a pin's head.

Here, then, in the course of two hours a very large quantity of gas was developed, though no single sign of putrefaction could be detected. This incipient process of putrefaction, for it is nothing less, is probably most apt to occur in parts of the body filled with fluid, as in lungs simply congested, or in the cases of pulmonary apoplexy which are apt to occur in children delivered after tedious labours, or extracted by instruments. If the lungs can be bruised in the course of labour, air may, of course, be thrown out in the midst of the effused blood, but there is no reason to believe that this formation of air is ever due to inflammation, nor is it necessary to have recourse to such an explanation of its origin. If the effusion of blood on the brain can cause the rapid formation of gas under the membrane, before putrefaction has set in so as to be recognised by its ordinary signs (and of this I have seen two well-marked instances), the same result may be expected to follow the effusion of blood in the texture of the lungs, as in pulmonary apoplexy, or even the mere accumulation of blood in the entire substance of those organs, as in the case now related.

* Lécieux, Considérations Médico-légales sur l'Infanticide.

If the so-called emphysema be really nothing more than an incipient process of putrefaction, then, the first objection to the floating of the lungs as a test of respiration merges in the second; and instead of three objections we have only two, viz. putrefaction and inflation.

For the reasons assigned I shall venture to regard the so-called emphysema as the product of incipient putrefaction, and shall state the objections to the floating of the lungs as a proof of respiration as two in number: 1. The formation of air in the cellular tissue in consequence of incipient or advanced putrefaction; and 2. Inflation.

1. Of the formation of air in the cellular tissue of the lungs in consequence of putrefaction. It is a remarkable circumstance that the possibility of the lungs becoming buoyant in consequence of the development of gas in their cellular tissue during the process of putrefaction, should have been called in question. The difference of opinion which has existed upon this subject can be accounted for only on the supposition that the putrefactive process does not always cause the formation of a sufficient quantity of gas to render the lungs buoyant; and that some experimenters have met with only those instances in which the lungs did not become buoyant from this cause.

Some experiments, which I made during the winter of 1839, will serve to illustrate this difference of opinion. I found that in some instances the lungs of still-born children, when placed in water, as soon as they began to give out a putrefactive odour, began also to leave the bottom of the vessel, and gradually rose to the surface, where they remained for many days, and then slowly sank to the bottom. In other instances large air vesicles were formed on the surface of the lungs, but not in sufficient number to give buoyancy to them; whilst in others, though the lungs gave out a strong putrefactive odour, there was no development of air-vesicles, and no tendency to rise to the surface, nor did they ever become buoyant either in the water in which they had stood, or in clear water. It is not easy to explain this remarkable difference, but I have no doubt that when the lungs contain a large quantity of blood, whether in their entire texture, or only in a part of it, putrefaction takes place more readily, and the formation of gas is carried to a greater extent.

Whatever may be the explanation of the remarkable difference of opinion which has existed on this subject, there is no longer any room to doubt that gases developed in the various stages of the putrefactive process may cause lungs which have not breathed to float. This objection to the hydrostatic test, therefore, is a valid objection, provided the test consist merely in placing the lungs, whether entire or divided, in water, and observing whether they float or sink.

2. The second objection, viz., that the lungs may be rendered buoyant by inflation, is also a valid one, inasmuch as the possibility of inflation being effectually performed to the extent of causing the lungs to float is now universally admitted. It is no doubt difficult to

inflate the lungs completely; but there is little or no difficulty, even when the mouth only is used, in introducing as much air as will suffice to render those organs buoyant. We may safely assume, therefore, that this is a valid objection to the hydrostatic test as now limited and defined.

From what has been stated, it follows that to the hydrostatic test, as originally and till a comparatively recent period performed, and used merely as a test of respiration, there are four valid objections, that is to say, two to the sinking of the lungs as a sign that respiration has not taken place, and two to the floating of the lungs as a proof that it has. To the sinking of the lungs as a proof of still-birth there are the objections of disease and imperfect respiration, and to the floating of the lungs as a proof of respiration there are the objections of putrefaction (in its several degrees and stages) and inflation.

Such is the value of the hydrostatic test, in the sense in which that term was used up to the period of the introduction of pressure as an auxiliary test. I now proceed to examine the hydrostatic test as modified by this important addition. The mode of applying pressure is not very material, provided it be not carried to the extent of destroying the texture of the lung. For some purposes the pressure of the finger and thumb under water is sufficient; but if stronger pressure be required it is best effected by placing the fragment of lung in a clean cloth, and, by the aid of an assistant, twisting the two ends of the cloth opposite ways. It can rarely be necessary to carry the pressure beyond this point, though in some experiments to which I shall presently allude, I submitted the fragments of the lungs to strong pressure by treading the cloth in which they were contained under foot.*

Assuming, as before, the position of a supporter of the hydrostatic test, in this its modern signification, I assert, on its behalf, that if the lungs, both entire and divided into several portions, when placed in water, sink, both before and after being submitted to pressure, that respiration has not taken place. The objections to this assertion are the same as those which apply to the earlier test, viz. disease and imperfect respiration, with this difference, however, that portions of lung containing a large quantity of blood and too little air to render them buoyant, may possibly become buoyant in consequence of a portion of the blood which they contain being forced out by the pressure. Hence the sinking of the lungs after the application of pressure affords a stronger reason for supposing that respiration has not taken place. Still it is quite possible that the quantity of air which has entered the lungs may be so small as even after the application of pressure not to render them buoyant, and hence the objections retain their full force.

* Mr. Jennings of Leamington, after applying pressure in the manner now recommended, and subsequently by means of weights, kneaded the several portions of lung in the palm of the left hand with the thumb of the right. Trans. Prov. Med. and Surg. Association, 1834.

On the other hand, supposing the lungs and the several portions into which they have been divided, to float both before and after being submitted to pressure, and it is asserted that this buoyancy of the lung is a proof of respiration, do the two objections urged with success against the earlier test, viz. putrefaction and inflation, hold good here also?

The objection on the score of putrefaction falls to the ground at once, for the slightest pressure of the fingers will expel the air generated by putrefaction, and cause the lungs to sink. It only remains, therefore, to consider the force of the objection, that inflation may cause the lungs to float.

That air artificially introduced into the lungs will render them buoyant, there can be no doubt. Does the employment of pressure serve to distinguish the buoyancy which is due to respiration from that due to inflation? This is a very important question, and one which demands a careful consideration.

The use of pressure as a means of distinction was first proposed by Béclard, and was introduced into practice in this country by Mr. Alfred Taylor,* and Mr. Jennings,† both of whom employed it as a diagnostic mark. The former concludes from repeated experiments, "that air, introduced by artificial inflation, may, under all circumstances, be expelled by compression, if the experiment be properly performed, and the pressure continued a sufficient length of time."‡ Mr. Jennings states that "air introduced into the lungs, by artificial inflation, may be expelled by pressure, so that the lungs will sink in water," and on the other hand, that "after respiration, the air cannot be expelled from the lungs without completely breaking down the structure of every part of the organ. Any part, however small, not thus broken down, will continue to float."

The value of this test can be decided only by an appeal to facts. Now it is conceded by Mr. Alfred Taylor, on the authority of Case III. reported in the Essay already cited,§ "that air, from respiration," (imperfect respiration) "may, by very moderate pressure, be forced out from divided portions of the organs;" and, on the authority of Case II. "that there are no satisfactory means of distinguishing artificial inflation from feeble respiration." Schmitt also reports a case in which the middle lobe of the right lung alone floated, and that imperfectly, but it sank again when forcibly compressed. The child had lived twenty-four hours, and artificial inflation had not been used.‖

Hence then it is established by fact, and admitted by one of the

* London Med. and Phys. Journal, Nov. 1832, and Jan. and May 1833.

† Trans. of Prov. Med. and Surg. Association for 1833.

‡ Guy's Hospital Report, No. v.

§ Ib., No. v. The child survived six hours, and breathed very imperfectly.

‖ Schmitt, Neue Versuche, &c. 93rd observation, p. 217.

proposers of the test of pressure, that that test does not distinguish imperfect respiration from imperfect inflation. On the other hand, my own experiments have proved, that lungs completely distended by artificial inflation cannot be made to sink by a degree of pressure short of that which will destroy the texture of the lung; and that lungs so distended with air differ from those which have breathed completely only by requiring somewhat more pressure to make them sink.

As this statement is important, I subjoin an account of one of these experiments, in the very words in which it was described from notes made at the time.

"On Saturday, April 10, 1841, I made the following comparative experiment. I took the lungs of a child two months old who had died of marasmus, and the lungs of a still-born fœtus at eight months. I inflated the fœtal lungs completely, and in doing so ruptured the air-cells, and produced emphysema over the entire surface, so that when I ceased to inflate them the lungs rapidly collapsed. I then took one lobe from the lung of either body, and, placing them together in a cloth, submitted them, by means of an assistant, to strong pressure. Both portions still retained their buoyancy. I next stood with my whole weight on the cloth which contained them, and repeatedly stamped upon them, but still both floated though their structure was almost destroyed. I then took a portion from the lungs of both children, distinguishing the lung which had breathed by the darker colour of its central portion, placed them both together in the same cloth, and proceeded as before. After applying pressure by twisting the cloth strongly, both pieces continued to float; they retained their buoyancy even after they were trodden upon, and it was not till they were pounded with the heel, and their structure thoroughly broken up, that the inflated portion sank: the portion of the lungs which had breathed still floated, though imperfectly. On pounding this portion of lung a second time, this likewise sank to the bottom. A second and a third experiment led to the same result, the inflated portion of lung sinking after a *less* degree of pressure than the portion which had breathed, but the structure being in both portions broken up before their buoyancy was destroyed." Another series of experiments was attended with the same result.

It appears, then, that where portions of lungs which have been inflated are submitted to the same amount of pressure with portions of lungs which have respired, the only difference observable is one of *degree;* the inflated lung, like that of the lung which has breathed, not sinking till its texture is destroyed, but a less amount of destruction being necessary, in the former than in the latter.

If, in these experiments, it had happened that a degree of pressure, short of that required to break down the structure of the lung, had caused the inflated portions to sink, while it was necessary to destroy the structure of the portions which had breathed before they could

be made to sink; we could have understood how *pressure* would be a means of diagnosis: but when the only distinction is the *degree* in which the structure of the lung is broken up, it is obvious that such a difference cannot be used as a test. In any given case we shall have to examine a portion of lung separately, and not side by side with one which we can take as a standard of comparison; we cannot, then, avail ourselves of a difference so slight as that pointed out,—a difference of degree and not of kind.

It follows, then, that the test of pressure does not distinguish imperfect respiration from imperfect inflation, nor complete inflation from complete respiration. If pressure is of any use, it must be in conditions of lung intermediate between the two extremes of imperfect and complete distention. In such cases, if on submitting the buoyant portions of the lung to pressure, the air contained within the air-cells can be expelled, and the lungs be made to sink without destroying or injuring their texture, we may be justified in stating that such portions of lung have been inflated. A reference to authors will prove that such cases may occur.

The only objections, then, to the value of the hydrostatic test as perfected by the addition of pressure, are three;—1. The lungs may sink, and yet the child to whom they belong have respired, inasmuch as respiration may have been too imperfect to render any portion of the lungs buoyant. 2. The lungs may sink though respiration have taken place, inasmuch as disease may have rendered them specifically heavier than water. 3. The lungs may float, and yet the child may not have breathed, inasmuch as inflation may render them buoyant, and pressure may fail to distinguish this effect of inflation from that of respiration.

In addition to the static and hydrostatic lung tests, other tests of respiration have been proposed; as changes in the size and shape of the chest, in the position of the diaphragm, in the volume, position, and consistency of the lungs themselves, and in the ratio which the weight of the liver bears to that of the rest of the body.

Changes in the Size and Shape of the Chest.—The chest before respiration is stated to be small, narrow, and flattened; after respiration larger, and of an arched form. Without insisting upon other objections to such a test, it is sufficient to state, that it is not wanted when respiration has been perfectly performed, and that where it is imperfect the presumed changes do not occur. It is unnecessary in the one case and useless in the other.

Change in the Position of Diaphragm.—The diaphragm, before respiration, is stated to be arched and to rise high in the chest; after respiration, to be flattened and depressed. This sign is open to the same objection as the foregoing.

Changes in the Volume of the Lungs.—The lungs are stated to be larger after respiration than before; this increase of size being dependent partly on increased afflux of blood, and partly on the admis-

sion of air. This test partakes of the fallacy of the static lung tests, and, like the two former, is not wanted where respiration is perfect or extensive, whilst it is useless in that imperfect respiration by which, as has been already shown, the lungs are not materially increased in size either by the afflux of blood or the admission of air.

Changes in the Position of the Lungs.—Before respiration the lungs are stated to lie far back in the chest, leaving the thymus and pericardium uncovered, and presenting sharp edges ; after respiration they project forwards, seeming to fill the chest, nearly covering the thymus and pericardium, and having their edges rounded. This is a description of fœtal lungs and of those which have fully respired. Now, in lungs which have fully respired, we do not want this test; and, in cases of imperfect respiration, it is no test at all ; for, in all the points just specified, fœtal lungs closely resemble those that have breathed imperfectly.

Changes in the Consistency of the Lungs.—Before respiration the lungs are as dense as liver ; after respiration, spongy and crepitous. When the lungs are found spongy and crepitous they have, of course, received air ; but that air may have been either inflated or respired. In cases of extremely imperfect respiration, there is no change in the lungs in this respect beyond the limits of the developed air-cells. This test forms a part of the description of the changes wrought in the lungs by respiration.

Weight of the Liver as compared with the rest of the Body.—After respiration a portion of that blood which had circulated through the liver is diverted to the lungs ; hence the liver must diminish in weight. Professor Bernt, of Vienna, availed himself of this fact to encumber the subject of infanticide with another useless test. All the objections already advanced against the static lung tests, and all which might be urged against any other test whatever might be made to apply to this. Orfila took the pains to submit it to experiment, and found that the ratio of the liver to the body before respiration was as 1 to 19 ; after imperfect respiration, when alone, if ever, such a test could be wanted, as 1 to $19\frac{5}{6}$; after complete respiration, as 1 to $17\frac{5}{6}$. The test is useless as well as unnecessary.

To all the foregoing tests, then, there is one simple objection,—that when respiration is complete they are unnecessary, and, when respiration is imperfect, useless. It is scarcely necessary to add, that they do not distinguish inflation from respiration, which is the only distinction really required beyond that obtained by the first glance at the surface of the lungs.

The refinements which some authors have endeavoured to introduce into the hydrostatic test, their balances and graduated jars, are as useless as subtile, and, like the tests now mentioned, may be safely consigned to oblivion.

A careful examination of the lungs themselves is the best, and only necessary means of determining whether or not the lungs have re-

ceived air through the air-passages. If the air-cells are found developed we have certain proof of respiration or inflation, and the number of cells so developed is the best measure of the extent to which those processes have been carried. The eye will detect these signs of the admission of air into the lungs where the quantity admitted is too small to render any portion of their texture buoyant. This sign, therefore, succeeds when the hydrostatic test fails. As to those cases, which are supposed by some authors to be possible, in which the air does not penetrate beyond the bronchial tubes ; if such cases do occur, the fact of the admission of air is not to be determined by any known test. The aspect of the lungs themselves, would teach us as little as the hydrostatic test.

The examination of the surface of the lungs, therefore, teaches us more surely than the hydrostatic test, that air has entered the lungs, but we cannot determine by mere inspection how the air got there. It may have been admitted by respiration or introduced by inflation.

The question of respiration or inflation can be determined only in those rare cases in which the quantity of air admitted is neither so small as in very imperfect respiration, nor so great as completely to distend the lungs. In such cases the test of pressure must be applied ; and should the several portions of the lung on being submitted to pressure short of that which would destroy their texture, sink, we may conclude that inflation has been practised. In any other case we shall be left in doubt.

In proving the hydrostatic test to be unnecessary except as a means, in certain cases, of discriminating inflation and respiration, an important service is rendered to those who may be called upon to give evidence in cases of infanticide. Appeals to the authority of Dr. Hunter, and objections to the hydrostatic test, have been urged in trials for infanticide, greatly to the annoyance of medical men, and to the hindrance of justice. These appeals and objections will no longer find place, and the whole subject will be greatly simplified.

The practical directions necessary for determining the question of respiration are very simple. Proceed at once to extract the lungs, taking care merely not to injure their texture, or that of the surrounding organs : examine carefully the surface of the lungs, and if that surface is found of a uniform colour, and the substance of a uniform firm texture like that of the adult liver, respiration has not taken place ; but if the surface is found mottled with spots of a bright vermilion, or of a rose colour, and these spots contain developed air-cells, then respiration or inflation has taken place. The ecchymoses sometimes seen on the surface of the lungs are nearly of the colour of the lungs themselves, and have no traces of a developed texture ; while air, the product of putrefaction, is obviously situated in the cellular membrane, and may be removed by the slightest pressure of the finger. Having thus ascertained that either respiration or inflation has taken place, divide the lungs into several portions, and place them in clear water of the

temperature of the air; submit the buoyant portions to firm pressure between the finger and thumb, or in a twisted cloth, or mould them with the thumb in the palm of the hand. If pressure short of injuring the texture of these portions of lung destroy their buoyancy, then we may safely assume that inflation has been practised, provided only that the lungs have neither been very incompletely distended, as in imperfect respiration, nor completely distended, as in perfect respiration or complete inflation. In both these cases we must remain in doubt, nor can any lung test help us out of our difficulty.

From all that has been stated, it appears that the only real difficulty which we encounter in determining the question of respiration, is that which is raised by the resemblance of the effects of inflation to those of respiration. It is therefore of the first importance to search for every means of discriminating the one from the other.

It is now generally admitted that the lungs of an infant may be inflated to a greater or less extent through the mouth, without having recourse to any instrument. It is generally thought that such inflation must needs be extremely imperfect; and in the majority of cases the general opinion is undoubtedly correct. Schmitt, however, succeeded in more than one instance* in completely inflating the lungs in this way; and in two cases so perfectly, "that not even a single point was to be found in either lung into which the air had not penetrated."† These are doubtless exceptional cases, for I have myself repeatedly removed the lungs, and inflated them by means of a blowpipe, and in no case have I been able to expand the entire texture of the lung without rupturing some of the superficial air-cells, and producing emphysema. Though the experiments of Schmitt oblige us to admit the possibility of inflating the lungs by the mouth, we may safely affirm that such complete inflation could not be practised by an unskilful person. Now, if the objection that inflation has been practised were urged on a trial for infanticide, it would be asserted to have been resorted to by the mother with a view of preserving the life of her child, (for the supposition that it might be put in practice by a malicious person with a view of criminating the mother is too absurd to be seriously entertained,) and should it appear in evidence that the lungs are completely expanded with air, the objection must fall to the ground; for it may be safely asserted that no unskilful female could so completely inflate the lungs of her child. On the other hand, should the lungs be found very imperfectly distended with air, we should be obliged to admit the possibility of their having been inflated.

In this case the circumstantial evidence would come to our aid; for to render the plea of inflation by the mother at all feasible, she must have shown in other ways her anxiety to preserve the life of her offspring. She must have made some preparations for her delivery, and

* Op. cit. Experiments, lxxx. & xcviii., also x. xliii. & xlix.
‡ Page 189.

must have prepared clothes for her child. In by far the majority of cases of infanticide, no such preparations have been made, and when they have been omitted, it is not likely that the objection on the score of inflation would make any impression on the jury.

Authors have laid down more than one distinction between the effects of inflation and respiration. Metzger, indeed, gives no less than four such means of discrimination. He states that inflation is distinguished by incomplete distention of the lungs, by flatness of the chest, by the want of crepitation when incisions are made into the lungs, but chiefly by the bloodless condition of the lungs without previous hæmorrhage. All these distinctions are proved by Schmitt* to be unfounded. It is scarcely necessary to observe, that respiration may also produce incomplete distention of the lungs; that it may be accompanied by perfect flatness of the chest, by absence of crepitation, and by a comparatively bloodless state of the lungs. The static lung tests have also been employed as a means of diagnosis, on the well-founded supposition that inflation does not increase the weight of the lungs. Now it has been already shown, that the static lung tests cannot be safely employed to distinguish respiration from non-respiration, and therefore as the inflated lungs are, as far as the blood they contain is concerned, in the condition of lungs which have not breathed, it follows that the static lung tests cannot distinguish respiration from inflation. There is fortunately one available distinction on which but little stress has been laid. It is this — in all unskilful attempts to inflate the lungs of a child through the mouth, air is introduced in considerable quantity into the stomach. The absence of air, therefore, from the stomach would go far to prove that inflation had not been practised.

Supposing the question of respiration to have been answered in the affirmative, a new inquiry suggests itself; viz. did respiration occur before, during, or after birth? for it is obvious that respiration having taken alone is no proof of live-birth, in the sense which the law attaches to that term.

Respiration may take place before complete delivery, 1. in the uterus; 2. in the vagina; and 3. after the delivery of the head of the child, the body still remaining in the passages.

1. Respiration may take place in the *uterus* in cases of face-presentation. Such an event, however, must be extremely rare, for face-presentations occur once only in about 300 deliveries. In this position, too, respiration would probably be extremely imperfect, so that the existence of complete respiration would at once negative the supposition of the child having breathed within the womb, and perished before complete delivery. Even when the parts of the mother are unusually capacious, it is very unlikely that respiration will take place to any great extent.

2. Respiration may also occur during the passage of the child

* Loc. cit. p. 180.

through the vagina. This is of frequent occurrence during the introduction of the hand to facilitate tedious labour, or to effect a change in the position of the child.* It must also be admitted to be possible in cases where no manual assistance is given, provided the parts of the mother are capacious. Here, too, it is probable that respiration would be very imperfectly established, so that the complete distention of the lungs would negative the supposition of respiration having occurred only in the vagina.

3. Respiration after the delivery of the head of the child, and before the complete separation of the body from the parts of the mother, is a common event. In such a case no serious impediment is likely to be offered to the complete delivery of the child. Schmitt relates no less than nine cases of this kind which occurred in his own practice, and in all of them the child was safely delivered.† On the other hand, a few cases are recorded in which children, having breathed in this situation, perished before the completion of the labour. Two of these are related by Dr. Campbell,‡ and a third by Dr. Hosack, of New York, in a letter to Beck.§

The possibility of respiration taking place before the complete separation of the child from the mother is thus placed beyond a doubt; and it must be evident that the mere inspection of the lungs will not enable the medical man to assert positively that respiration took place before, during, or after the birth, except in the rare case that the lungs are found fully distended with air. Such complete respiration, in all probability, would not occur in any of the cases just mentioned. In cases of imperfect respiration, we must look for other means of proving that the child has been born alive.

Having now examined the evidence of live-birth to be found in the establishment of respiration, it remains to examine certain other evidences of live-birth which are independent of respiration. These consist in certain changes,—*a*. In the organs of circulation. *b*. In the umbilical cord; and *c*. In the skin: to which may be added, certain indications to be drawn from an examination of the stomach, intestines, and bladder.

The changes in the organs of circulation, in the umbilical cord, and in the skin, at the same time that they are proofs of live-birth, are also means of determining how long a child has survived its birth. The more minute examination of these points will, therefore, be reserved till the question to which they relate comes under examination. The examination of the stomach, intestines, and bladder, belongs properly to this place.

The *stomach* may contain milk or farinaceous food. The discovery of either of these substances would furnish certain evidence that the child was born alive, and had survived its birth some time. The coagulated milk is easily identified; the farinaceous food may be

* See Schmitt, p. 173.
† Loc. cit. pp. 163—8.
‡ Midwifery, p. 105.
§ See Beck's Med. Jour. p. 306.

detected by the test of iodine, which strikes a characteristic blue colour with the starch contained in the food.*

The examination of the *intestines* may sometimes throw light on the question under consideration. In mature still-born children, the large intestines are found filled with meconium ; and although this may be partially expelled during labour, a considerable quantity of it will remain in the large intestines in all cases of still-birth. The complete expulsion of the meconium, therefore, will furnish strong evidence that a child has survived its birth. Its expulsion takes place from a few minutes to two or three days after birth. The intestines are found defended from the meconium by a layer of tenacious mucus, and when this is discharged the lining membrane is left of its natural colour. The meconium must not be confounded with a greenish-yellow secretion which is formed soon after birth, and which is sometimes found to tinge the intestines.

Some stress has been laid on the state of the bladder as a sign of live-birth. As this viscus is commonly emptied of its contents soon after death, its being found empty is regarded as a proof that the child was born alive. This sign is not of any great value, as there is no doubt that the bladder may be emptied of its contents during labour.

3. HOW LONG DID THE CHILD SURVIVE ITS BIRTH?

Some of the signs already alluded to, are, as has been stated, both evidence of live-birth, and means of determining with some sort of accuracy how long the child has survived. They are changes in the organs of circulation, in the state of the umbilical cord, and in that of the skin.

Changes in the Organs of Circulation.—There exist in the fœtus certain temporary additions to those organs of circulation which are destined for extra-uterine life. These additions consist of the umbilical arteries and vein, the ductus venosus, the ductus arteriosus, and the opening between the right and left auricle—the foramen ovale. All these parts, being unnecessary to extra-uterine life, are closed after birth ; and as the period of closure is different in the case of each of these parts, we are hereby furnished with a means of determining approximatively how long the child has survived its birth.

The Umbilical Arteries and Veins.—The obliteration of the *arteries* takes place much more speedily than that of the veins. At the end of the first twenty-four hours the umbilical arteries present a marked diminution in their calibre, and an increase in the thickness of their coats in the immediate neighbourhood of the umbilicus. At the end of two days the contraction extends through a great part of their length, and at the end of the third day reaches nearly to their termi-

* This test was successfully applied in a case communicated to Mr. A. Taylor by Dr. Geogehan of Dublin. Guy's Hospital Reports.

nation in the iliacs. The closure, then, of these vessels will prove that a child has survived its birth ; the degree and extent of their obliteration will enable us to judge of the length of time that it has lived.

The changes which occur in the *umbilical vein* and in the *ductus venosus* take place much more slowly. During the first three days a slight contraction only takes place ; on the fourth day this contraction is more marked, and on the fifth it is with few exceptions complete. By comparing the rapid obliteration of the umbilical arteries with the more slow obliteration of the vein, we may give, during the first few days of life, a fair guess at the age of the child.

The changes which take place in the *ductus arteriosus* have been minutely described by Bernt of Vienna, and constitute the Vienna test.

This vessel is about half an inch in length, uniformly cylindrical, and about the size of the pulmonary artery. According to Bernt, a few respirations suffice to destroy the cylindrical shape of the vessel, and to cause it to contract towards the aorta. If, however, the child has lived some hours or days, it resumes its cylindrical shape by becoming uniformly contracted throughout. At the end of a week it has diminished from the size of a goose-quill to that of a crow-quill. At the eighth day the duct is obliterated in half the children, and about the ninth or tenth in all of them. It was at first supposed that the Vienna test would form an important addition to our means of ascertaining how long a child had survived its birth ; but further experience has shown that the changes which take place are not sufficiently uniform, either as to the time or mode of their occurrence, to be of any service in fixing the duration of a child's life. An examination of the arterial duct ought not, however, to be neglected, as the actual existence of the changes just described will furnish a proof that the child was born alive.

The last sign derived from the state of the organs of circulation is to be found in the *foramen ovale*. This is by no means a certain sign, the period of obliteration being extremely variable. Thus Billard found the foramen ovale obliterated in 1 out of 18 infants of a day old ; in 4 out of 22 children of 2 days old ; in 3 out of 22 children of 3 days old ; and 2 in 27 of 4 days old. Devergie confirms these observations as to the uncertain period at which the foramen ovale is closed. No precise period can, indeed, be fixed for the obliteration of this aperture ; it often continues open till an advanced age, and is said not to be completely closed in more than one out of five hearts. This is an exaggeration ; but there is no doubt that the foramen ovale frequently remains open, even in the adult, and that without producing any dangerous consequences. All, then, that we can say of the foramen ovale is, that its closure is a certain sign of respiration and of live-birth ; but its being open is no proof whatever that a child has *not* been born alive.

Professor Bernt thought that he had made a useful discovery with regard to the situation of the aperture, which exists in the fossa ovalis. He observes, and, as a general rule, his observation is correct, that the opening is at first situated in the centre of the valve ; that as soon as respiration begins it is on the right side, and gradually rises with the continuance of respiration round the upper part and right side of the valve till it reaches its upper edge. Now all this may be true enough, but it is clear that such a sign would require to be observed with care, and by an experienced person, and could be of no use in the hands of the inexperienced. It may be useful by confirming other tests of more value ; in itself it can lead to little that is satisfactory.

Having now considered the various changes which take place in the organs of circulation, there remain to be examined those which occur in the umbilical cord and in the skin.

Changes in the Umbilical Cord.—In a new-born child the umbilical cord is fresh, firm, round, and of a bluish colour ; its vessels still contain blood, and its size varies according to the quantity of gelatinous fluid which it contains. The shrinking or withering of the cord is the first change which takes place ; it commences at the ligature, and gradually extends to the umbilicus. In some cases it begins directly after birth ; in others, not till some hours have elapsed ; it is rarely delayed longer than thirty hours or two days, and never longer than three. The cord is now flabby, and frequently a distinct redness is perceptible around the umbilical ring. The second change which takes place is the *desiccation* of the cord. It first assumes a reddish brown colour, and becomes semi-transparent ; it is then flattened and shrivelled ; and when the process is still more advanced it becomes quite transparent, and of the colour of parchment. The umbilical vessels are distinctly seen contracted, and containing clotted blood, and are sometimes completely obliterated. The commencement of this process of desiccation dates from *one* or *two* to *four* days after birth. The period at which the process is complete varies from one to five days, but the most usual period is three days. The last stage of the process is the falling off of the cord ; this may happen from the first to the seventh day, the most usual period being the fifth day.

In general, then, it may be stated that the cord withers during the first day ; that desiccation is complete on the third, and that the cord falls off on the fourth or fifth day. But this is merely general.

Mention has been made of an inflammatory circle formed around the umbilicus during the process of desiccation. This is regarded as a pretty sure sign that the child has lived ; but it is more frequently absent than present. Out of 86 cases mentioned by Billard, there were only 25 in which this inflammatory redness occurred. The want of it, therefore, is no proof that a child has not lived. On the other hand, Devergie* and Mr. Taylor† have mentioned instances in which this

* Méd. Légale, *art.* Infanticide. † Guy's Hospital Reports, No, v.

inflammatory circle has been found in still-born children; and I have myself seen one case of this kind. The presence of this inflammatory circle, therefore, must not be regarded as a proof of live-birth. The changes in the umbilical cord which have been now described are considered by Billard as affording certain evidence that a child has survived its birth. Those which take place in the cord of a child born dead, are merely the common changes induced by putrefaction. Repeated observation has convinced Billard, that the phenomena of desiccation do not show themselves in the cord of a dead child till after the latest period at which desiccation takes place in the cord of a living child. No separation of the cord occurs in a dead child, although the cuticle can be readily peeled off. *Cicatrization* of the umbilicus is the last change which occurs, and this takes place from the tenth to the twelfth day. If, then, the cord be found withered, the child must have lived from a few hours to three days; if desiccated, from one to five days; if it have fallen off, from one to seven days; and if the umbilicus have cicatrized, from ten to twelve days.

Change in the Skin.—This consists in an exfoliation of the epidermis, beginning on the abdomen, and extending successively to the chest, groins, axillæ, interscapular space, limbs, and, lastly, to the hands and feet. Sometimes the skin comes off in layers or scales, and sometimes in the form of a dust. This process of exfoliation, or desquamation, of the cuticle, sometimes begins when the child is a day old, sometimes it is delayed till the third or fourth day. It lasts, also, a variable period,—sometimes of thirty days, and sometimes of two months. It continues longest in feeble and delicate children.

This, too, is a vital process differing essentially from that separation of the cuticle which takes place in consequence of putrefaction. Although the period of its occurrence is variable, its existence will afford clear proof that the child has lived.*

Devergie has thrown together the various changes which take place in the organs of circulation, in the cord, and in the skin, at different periods, beginning with the first, and ending with the thirty-fifth day. This may form a sort of guide by which to judge of the age of a child.

On the 1*st Day.*—Cord beginning to wither. Foramen ovale, arterial and venous ducts, and umbilical vessels open.

2*nd Day.*—Withering of the cord complete.

Foramen ovale closed in two out of eleven cases, partially closed in one out of seven.

Ductus arteriosus.—Beginning to close.

Umbilical arteries.—Obliterated to a greater or less extent.

Umbilical vein and ductus venosus.—Still open.

3*rd Day.*—Desiccation of the cord.

Foramen ovale.—Sometimes closed.

* Billard, Maladies des Infans, pp. 13—24.

Ductus arteriosus.—Obliterated in one in eleven cases.
Umbilical arteries.—Very often obliterated.
Umbilical vein and ductus venosus.—Still open.

4th Day.—Cord beginning to fall off.
Foramen ovale.—Closed in about one-third of the cases.
Ductus arteriosus.—Still open in the majority of cases.
Umbilical arteries.—Closed, but sometimes open near the iliacs.
Umbilical vein and venous canal.—Much contracted.

5th Day.—Separation of the cord, with rare exceptions.
Foramen ovale.—Closed in more than half the cases.
Ductus arteriosus.—Closed in about half the cases.
Umbilical vessels.—Closed. Vein occasionally open.
Separation of the cuticle.—Advanced.

8th Day.—Entire separation of the cord, with commencing cicatrization.
Foramen ovale.—Closed in three-fourths of the cases.
Ductus arteriosus.—Completely obliterated in half the cases.
Vessels.—Closed.

9th to 11th Day.—Cicatrization of the umbilicus often complete; sometimes, however, there is an oozing of mucus from the cord for many days, so that the cicatrix is retarded.
Separation of the cuticle, on the trunk, chest and abdomen, and at the articulations.

20th to 26th Day.—Separation of the greater part of the cuticle.

30th to 35th Day. — Separation of the entire cuticle, excepting that of the hands and feet, which is often delayed till the 40th day.

The following tables, formed from the observations of Billard,* present at one view the principal changes just described, with the probable date of their occurrence, and the proportion of cases in which they have been observed to take place.

* Maladies des Enfans.

Obliteration of the Foramen Ovale. (Billard.)

		PER CENT.					
	No. of Observations.	Open.	Closed.	Imperfectly Closed.	Open.	Closed.	Imperfectly Closed.
1 Day	19	14	2	3	74	10	16
2 Days	22	15	4	3	68	18	14
3 Days	22	14	3	5	64	13	23
4 Days	27	17	2	8	63	7	30
5 Days	29	13	16	—	45	55	—
8 Days	20	5	11	4	25	55	20

Obliteration of the Ductus Arteriosus. (Billard.)

		PER CENT.					
	No. of Observations.	Open.	Closed.	Imperfectly Closed.	Open.	Closed.	Imperfectly Closed.
1 Day	19	13	2	4	68	11	21
2 Days	22	13	3	6	59	14	27
3 Days	22	15	2	5	68	9	23
4 Days	27	17	10	—	63	37	—
5 Days	29	15	14	—	52	48	—
8 Days	20	3	17	—	15	85	—

Table combining the Changes which take place in the Umbilical Cord, with the date of the Obliteration of the several Openings.

Days.	Umbilical Cord.	Foramen Ovale.	Ductus Arteriosus.	Umbilical Arteries.	Umbilical Vein.	Ductus Venosus.
		Open per cent.	Open per cent.			
1	Withering.	74	68	Open.	Open.	Open.
2	. .	68	59	Obliteration advanced.	Open.	Open.
3	Desiccating.	64	68	Obliterated.	Open.	Open.
4	Beginning to separate.	63	63	. .	Contracted.	Contracted.
5	Separation usually complete.	45	52	. .	Obliterated.	Obliterated.
8	Separation complete.	25	15			
9 to 11	Cicatrization commencing					
	Cicatrization complete.					
	Mucous Exudation.					

All these signs taken together will enable us to answer, with some confidence, the question, *Has a child survived its birth?* The presence of any one of them, in fact, is decisive; their absence would of course leave us in doubt. If, for instance, either the foramen ovale, the ductus arteriosus, or the umbilical vessels were found closed, we should conclude that the child was born alive; but if *all* these parts were open we could not be sure that it was born dead. So with the changes in the skin and umbilical cord: their presence would afford sure proof of life; though they might be wanting, and yet the child might not have been born dead. The extent to which these several changes had taken place would also afford us some clue to the length of time that a child had lived. The answer to this question is important, as we may be called upon to state whether or not a woman, suspected of having given birth to a child found dead, is the actual mother; whether, in fact, the appearances on her body correspond with those of a woman recently delivered, and whether the time which has elapsed since her delivery corresponds with the time that the child has survived its birth.

By means of the various signs which have been just examined, we are enabled to answer two important questions.—1. Was the

child born alive? and, 2. If born alive, how long has it survived its birth? Having answered these questions in the affirmative, we have next to inquire,

HOW LONG HAS THE CHILD BEEN DEAD?

This question also is important, because we may be required to state whether a child found dead owed its birth to a mother who was delivered at a certain known time.

The process of putrefaction differs in no material respect in the adult and in the infant. The same changes occur in the same order. The animal heat is first extinguished, rigidity then comes on, and putrefaction follows. These several changes probably take place more rapidly in the infant than in the adult. There is little doubt that the body of the new-born infant parts with its heat very rapidly; the rigidity which follows the loss of animal heat is as great, and lasts as long in the infant as in the adult; and the process of putrefaction itself, according to Devergie, goes on more rapidly. But accurate experiments are still wanting to determine the length of time occupied by the several parts of the putrefactive process in infants and adults respectively. The experiments of Orfila were made chiefly on fragments of the bodies of infants, and not on the entire body; they are, on that account, not very satisfactory. All then that we can say on this subject at present is, that the process of putrefaction is probably more rapid in the infant than in the adult, and that this circumstance must be borne in mind when we are deciding the question before us. With the exception of the time required, the principles which will guide us in our decision will be the same at all ages. These will be the subject of a future chapter. The effects of intra-uterine maceration, described at p. 121, must not be confounded with those of putrefaction. The absence of the odour of putrefaction will alone serve as a distinction.

The first great question of live-birth having been answered in the affirmative, another question arises—

WHAT WAS THE CAUSE OF DEATH?

This question, like those already examined, involves a great number of details. The best division which can be made is into *death from natural causes*, and *death from violence or neglect.*

1. *Death from Natural Causes.*—There is a great variety of ways in which the life of a child may be sacrificed, within a short period of its birth, without any violence being used on the part of the mother. It may labour under a congenital disease, which will either effectually prevent the establishment of the several vital functions, or it may be so feeble as to be unable to maintain an independent existence of however short duration; or it may perish in the course of a slow and lingering parturition. The congenital diseases, which may either entirely prevent the establishment of the several vital

processes, or render their continuance for any length of time impossible, have their seat in the three organs most essential to life ;—the heart, the lungs, and the brain.

There are diseases of the *heart and large vessels*, which may prevent the continuance of life beyond a few days ; but there are none on record which cut life short so speedily as to raise any questions of a medico-legal nature. Of the cases collected by Beck, there is only one which proved fatal within a week of birth.*

The diseases of the *lungs* are more important in relation to the present question. They are five in number,—1. Hepatization (red and grey), the consequence of pneumonia occurring before birth. 2. Pulmonary apoplexy. 3. Pulmonary tubercles. 4. Œdema. 5. A disease described by Devergie, and called by him Œdema lardaciforme, which seems to differ from common œdema, and to be a sort of mixture of that and schirrus. The disease affects the thymus as well as the lungs.

These diseases of the lungs may affect either their entire structure or a part only. Where the whole lung is involved, it is clear that respiration cannot be perfectly established, and the child cannot long survive its birth ; where, however, the disease is partial, the medical man must state, to the best of his judgment, whether it is extensive enough to prevent the continuance of life.

In the foregoing enumeration of the diseases of the fœtal lungs, no notice is taken of a condition of the lungs to which Dr. Jörg of Leipsig has given the name of *atelectasis pulmonum*, or imperfect expansion of the lungs. This is not, strictly speaking, a disease, but merely an absence of respiration and a persistence of the fœtal condition, which is found in by far the majority of new-born children, and may even continue for days or weeks. The substance of the lungs in the unexpanded parts is perfectly healthy, the want of expansion depending probably upon some defect of innervation.

The difficulty already alluded to of completely inflating the lungs of still-born children seems to prove that something more than the mere expansion of the chest is required in order that respiration may take place ; and this is probably that degree of innervation essential to the due performance of the functions of every organ of the economy.

This question of atelectasis is speculative and not practical ; all that need be known concerning this imperfect expansion of the lungs is the fact already stated,—that it has been found to exist extensively in children who have survived their birth some weeks. Life, therefore, is not curtailed by it to such a degree as to affect the question now under consideration.

The chief diseases which affect the *brain and spinal marrow* are accumulations of fluid and morbid softening. When serum exists to a limited extent either between the membranes or in the ventricles of the brain, life is not necessarily compromised, at least not within a short period of birth ; when, however, the accumulation of serum is consider-

* Med. Jur., p. 326.

able, it will materially interfere with the functions of life, and may afford a sufficient explanation of the premature death of the child. The same remark applies to morbid softening of the brain and spinal cord. It must be borne in mind, however, that the brain of the fœtus is naturally softer and much more vascular than that of the adult. This difference is important in a medico-legal point of view.

The Alimentary Canal occasionally presents appearances worthy of note. Sometimes the lining membrane of the *œsophagus* presents a marked injection, in the form of spots, longitudinal lines, or ramifications. These may happen to be arranged transversely and may be mistaken for the effects of a ligature applied to the neck. *The stomach*, moreover, may be the seat of ulcerations with a sanguinolent, dark-coloured discharge,—these appearances may cause a suspicion of poisoning. The same changes may be found in the rest of the alimentary canal.

All these morbid appearances, existing before birth, may rapidly increase after birth, and prove speedily destructive of life. The medical man, therefore, ought to be extremely careful in examining the bodies of children supposed to have been murdered, to let none of these morbid changes escape his observation. The discovery of them may be of the first importance to the ends of justice.

The same remark applies to all the diseases just specified, viz. that they are of rare occurrence; that where they are present, it is rarely to such a degree as to affect the question of infanticide; and that it is only when they exist in a marked form and to a considerable extent, that they can be received in explanation of the early death of the child.

But in addition to severe congenital disease there are other natural causes of the death of the new-born infant.

The child may be immature, and on that account incapable of maintaining an independent existence, or it may be mature and well-formed, and yet perish from extreme weakness, the consequence of a protracted labour or of abundant hemorrhage.

Respiration may also be prevented from taking place by accumulations of mucus in the fauces, or, having been imperfectly established, may be prevented by this cause from continuing.

The life of a child is often lost during protracted delivery. The mere lengthening out of the process of delivery, without any malformation, disease, or even debility on the part of the child, may cause its death. This is still more likely to take place where there is any marked disproportion between the size of the child and that of the mother, or where any part of the child's body, but especially the chest, is unusually developed. If hemorrhage take place during parturition, on account of the partial separation of the placenta, or in consequence of an abnormal situation of that organ, the life of the child may also be in danger. So also if the umbilical cord suffer compression during labour, and before respiration has taken place, the child's life will probably be sacrificed.

A careful examination of the child may enable the medical witness to decide whether its death took place from any of the causes now specified. The existence of disease, the fact of immaturity, the marks of protracted labour, the signs of previous loss of blood, and the presence of mucus in large quantity in the mouth and air-passages, may all be verified by a careful inspection of the body.

It is only when proofs of respiration are present that these signs of death from natural causes have any value; and in the case of children who have survived their birth but a short time, it may be laid down as a general rule, that the absence of marks of violence affords a fair presumption that death has been due to natural causes. It is true that, in such a case, the child may have been the victim of intentional neglect, and may have died from the want of those simple aids by which the lives of children in more favourable circumstances are preserved; or it may have been prevented from continuing to breathe by simply closing the mouth and nostrils; but the medical man has no means of detecting these causes of death, and the accused must have the benefit of the doubt which attaches to the case.

It must also be borne in mind that about one child in every twenty is still-born, and that the proportion is twice as large in the case of illegitimate children.* It must not be forgotten, moreover, that large children are most likely to perish in the birth, so that the large size of a child affords a presumption in favour of its being still-born.

2. *Was the Death due to Violence?* and if so, was the violence the result of accident or design?

In some cases the traces of injury are so marked and of so undoubted a character, that we may decide without hesitation that they are due to murderous violence. Such is the case when the fontanelles, orbit, or nuchæ are punctured, when the neck is forcibly twisted, when a sharp instrument is introduced into the heart, when the head is separated from the body, or strangulation is effected with unusual force.

All of these causes of death have been employed, and none are more insidious and more likely to escape observation than minute wounds inflicted by pointed instruments on the head, heart, or spine. There is a story told in the *Causes Célèbres* of a diabolical French midwife who used to despatch her victims by thrusting a long needle into the fontanelle as soon as it presented.

Another mode of destroying the life of the infant is less likely to be employed—that of crushing the head. Foderé has given an account of a singular mode of committing this kind of murder, practised not long ago by a young widow in France. Being seized one evening with labour pains while receiving a visit from eight of her neighbours, she complained of colic, seated herself on a bucket in bed, and when the child's head had passed the vagina, she squeezed it flat by compressing it with her thighs.

* Bisset Hawkins, Medical Statistics.

These cases can create little difficulty, as it is not easy to confound the appearances produced, with any injury which the child is liable to suffer during birth. But there are other cases which may be less easy of decision, and where a minute and careful examination may be necessary.

Suffocation.—The modes in which this may be accomplished are very various. When no marks of violence are present, the medical man can do no more than the unskilled witness towards determining whether or not the mother is guilty. It is clear, indeed, that a child may be placed, or intentionally left, in a condition or place in which suffocation is inevitable, and it would be impossible to say whether it fell into this position or place of itself, or was criminally allowed to remain there, or was put there by the mother.

In some cases respiration is altogether prevented in a child born alive and fully prepared to breathe. Thus instances have occurred of children born in the membranes, who have shown strong signs of life for many minutes, and required to be extricated from the womb in order that they might breathe. In other cases the child may fall into the midst of the discharges or on to a soft bed, or may be prevented by some similar obstacle from breathing at all.

In these cases there may be criminal negligence on the part of the mother, but it will not be in the power of the medical man to discover her crime.

In other instances, respiration having commenced will be prevented from continuing by causes which may be accidental or designedly brought into play, but which leave no trace of violence on the body. The child may breathe, and then fall into the fluid discharges, or it may be overlaid in bed, or its mouth may be obstructed by accumulations of mucus which must be removed in order that respiration may continue. These, too, are cases in which, no outward mark of violence existing on the body, we are unable to decide whether the death was accidental or intentional.

There is one form of death, unaccompanied by violence, which requires to be examined in this place: A child is found in a privy, and the question arises whether the child was suffocated by being thrown into it, or whether it might have been expelled while the mother was there for a natural purpose. Supposing a child to be found in such a situation, and, on inspection of the body, respiration was found to have taken place completely, or to a great extent, that circumstance alone would furnish the strongest presumption against the child's having been expelled in the way now mentioned. If, on the other hand, the signs of imperfect respiration were present, it is possible that the child may have breathed during the birth, and all that is required to give some plausibility to the present supposition is the fact, that such sudden deliveries may occur.

Many cases of sudden parturition are on record. Thus Jörg relates the case of a pregnant woman who, "on account of a desire to eva-

cuate the bowels, went to the night-stool, and brought forth sitting on this, without any pain or bearing down, a large boy, who first struck the edge of the night-stool with his head, and then fell on the ground."* There was in this case an extravasation of blood on the left parietal bone. Mr. Tatham also mentions the case of a married lady delivered of twins on the night-stool. It was not her first labour, but probably her second. Both the children died.† These cases are not of very rare occurrence.

Several other cases of sudden delivery in the horizontal and erect posture are on record.

It is probable that such cases of sudden parturition are rare in women who have not previously borne children. It must be admitted, then, as *possible*, that a fœtus found in a privy may have been discharged in the course of a sudden delivery, and may be there asphyxiated.

There is one form of suffocation which is attended by violence, viz. where a foreign substance is introduced into the fauces. The mucous membrane, in these cases, is stated to be congested anterior to the situation of the plug, and pale where the greatest pressure has been exerted.

Another mode of effecting suffocation is by rolling the tongue back into the throat. As the tongue would probably resume its original situation, it is not likely that this cause of death would be detected.

Strangulation.—A child may be strangled by the application of a cord, and yet no marks of violence appear on the neck. But let us suppose that marks of violence do show themselves, that there is a discoloured depression round the neck;—is it certain that this has been done by the mother? Might not this appearance arise from the twisting of the cord around the neck, or by the pressure of the neck of the womb? Klein, an eminent German authority, has examined this point with great care. He says, "I have never met with an instance of marks of injury of the kind supposed—ecchymoses or suggillations—produced by the orifice of the uterus, or by the umbilical cord, although I have known a great number of cases in which the neck of the infant had been strongly girded by the funis once or twice twisted round it, strangulation having been either actually produced, or rendered most palpably imminent." He then goes on to speak quite as decidedly regarding the pressure of the neck of the uterus; not a bruise, as he tells us, nor mark of any kind being left on the infant which has perished in this way. A case mentioned by Jörg shows that the experience of Klein is not to be implicitly trusted:—"The navel string had been twisted five times round the neck, and had left five tolerably deep red impressions." Taufflieb also has recorded cases of the same kind.*

Marks of pressure on the neck, therefore, cannot always be attri-

* Die geburtshülfliche exploration, p. 116.
† London Medical Repository, vol. i. part iv. New Series.
‡ Annales d'Hygiène, vol. xiv. p. 340.

buted to intentional violence; but as in most instances a murderer uses more force than is necessary, it will often happen, in cases of infanticide, that the marks are too distinct to be accounted for by the accidental twisting of the umbilical cord round the neck. Moreover, if respiration is found to have been completely established, there will be the strongest presumption against the strangulation having been produced by a cause acting during the birth.

Strangulation may also be effected by the pressure of the fingers on the throat, in which case ecchymoses may be found corresponding with the cause.

Drowning.—The signs of this form of death will be the same in the infant and in the adult. These signs will be described in a future chapter.

Fracture of the Skull.—It is asserted that this may happen in three ways:—1. In the course of labour. 2. By falls on the floor. 3. By intentional violence.

In illustration of this latter cause, falls on the floor, Chaussier has made some interesting experiments. 15 still-born children were allowed to fall perpendicularly, and head foremost, from a height of 18 inches on a stone floor. In 12 of them one or other of the parietal bones was broken. When the height was 3 feet and upwards the fractures were proportionably greater. Fractures were also produced by strong pressure and by blows.*

But Dr. Klein has adduced facts which seem to render it doubtful whether fracture ever occurs in sudden labours from falls on the floor. He availed himself of the opportunities he possessed, by his official station in the kingdom of Wurtemberg, to procure returns of all such labours occurring within his jurisdiction. The result was 183 well-authenticated cases, in 150 of which the mothers were suddenly delivered standing; yet there was not a single case of death among them, nor of fracture of the skull, or other mischief happening to the infant; though some of the children had fallen on bare boards, and some on the pavement. The reason of the difference between the experiments and those cases occurring naturally is supposed to be that, in the latter, the direction in which the body of the infant is projected is oblique, and the fall is not so instantaneous as in the experimental essay.

The possibility of fracture of the bones of the skull being produced during labour, is proved by more than one well-authenticated fact. Siebold relates a case in which a female with a very narrow pelvis was delivered, by the efforts of nature alone, of a well-formed still-born female child. On examining the head, a great quantity of blood was found extravasated upon the surface of the cranium, and there were three fissures in the left parietal bone, and one in the left frontal bone. Michaelis of Keil also reports the case of a woman with a well-formed pelvis, who was delivered of her first child after a natural

* Considérations Médico-légales sur l'Infanticide par Lecieux.

labour. The child breathed both during and immediately after birth, but then died. The head was much disfigured; and on examination, the right parietal bone, which during birth had been directed under the promontory of the sacrum, was covered anteriorly and above with effused blood, and on the removal of the periosteum was found fractured in five places. The whole of this bone was uncommonly thin. On opening the skull there was found no extravasation beneath the fissures, but the longitudinal sinus was ruptured, and there was an extensive coagulum on the cerebrum on both sides, under the dura mater, and on the tentorium.* These two cases will show the great amount of injury which the head may sustain during birth.

Seeing then that fracture of the skull during labour is possible, what is the difference between fractures thus produced, and those the result of violence? There will be no difference, except in those rare instances in which unusual violence has been used, and the bones of the face as well as those of the skull are fractured.

Fracture and Dislocation of the Neck.—This form of injury is never present before birth; it is, therefore, a sure sign of criminal violence.

Contusions.—In examining bruises on the head it is necessary to bear in mind, that tumours may result from compression of this part during labour: a mere swelling on the head must not, therefore, be taken for a mark of criminal violence. It is not probable that a contusion of the head unaccompanied by fracture of the skull would prove fatal.

Incised and Punctured Wounds.—There is nothing peculiar in these wounds as inflicted on the new-born infant. For the distinction between these and other wounds inflicted during life and after death, the reader is referred to the subject of Wounds.

Poisoning.—The rules for the examination of the stomach and intestines, and of the substances contained within them, are the same for the infant and the adult; they will therefore be treated of under the general head of Poisoning. This form of death is rare in the case of the new-born child.

Infanticide by Omission.—The omission to tie the umbilical cord sometimes proves fatal; and there can be no doubt that that omission is in some instances a criminal one. Some authors have doubted the correctness of the general opinion of the necessity for tying the cord, and have adduced arguments in favour of their own view of the case. There are, however, facts enough on record to show that such an omission may be attended with danger. Foderé relates one case in which the child perished in consequence of the ligature becoming loose;† and Dr. Campbell two fatal cases, one from the accidental, the other from the intentional, removal of the cord.‡

It is probable that fatal hemorrhage would very rarely follow a rupture of the cord, and this probability is strengthened by the testi-

* Quoted by Beck, p. 319. † Vol. iv. p. 515.
‡ Introduction to the Study and Practice of Midwifery, p. 151.

mony of Klein. Such a rupture of the cord is not necessarily the act of the mother, for it may occur in cases of sudden delivery taking place in the erect posture.

The signs of death from hemorrhage are the paleness of every part of the body, and the small quantity of blood contained in the heart and large vessels. In the absence of wounds to account for the hemorrhage, such a bloodless state of the body may be regarded as in all probability the effect of hemorrhage from the cord.

The child may perish by other acts of omission—as of proper clothing or food, which circumstances will be readily ascertained by an inspection of the body, and an examination of the stomach. Supposing it to have been previously shown that the child had survived its birth for some days, death from want of food would betray itself by the great emaciation of the whole frame, and the empty state of the alimentary canal. In these cases the child is at the same time often exposed to the action of cold. This form of death is characterised by pallor of the surface, with congestion of the internal parts.

As a general rule, infanticide by omission will be inferred from the position in which the body is found; from its exposure, the untied state of the cord, and the absence of covering; or, if the child seems to have survived its birth any length of time, the empty state of the alimentary canal.

Such cases of infanticide by omission being difficult of proof are never punished with death, but the mother is convicted of the lesser crime of concealing the birth. Even when marks of violence are found on the body, the inquiry generally assumes so complicated a shape, that the jury cannot be induced to return a verdict of wilful murder.

EXAMINATION OF THE MOTHER.

The first inquiry with reference to the female suspected of having given birth to the child is,—Whether she has been recently delivered, and if so, whether the period of her delivery corresponds with the time at which the child is supposed to have been born. This part of the inquiry belongs to the subject of delivery (p. 94).

Another inquiry may be necessary in certain cases; and that is into the state of the mother's mind. Puerperal insanity is by no means a rare disease, and there is no doubt that it sometimes takes the form of homicidal mania, threatening the life of the child. An interesting case of this kind is quoted by Paris and Fonblanque.* It was that of a married woman, of good reputation, who being delivered of a child, and not having slept many nights, fell into a temporary frenzy, and whilst alone killed her infant; but company coming in, she told them that she had killed it, and *there* it lay. The good reputation which the woman had previously borne, the long want of sleep, the entire absence of the usual motives to the commission of such a crime, added to "many circumstances of insanity appearing," led to

* Med. Jur. vol. iii. p. 129.

her acquittal. Dr. Paris observes, in reference to this case, that "had this woman been of doubtful character, though innocent, she might have been executed for want of medical evidence to prove the nature and frequency of puerperal insanity."

This subject will be best brought to a conclusion by the following summary of the chief points to be attended to in cases of infanticide.

1. Examine the body of the child in order to determine its degree of maturity; for this purpose, weigh and measure it, ascertain the position of the centre of the body, and attend to the several points comprised in the description of the growth and development of the fœtus (pp. 99 et seq.).

2. Note the several circumstances by which the time that has elapsed since the death of the child may be determined, such as the presence or absence of animal heat and rigidity, the existence or non-existence of putrefaction, and, if putrefaction be present, the degree to which it has advanced.

3. Examine the entire surface of the body with a view to ascertain the presence of marks of violence, and, if any be present, determine whether they might have been produced during birth, or were the effect of accidental causes acting after birth. Examine the mouth, fontanelles, orbits, nuchæ, &c., in search of wounds inflicted by pointed instruments. Note the state of the umbilical cord, measure it, and ascertain whether it has been torn or cut; and observe the condition of the skin.

4. Open the chest, and remove the heart, lungs, and thymus gland. Separate the lungs, and carefully inspect their surface. Observe whether they are of a uniform liver-colour and compact consistence throughout, or uniformly spongy like the adult lung, or mottled with developed air-cells, as in imperfect respiration. If there are any parts of a lighter colour than the rest, observe whether the structure of the lung itself is developed in those parts, and distinguish the developed air-cells from air contained beneath the pleura, the result of incipient or advanced putrefaction, by applying gentle pressure with the finger. Having ascertained that the air-cells are developed, cut the lung into small fragments, and place the fragments in water, subsequently applying pressure to such of them as float. If any portions of the lung, being originally buoyant, can be made to sink by pressure short of that which would destroy their structure, it is probable that the buoyancy is due to inflation.

5. Examine the heart and blood vessels; the foramen ovale, the ductus arteriosus, the ductus venosus, and the umbilical arteries and veins. Observe whether these several parts are contracted or obliterated, and to what extent and degree; and whether they contain much or little blood.

6. Examine the stomach and intestines; the stomach to ascertain whether the child has been fed, the intestines to determine the presence or absence of meconium. If there is any appear-

ance of inflammation in the alimentary canal, test its contents with a view to the discovery of poison. Note whether the urinary bladder contains urine.

7. Examine the bones of the skull both at the vertex and base, in search of fractures. Inspect the brain and its membranes, and note any effusion of blood or serum. Examine the spine and spinal cord with a view to the discovery of dislocation or fracture of the vertebræ.

8. Examine the suspected female in order to ascertain whether she has been recently delivered, and how long. It may be necessary, also, in certain cases, to inquire into the state of the woman's mind.

The Author trusts that he will escape the charge of presumption, if he ventures to comment on the state of the law as it affects the child-murderer.

It is notorious that the law, as it now stands, is altogether inoperative, and that the only punishment really awarded to the child-murderer is the two years' imprisonment with which it visits the concealment of the birth. This impunity is due to the unnecessary refinement of the law, which requires at the hands of the medical man a distinction that, in most cases, it is out of his power to make. The child must be *born alive*, and unless the medical witness can prove that it has been born alive, it may bear on its body the clearest marks of murderous violence, and yet the murderer may escape unpunished.

In most instances, the crime of infanticide is committed so soon after the birth of the child, that the only proof of its having been born alive is that furnished by the presence of the signs of respiration. But it has been already shown that respiration may take place before and during the birth, as well as after it ; and, in by far the majority of cases, all that the medical man can succeed in proving is, that the child has or has not breathed : and it is not in the nature of things possible that he should say whether respiration, if it have taken place, occurred before or after the birth. Now, it may be fairly asked, Why require proof of live-birth at all ? for it is notorious that this question does not lead to the punishment, but to the escape, of guilty persons.

The suggestion which we would make is this : Let the law be so framed as to exclude as much as possible all appeal to scientific authority. If the child-murderer is to be punished, all question as to the child being *born alive* must be done away with ; and whenever there are found on the body of an infant marks of violence sufficient to account for its death, which marks of violence could not be produced in the natural progress of the labour, or by any accident occurring afterwards, let the female be punished as guilty of murder. Medical evidence would thus be restricted to the two questions, Were the injuries found on the child inflicted while the blood was still circulating ? and are they such as could not be accounted for in

either of these two ways? There would be no injustice in such an enactment, for the same injuries which would destroy the life of a child that had already breathed, would effectually cut off all chance of its preservation; and it is in the highest degree improbable that a female would inflict such injuries on a child that did not show some signs of life.

On the other hand, as, in the absence of all external injury, it is impossible to prove that a child has been murdered; and yet it may be easy to show that the female has been guilty of criminal negligence; let that criminal negligence be punished according to its degree. The law, as it now stands, contemplates only one degree of criminal negligence, viz. the concealment of the birth; and the concealment of the birth, except in as far as the life and well-being of the child is thereby affected, is but the concealment of shame. The concealment of the birth is criminal, inasmuch as such concealment presupposes the want of that assistance which all women know to be necessary to the well-being of the new-born child. Let the concealment of the birth, then, be punished as now by imprisonment for such a time as the law sees fit. Another omission,—that of providing proper clothing and shelter for the child—at present escapes punishment altogether, and certainly demands a separate enactment.

LEGITIMACY.

Legal Relations.—Duration of Pregnancy.—*Modes of Reckoning.—Single Coitus.—Observations on Animals.—Estimates of Authors.—Summary of the Arguments in favour of a Variable Period.—The Gardner Peerage Case.—Case of the Rev. Fergus Jardine.*—Earliest period at which a Viable Child may be born.—*Meaning of the term Viable.—Signs of Maturity and Immaturity.—Cases of Belloc, Rodman, and Outrepont.—Tenancy by the Curtesy.—Monsters.*

The law always supposes that a child born in wedlock has the mother's husband for its father, but this presumption may be rebutted by evidence. "As, if the husband be out of the kingdom of England," (or, as the law somewhat loosely phrases it, extra quatuor maria,) for above 9 months, so that no access to his wife can be presumed, her issue during that period shall be bastards; but it was held that if the husband was in England during any part of the time between the conception and the birth, the child would be deemed legitimate." This was the law formerly; but it is now held that the husband's being within the four seas is not conclusive evidence of the legitimacy of the child, and it is left to the jury to consider whether the husband had access to his wife.

The law, then, first presumes that a child born in wedlock has the mother's husband for its father; but allows evidence to be adduced to prove non access on the part of the husband, or impotence, or any

other cause which makes it impossible that the reputed should be the real father.

The question of legitimacy is comparatively simple when one individual only, viz. the husband of the mother is concerned ; but it assumes a more complicated shape where it lies between two husbands and two possible fathers. Thus, if a woman marries a second husband immediately after the loss of the first, the law regards both husbands as equally likely to be the real fathers, and the question of paternity can be determined only by medical or other evidence. The law on this subject is thus laid down by Blackstone and Coke : " If a man dies, and his widow soon after marries again, and a child is born within such a time as that by the course of nature it might have been the child of either husband, in this case he is said to be more than ordinarily legitimate, for he may, when he arrives at years of discretion, choose which of the fathers he pleases."

In cases of disputed legitimacy, the medical man may have to furnish evidence to show that the reputed parent was, at the presumed time of conception, or permanently, impotent ; or, on the other hand, to solve certain difficult questions connected with the maturity of the offspring, or the duration of pregnancy. The question of impotence has already been discussed ; it remains, therefore, to examine the other questions now referred to.

There are several circumstances out of which the question of legitimacy may spring. A woman may bear a child after her husband has been absent from her more than nine calendar months ; and in this case the question arises, does the period of utero-gestation admit of being extended beyond this the *usitatum tempus pariendi?* On the other hand, a woman within an unusually short period of her marriage may bring forth a child capable of being reared, and here the question may arise, what is the earliest period at which a viable child may be born. Again, a woman before the expiration of the full term of nine calendar months, say in the 7th or 8th month, may be delivered of a child having the size and general appearance of one at full term ; and it may become a question whether a child of such a size, and apparently so mature, could have been of the supposed age. Here an accurate knowledge of the growth and development of the fœtus will be necessary. Questions of this kind may also be raised where a woman marries a second husband soon after the death of the first. In this case, too, the question of superfœtation may be involved.

The principal questions raised in cases of disputed legitimacy are 1. What is the longest possible duration of pregnancy? and 2. What is the earliest period at which a viable child may be born? These points will be first examined, and then one or two questions of less importance will be briefly noticed.

DURATION OF PREGNANCY.

This is a question to be decided by medical evidence; for, though the practice of our courts of law is to consider forty weeks as the more usual time, medical men are allowed to give evidence as to the possibility of that period being extended.

The general belief among medical men, as well as among the vulgar, is, that the period of utero-gestation is 9 calendar months, 10 lunar months, 40 weeks, or 280 days; and we often meet with the less definite expression "9 months, or 40 weeks." Now, it is important to understand at once, that there is a material difference between 9 calendar months on the one hand, and 10 lunar months, 40 weeks, or 280 days on the other; for nine calendar months may consist either of 273, 274, 275, or 276 days, falling short of 280 by from 4 to 7 days. This difference must be borne in mind.

Having premised thus much regarding the expressions made use of in speaking of the duration of pregnancy, the next inquiry is as to the means which we possess of ascertaining the duration of pregnancy in particular cases. These means are four in number.

1. *Peculiar Sensations* at the time of conception, or within a few hours, or two or more days, after the *coitus* which was succeeded by impregnation. 2. *Cessation of the Catamenia.* 3. *The Period of Quickening:* and 4. *A single Coitus.*

A few words on each of these modes of reckoning will form a necessary introduction to the arguments to be advanced, whether founded upon analogical reasoning, or on the more direct and satisfactory evidence of facts.

1. *Peculiar Sensations felt at, or soon after Conception.*—This mode of reckoning is inaccurate, inasmuch as these sensations are not defined so as to be recognised by those who conceive for the first time; they are not constant in their occurrence in the same female, and they do not take place at any particular time. Hence they are wanting in the necessary precision.

2. *The Cessation of the Catamenia.*—There are also great objections to this mode of reckoning. The catamenia may cease from causes other than conception; for it is well known that a woman may conceive without being regular, and that women who have never menstruated have conceived. Hence the following case is a possible one: a woman, from some cause quite independent of conception, ceases to menstruate, and immediately before or after the next suppressed period she conceives, but she dates the conception from the first suppressed period. Now, as the cases of protracted gestation are not very numerous, a part of them may perhaps be explained in this way. On the other hand, a female may menstruate once, or more than once, after conception, in which cases her reckoning will fall short of the real duration of pregnancy.

But, even allowing the cessation of the catamenia to be a sound

starting point in our reckoning, it can give only an approximative result; for as 28 days (according to the best authorities) intervene between the commencement of one menstrual period and the commencement of another, there may be an interval between the termination of one menstrual period and the beginning of another of nearly 28 days, say 25 days.

Let us suppose conception to take place on the first day after the cessation of the menstrual discharge, and that we reckon from the first suppressed period, the calculated duration of pregnancy will fall short of the real duration by the twenty-five days preceding the suppression. Suppose, on the other hand, that conception takes place on the day preceding the period of *suppression*, and that we calculate from the last appearance of the menses; then the calculated duration of pregnancy will exceed the real duration by the same number of days. Hence, in ordinary cases, we may have a difference in our reckoning of nearly a month.

To avoid so great a discrepancy, accoucheurs have adopted the expedient of dividing the interval between the two periods into two parts, and reckoning from the division. Hence the difference is reduced one half, and we cannot be out of our reckoning more than about twelve or thirteen days.

But there are cases in which the interval is greatly contracted, either by the menses continuing for several days or recurring more frequently than usual. Thus, in some cases we have the menses every three weeks, in others every fortnight. In other instances, again, the interval is prolonged, the menstrual periods being separated by five or six weeks, or even two months. In these latter cases our estimate will be still less exact. If accurate observations had been made on females menstruating every 14 days, we should have had approximative data of more value, but we have no facts concerning persons who menstruate at periods different from the usual ones.

From what has been now stated, it will be readily understood how extremely fallacious a mode of reckoning that must be, which turns upon the suppression of the menses, whether we start from the last menstruation, or the first suppression, or even from the middle period between the two.

3. *The Period of Quickening.*—On this point it is only necessary to refer to what has been already stated in speaking of the signs of Pregnancy, viz. that quickening, where it is perceived, occurs at very variable periods, having a range, according to the best authorities of six weeks (from the 12th to the 18th), and, if we combine the statements of several authors, from the 10th to the 26th,—a range of no less than sixteen weeks. It must be very obvious, then, that the period of quickening is a still more variable and fallacious starting point, from which to reckon the duration of pregnancy, than is the suppression of the menstrual discharge.

4. *A single Coitus.*—This of course, is the only accurate mode of

reckoning; but, from the very nature of the case, it must be extremely difficult to collect a sufficient number of well-attested facts by which to determine the knotty question of the duration of pregnancy.

The following cases are on record: —

	Duration.
A case by Dr. Nixon* . . .	273 or 276 days.
Dr. Montgomery	280
Dr. Forster of New York . .	283 or 285
Seduction case (Lancaster Assizes)	284
Dewees	286 or 288
Desormeaux	290
Dr. Reid†	292 or 293

The results of these cases are as follow:—

Average of the 7 cases	284 or 285 days.
Minimum . . .	273 or 276
Maximum . . .	292 or 293
Range . .	16, 17, 19, or 20
Excess above	280 days, 12 or 13 days.
Excess above	9 calendar months 16 or 17 to 19 or 20 days.

These cases, then, furnish the strongest possible reason for regarding the period of utero-gestation as variable and not fixed, and as so great an amount of variation is shown to exist in seven cases, we may fairly expect a still greater difference from the collection of a greater number of similar facts.

The inference drawn from these facts derives the strongest confirmation from the analogy of animals.

Formerly the period of gestation in animals, like that in the human species, was held to be a fixed period. For instance the duration of pregnancy in the mare was fixed at 11 months, and in the cow at 9 months. Subsequent observations have shown that, in those animals, the period is far from being a fixed one, and has thus furnished a strong argument to the advocates of a variable period in the human species.

The well-known observations of M. Tessier, which extended to 102 mares and 160 cows, give the following striking results:—

	In the Mare.	In the Cow.
Shortest period	311 days.	241 days.
Longest period	394	308
Range	83	67
Excess above the stated period	57 or 60	32 or 35
Average period . .	11 mths. 10	9 mths. 10

The difference observed in the case of both these animals is very

* Dublin Medical Journal. † Manual of Midwifery.

remarkable, and certainly much greater than might have been anticipated. The excess above the assumed period is also very great in both instances.

Earl Spencer has made a still more extensive series of observations on the period of gestation in the cow.*

His Lordship's observations were made on 764 cows, and the results may be briefly stated thus:—

Shortest period of gestation, a live calf being produced	220 days.
Shortest period of gestation, when the calf was reared	242
Longest period of gestation	313
Range (greatest)	93 days.
Range in the case of a viable calf	71
Excess beyond 260 days, before which period his Lordship considers a calf decidedly premature	53
Excess above 9 calendar months	37 or 40
Excess above 10 lunar months	33
Average duration	284 or 285

It appears also to be well made out from his Lordship's observations, that by far the majority of instances of gestation protracted beyond the average period, occurred in the case of bull-calves, the numbers being, of cow-calves 90, of bull-calves 152.

These observations of Lord Spencer, added to those of M. Tessier, establish beyond a doubt the fact, that the period of utero-gestation in the cow and horse, which, like that of the human subject, was formerly regarded as fixed, is not only variable, but that the extremes are widely separated from each other, and the longest period in excess by considerably more than a calendar month of the average duration.

There are two circumstances which might appear to weaken the force of this argument from analogy, viz. that menstruation is peculiar to women, and that sexual intercourse may take place in the human species at any period. These objections are not of any value, as, conception having once taken place, the duration of pregnancy cannot be supposed to be affected by these circumstances.

There are other considerations which favour the above *analogy*, and serve to show that if the period be variable in animals, it is likely to be still more variable in our own species, exposed as we are to influences, accidents, and diseases, from which animals are free, and notoriously distinguished from animals by the great degree to which

* See the British and Foreign Medical Review for Jan. 1841.

all *extreme* values obtained from observation fall short of, or exceed, the *mean*.

The argument from analogy, then, must be allowed to have great force, and to be scarcely less conclusive than the result of cases in which the duration of pregnancy has been determined by a single coitus.

The case in favour of a variable period is still further strengthened by other arguments.

In the first place, it must be allowed that there is much force in the observation just made, that all the functions of the human body which have been carefully examined, are found not only to be variable, but to vary within wide limits. The pulse, the respiration, the secretion of urine, the cutting of the teeth, and many other functions, might be instanced; but it will be more to the purpose to confine our remarks to those functions which have a close connexion with pregnancy: for instance, the catamenia. They make their first appearance at any age, from 9 years up to 23 or 24 (and even earlier and later than those ages), and they continue up to any age from 35 to 55. In some women they recur at intervals of a month, in others of six weeks, in others of a fortnight, and each period may comprise a variable number of days. Then again the period of quickening varies from the 10th or 12th to the 18th or 20th week, or even later; and child-bearing, which in the majority of cases ceases at 45, may occur as late as 54, and probably at a still more advanced age.

It is impossible to deny the force of these remarks, and the close bearing which they have on the question before us.

Another argument of no slight force in favour of a variable period, and of possible parturition beyond the usually assigned limit is this, —that the advocates of a fixed period are by no means agreed among themselves as to what that fixed period is to be. Thus of the seventeen medical men examined in the Gardner Peerage case, five advocated a fixed period, and were opposed to the idea of protracted delivery, but all of them stated the duration of pregnancy differently.

Sir Charles Clarke	40 weeks	280 days.
Dr. Blegborough	39 weeks (usual)	40 weeks. 273—280
Mr. Pennington	37 weeks (some)	40 weeks. 259—280
Dr. Gooch, a day or two before or after 9 calendar months		271, 274—275, 278
Dr. D. Davis, a day or two under 9 calendar months.		271

It will be seen that if we include Mr. Pennington's estimate, and assume that all the witnesses were right, we may have the period of gestation ranging from 259 to 280 days, or 21 days; and if we exclude this, as being an extreme estimate, we have a range of 9 days.

If the advocates of a fixed period, all of them men of acknowledged eminence and experience, can differ thus widely in their estimates, they may differ as widely from nature herself.

Dr. Merriman has contributed several carefully observed and reported facts in illustration of this subject, of which the results are worthy of attention.

Dr. Merriman calculates the duration of pregnancy from the last day on which any appearance of the catamenia was distinguishable, and reckons 40 weeks from this day, assuming that the 280th was to be considered as the legitimate day of parturition. He has prepared a table, which clearly shows how often this period was departed from.

The following are the results of this table, founded upon the births of 114 mature children, calculated from, but not including, the day on which the catamenia were last distinguishable:

Shortest period	255 days.
Longest period	306
Range	51
Excess above 280 days	26

Though these facts are decidedly favourable to the belief in a variable period, they do not so strongly confirm the theory of protracted gestation; for, as the duration of pregnancy was reckoned in all cases from the last appearance of the catamenia, and the excess above 280 days is only 26 days, we have only to suppose the proper reckoning to have been from the first suppressed period, in order to make the facts militate against the theory of protracted gestation. When, however, we consider that no less than 51 out of the 114 cases exceeded 280 days, it does seem extremely unlikely that every one of these children should have been the product of conception occurring on the very day after the cessation of the catamenia. Still, as this is possible, we can use these facts only as proof of a variable period, and not as evidence of the possibility of gestation being protracted beyond the 280 days.*

Another argument in favour of the occasional extension of the period of utero-gestation is that derived from authority. Amongst the more ancient authorities in favour of retarded delivery are Hippocrates, Aristotle, Pliny, Teichmeyer, Heister, Albert, Vallentini, Bartholin, Haller, Antoine Petit, Lieutaud, Vicq d'Azyr, and Capuron; on the other hand, Bohn, Hebenstreit, Astruc, Mauriceau, De la Motte, Rœderer, and Baudelocque reject the belief in retarded delivery. If we turn from these ancient and foreign authorities to those of more modern times and of our own country, we find that, while five of the seventeen medical men examined in the Gardner Peerage case supported the opinion that the period of gestation was fixed, or nearly so, twelve believed that it might be protracted to $9\frac{1}{2}$, 10, or 11 calendar months, or (288—290) (304—306) (334—337) days.

To the list of authorities already quoted may be added the names

* See these facts stated at length in Beck's Medical Jurisprudence, title Legitimacy.

of Hunter, Foderé, Gardien, Velpeau, Capuron, Desormeaux, Richerand, Dewees, Hamilton, Burns, Denman, and Montgomery.*

To the foregoing arguments may be added the fact, that legal decisions in this country have been favourable to protracted gestation, and that the same may be said of the decisions and even of the laws of other countries. Thus, the law of France does not allow the legitimacy of a child born after a gestation of 300 days to be disputed, and admits evidence as to more lengthened gestation.

The arguments in favour of a variable period and the possible protraction of gestation, then, are

1. The strong analogy of animals, whose period of gestation, like that of the human female, was originally supposed to be fixed, but which is now proved, by careful and extensive observation, to be subject to great variety, and to be much protracted beyond the assumed limit.

2. The analogy of other functions of the human body, and especially of menstruation and child-bearing, all of which present wide limits of variation in time and degree.

3. The absence of any exact conformity in the statements of those who advocate a fixed period, and deny the possibility of its extension.

4. The balance of authority, both ancient and modern, in favour of its possible extension.

5. The legal decisions and laws of our own and other countries.

6. (And this is the most conclusive) the facts founded on accurate observation in cases of a single coitus.

These arguments must be admitted to have far greater weight than the general impression in favour of a fixed period. But, though they render it in the highest degree probable that the period of utero-gestation may fall short of, and extend beyond, 280 days, the degree to which it may be lengthened out must still remain a subject of discussion.

This question, of the extent to which the period of utero-gestation may be protracted, assumed a definite shape in the celebrated Gardner Peerage Case, of which the following is a brief outline.

In the month of March 1796, Alan Hide Gardner, afterwards Lord Gardner, then a captain in the navy, was married to Miss Adderley. They cohabited together as man and wife from the time of their marriage until the month of January 1802 (except during the occasional absence of the husband). On or about the 30th of January, Alan Hide Gardner took leave of his wife, and sailed a few days afterwards for the West Indies, and did not return to England until the 10th day of July in the same year, his wife remaining in England during the whole of that period. Towards the end of the year 1801, when Alan Hide Gardner was absent on his Majesty's service, his

* For the precise statements of these authorities, see the article Succession, by Dr. Montgomery, himself a firm believer in protracted gestation, in the Cyclopædia of Practical Medicine.

wife entered into an adulterous conversation with Henry Jadis, Esq., which Alan Hide Gardner did not discover until the month of June 1803 ; after which time he did not live or cohabit or have any intercourse whatever with his said wife. On the 8th of December 1802, she was, without the knowledge of Alan Hide Gardner, delivered of a male child, which was afterwards baptized by the name of Henry Fenton Gardner. In Easter Term 1804, Alan Hide Gardner brought his action in the Court of King's Bench against Henry Jadis, for criminal intercourse with Maria Elizabeth Gardner, and in that action obtained a verdict against Henry Jadis for 1000*l.* damages. He also obtained a sentence of divorce in the Consistory Court, and the marriage was subsequently dissolved by Act of Parliament. Alan Gardner, Baron Gardner, died on the 30th of December 1808, leaving Alan Hide Gardner his eldest son and heir, who thereupon succeeded to the barony, and became the second Baron Gardner. On the 10th of April 1809, Alan Hide, Lord Gardner, was married to the Honourable Charlotte Smith, daughter of the Right Honourable Robert, Lord Carrington, and by her had issue Alan Legge Gardner, his only son, who was born on the 29th of January 1810, and one daughter. Alan Hide, Lord Gardner, died on the 22nd of December 1815, leaving Alan Legge Gardner his only surviving son, who succeeded to the title. Henry Fenton Gardner attained the age of twenty-one years in the month of December 1823. Alan Legge Gardner, being an infant of the age of fourteen years or thereabouts, petitioned his Majesty for a recognition of his right to the title by letters patent, or by ordering his name to be entered on the Parliament Roll as a minor peer.*

It was proved on the trial that there was a possibility of access on the 30th of January, from that date to the 7th of February, and on or after the 11th of July. Hence the three questions proposed to the medical witnesses :—

1. Could a child born on the 8th of December have been the result of sexual intercourse either on the 30th of January, or anterior to it, being 311 days?

2. Could a child born on the 8th of December have been the result of sexual intercourse on the 7th of February, or anterior to it, being 304 days?

3. Could a child born on the 8th of December, and living to manhood, have been the result of sexual intercourse on or after the 11th of July, a period of 150 days, or two or three days short of five calendar months?

The first two of these questions may be reduced to one, and we shall have the following alternative :—if the child were legitimate, he must have been either a five months' child, or, to speak more correct-

* This account is taken with alterations from Le Marchant's history of the Case.

ly, a 150 days' child, or a 304 or 311 days' child (one calendar month and two or nine days beyond the *usitatum tempus pariendi*).

The latter alternative, viz. gestation protracted to the 304 or 311 days, was the one chiefly insisted upon in this celebrated trial.

Of the medical witnesses who were examined, the majority gave their evidence in favour of protracted gestation; a small number of influential names was ranged on the side of a fixed period. As the opinions of these latter authors have been already stated, and the subject of protracted gestation has been discussed at as great length as is consistent with the limits of this work, the reader is referred for further particulars to Dr. Lyall's pamphlet.* The decision of the case did not turn upon the medical evidence, but upon the adultery of the mother of Henry Fenton Jadis. The claim of the petitioner, Alan Legge Gardner, was allowed.

The other principal question involved in cases of legitimacy is, What is the shortest period of gestation at which a *viable* child may be born?

As the Gardner Peerage case is the most interesting which bears on the first question, so that of the Rev. Fergus Jardine has the most important bearing on the second.

This case, though less known than the Gardner case, is equally interesting; and as in the latter case no less than 17 medical men were examined, so in this case of Mr. Jardine 14 medical men were summoned, and a still greater number of non-professional witnesses gave their evidence. The parallel holds good still further; for in this case, as in the other, there was great difference of opinion among the medical witnesses. There was, however, one peculiarity, that the evidence of Drs. Alison and Christison was admitted, simply because their attention had been directed to the question involved as Lecturers on Forensic Medicine; and it may be safely affirmed, that the evidence of the last-named witness, Dr. Christison, threw more light upon the question than that of all the other witnesses put together. It may also be mentioned as a peculiarity in this trial, that the medical witnesses were not only allowed to cite authorities, but were minutely cross-examined as to the opinion which they themselves entertained of the facts bearing upon the question. The following is a short abstract of the case of Mr. Jardine:

The defendant, the Rev. Fergus Jardine, was married to Miss Janet Martin on the 3rd of March, 1835; and on the 24th of August following, Mrs. Jardine was delivered of a girl. Supposing this child to have been the fruit of sexual intercourse on the day of the marriage, it was only 174 days, or five calendar months and twenty-one days old. The infant, which was undoubtedly immature, though the degree of immaturity could not be ascertained or deter-

* "Medical Evidence relative to the duration of human pregnancy, as given on the Gardner Peerage Case." See also Beck, title Legitimacy.

mined, died on the 20th of March, 1836, having survived as nearly as possible seven months.

The libel charged Mr. Jardine with having committed fornication with his wife before marriage. A great many witnesses were called, some to establish the possibility of sexual intercourse before marriage, by showing that the defendant had slept at the house of the parents of Mrs. Jardine during their absence from home, or that he had had opportunities of being alone with her; others to show that the child, though small and feeble, was not immature, or at least not so immature as the date of the marriage would make it; and others to speak to the impossibility or improbability of a child surviving at that early period. The extent to which the allegations of the libel were made good, and the vague nature of the evidence adduced in their support, will be best seen by the following extract from the decision of the Presbytery, November 7, 1838: "The Presbytery having had under their consideration the libel, at the instance of certain parishioners of Kinghorn, against Mr. Fergus Jardine, minister of the said parish, and the citation of the said Mr. Jardine, his compearance, his answers to the said libel, and proof adduced,—find, that in so far as the said libel charges Mr. Jardine with having committed fornication in the manse of Kirkaldy, is not proven; but that the testimony of the several witnesses, both with respect to matters of fact, viz. the appearance of the child at birth, &c., and also with respect to the opinions of medical men regarding the viability of such a premature child as the child in question is said to be, is of such an opposite and contradictory nature, that the Presbytery, with their present light, have great difficulty in coming to any decision on these points. The Presbytery, therefore, agreeably to a common maxim of law, *Satius est impunitum relinqui facinus nocentis quam innocentem damnari*, find the libel not proven."* The medical evidence will be discussed at greater length.

The principal points established by the general and medical evidence in relation to Mrs. Jardine and her infant were, that she had menstruated as usual the week previous to her marriage; that she was, both before and after her marriage, in a very weak state of health; that she was herself a seven months' child; and that she had a second child, a daughter, which she believed to have been born "just about the commencement of the eighth month of her pregnancy." As regards the infant, the evidence, though contradictory on many points, showed that the child was small and very feeble, and required to be nursed with care; no baby linen had been prepared, and all the evidence went to show that the child was premature. There were no exact data from which the degree of immaturity of the child could be calculated; but Dr. Thatcher, who was sent to examine it, alludes, in his reply to the

* Record of the proceedings in the reference by the Synod of Fife, to the Venerable the General Assembly of the Church of Scotland, in May, 1839, of the case of Mr. Thomas Barclay, Town Clerk, and nine of the Parishioners of Kinghorn, against the Reverend Fergus Jardine. Edinburgh, 1839.

summons, to the weight of the child at birth, being three pounds. One thing is quite evident from the whole tenor of the evidence, that none of those precautions for preserving the child's warmth were taken, which seem to have been absolutely necessary to the preservation of the lives of the children whom there is the best reason for believing to have been born at a very early period. There was no wrapping in wool, no adult female constantly sleeping with it, or keeping it in her arms to give it warmth,—an absence, in fact, of all those precautions which give probability to the cases of Drs. Rodman and Outrepont.

The question on which this case hinges is simply this—Could a child born 174 days, or five calendar months and twenty-one days after marriage, be reared to the age of seven months? and the more general question which the case suggests is—What is the earliest period of gestation at which a viable child may be born?

In discussing this question, we must first inquire into the meaning of the term *viable*.

Devergie gives the following definition:—"an aptitude for extra-uterine life, characterised by the maturity of the infant, the good conformation of the principal organs of the economy, and the healthy state of those organs at the epoch of birth." This definition, as it seems to make the maturity of the infant a part of the notion of viability, is certainly altogether inapplicable to our present purpose. The maturity of the infant seems, indeed to be a part of the definition of viability, according to the best French authorities; for we find Billard mentioning first among the indispensable conditions of viability, "the infant should be born at term."

It is evident, then, that this French definition of the term *viable* will not suit the present inquiry, and it is not easy to invent a better one, inasmuch as it is quite impossible to fix any age, to which a child attaining, shall be deemed *viable*. We shall not, therefore, attempt a definition, but shall content ourselves with inquiring what is the earliest period of gestation at which a child has been born, and has survived its birth so long as to prove that there was no physical obstacle to its attaining the adult age.

Now it may be fairly assumed that if any child, born at a given period of utero-gestation, has survived its birth a week or ten days, it is quite *possible* that a child of the same age may be reared to manhood; for a child surviving its birth a week or ten days will have fully overcome all obstacles to the establishment of the respiratory and circulating functions, and, provided its frame be free from disease, and well-formed in all its parts, may continue to live. Considering that all medico-legal questions turn upon the *possible* and not on the *probable*, we may safely start with this assumption. In actual practice, however, it is extremely unlikely that we shall ever have to give evidence as to cases in which a child has survived its birth so short a space of time as this. The child of Mr. Jardine lived seven months.

Returning then to the question—What is the earliest period of gestation at which a viable child may be born? we must obviously, as a preliminary measure, furnish ourselves with some standards of comparison applicable to the ages about which there can be any reasonable doubt. Now it is universally admitted that a child may be born and reared to manhood at the seventh and eighth, as well as at the ninth, month. All authorities are agreed as to the possibility of a child of seven calendar months living to manhood; it is only, therefore, with regard to periods anterior to this that any doubt exists. On the other hand, in spite of the case of Fortunio Liceti, said to be born at four and a half months, and to have lived to 80, we may pretty safely affirm that a viable child cannot be born before five calendar months, or 150 days. Our attention, then, will have to be directed to the periods of five and six months, and it may be useful, in this place, to give a short summary of the characters which a fœtus of these respective ages would present. This summary is taken in part from the history of the growth of the fœtus, given at the beginning of this chapter. These data, for distinctness' sake, are best thrown into a tabular form.

	5 Months.	6 Months.
Length (Estimates of authors)	6 to $12\frac{3}{4}$ in.	8 to $13\frac{1}{3}$ inches.
„ (Actual measurements in 4 cases.)	$9\frac{1}{3}$ to 13 in.	$10\frac{1}{2}$ to 16 in. 1 line.
Weight (Estimates of authors)	5 oz. to 1 lb. 1 oz.	1 lb. to 2 lb. 2 oz.
„ (From actual observation.)	10 oz. to 1 lb. 13 oz.	13 oz. to 3 lb. 13 oz.
Centre of body . .	Above the lower end of sternum.	Lower end of sternum.

Head—very large as compared with the body; bones widely separated.

Eyes—Eyelids agglutinated; Membrana pupillaris present.

Skin	Without sebaceous covering.	Sebaceous covering beginning to appear.

Of these particulars by far the most precise are the weight and length. We propose, therefore, to compare the observed length and weight of children reported to have been born viable at early periods of gestation, stating the asserted age, and contrasting this with the age which would correspond with those measures and weights. Having done this, we shall proceed to state at length some of those cases which are best attested, and most worthy of confidence. These facts, too, are for distinctness' sake thrown into a tabular form. A column is added, showing the age which the children attained. It will be seen that of the ten cases, six survived their birth less than a week, and two only a few hours. In the cases of Outrepont and Belloc, the age stated is that at which the children were last seen alive by the reporters.

Table showing the Lengths and Weights of Children reported to be born during the 5th and 6th Months of Gestation, with the assumed Age and the probable Age, according to the foregoing Estimates and Observations.

Author.	Length.	Weight.	Survived its Birth.	Asserted Age.	Age according to Estimates and Observations.
	Inches.	lb. oz.		Days.	
Rodman .	11—13 at 3 weeks.	1 13	1 yr. 9 m.	133	5 months possibly.
Outrepont .	13½	1½ 0	8 years	175 or 189	6 months.
Belloc . .	12¾	- -	17 years	6 months	possibly 5 months.
Bucholtz* .	14	1½ 0	2 days	189 days	6 months.
Kopp† . .	12¼	2 0	4½ days	182	6 months.
Fleischmann‡	11½	1 5	8 days	168	possibly 5 months.
Christison§ .	13	1 7	8½ hours	167	possibly 5 months.
Mr. Thomson‖	12½	1 8¾	3½ hours	5 months	5 months.

This table is certainly confirmatory of the views of the reporters of the several cases: there is not one of the cases in which the asserted age does not correspond pretty closely with the estimates and measures already given, and, in some cases, the observed weights and measures might have belonged to an earlier period of gestation.

If now we revert to the case of Mr. Jardine, we find a weight of 3lbs. stated to belong to a child born at 174 days, or before the completion of the 6th month, and, from actual observation it would appear, that at that age a child may weigh 3 lb. 13 oz. Hence, as far as the weight is concerned, it is quite possible that the child may have been born after only 174 days' gestation. It must not be forgotten, however, that this weight of 3 lb. 13 oz. is much above the highest estimate of authors, and may be itself founded upon an incorrect calculation.

Though the foregoing considerations, founded on the length and weight, afford a strong probability that the estimated periods of gestation in some, at least, of the cases on record is the true one, that pro-

* Beitrage, ii. 104.
† Jahrbuch, iii. 128.
‡ Henke's Zeitschrift, vi. 12.
§ Jardine's Trial.
‖ Of Alva, Stirlingshire, quoted by Beck, p. 212.

bability requires to be confirmed, by contrasting the other particulars of their histories with the acknowledged signs of immaturity.

The following description of the signs of maturity and immaturity, founded upon that of Foderé and Capuron, will serve to contrast the one with the other.

The signs of maturity are the following:

The ability to cry as soon as the child reaches the atmospheric air, or shortly thereafter, and also to move its limbs with facility and more or less strength; the body being of a clear red colour; the mouth, nostrils, eyelids, and ears perfectly open; the bones of the cranium possessing some solidity, and the fontanelles not far apart; the hair, eyebrows, and nails perfectly developed; the free discharge of the urine and meconium, in a few hours after birth; and, finally, the power of swallowing and digesting, indicated by its seizing the nipple, or a finger placed in its mouth.

The signs of immaturity, on the other hand, are the following:

The length and volume of the infant much less than those of an infant at full term; it does not move its members, and makes only feeble motions; it seems unable to suck, and has to be fed artificially; its skin is of an intense red colour, and traversed by numerous bluish vessels; the head is covered with a down, and the nails are not formed; the bones of the head are soft, and the fontanelles widely separated; the eyelids, mouth, and nostrils closed; it sleeps continually, and must be preserved by artificial heat; and, lastly, it discharges its urine and meconium imperfectly, and often after a long interval.

The presence of the membrana pupillaris, the position of the centre of the body, the non-descent of the testicles, the large size of the head as compared with the body, the great prominence and deep red colour of the parts of generation, and the absence or scanty deposit of sebaceous matter on the skin, may be mentioned as additional signs of immaturity.

By comparing this description with some of the more remarkable recorded cases, it will be seen what degree of probability attaches to the estimates of authors. Only three of these cases are here selected for consideration, viz. those related by Belloc, Dr. Rodman of Paisley, and Dr. Outrepont.

"I have seen," says Belloc, "a girl who, at birth, was only $12\frac{3}{4}$ inches in length, whose skin was of a marbled redness, whose head was covered with down, whose nails were imperfectly formed, and who altogether bore a close resemblance to a young flayed rabbit. She was fed with the spoon for eight days, because she was unable to suck. Nevertheless, she is not only at the present moment alive, in her seventeenth year, but is likewise an extremely clever, amiable girl, above the middle stature, graceful in figure, and gay in her dispositions. The mother could not fix with precision the date of her conception, but was convinced she was not at the term even of seven

months. I considered her at six months at the utmost." * To this narrative Dr. Christison (Jardine's case) adds the following observations: "Hencke, in his essay formerly mentioned, objects to this case, that the author does not say whether he examined the child at birth, or merely knew her when a grown girl, and got the particulars from her mother. But I think Belloc's expressions scarcely admit of this doubt. The case might have been more fully detailed and more clearly described; but his words at the end, 'sa mère ne peut pas se fixer sur le temps de sa grossesse; mais elle était persuadée, qu'elle n'était pas à terme même de sept mois: *je la jugeais tout au plus de six*,' scarcely admit of any other interpretation, than that he formed this opinion at the time of the birth."

Dr. Rodman's case is as follows:

After describing the mother as "more cautious in her decisions, accurate in her observations, and steady in her deportment, than what is usually met with in society," and stating that she had borne five children, and "was confident that the period of her gestation was less than nineteen weeks," Dr. Rodman says, that premature labour came on in consequence of fatiguing exertions, and she was delivered of a living male infant.

"Not daring to allow the washing of the infant's body, he was speedily wiped and wrapped in flannel, with only an opening in the dress around his mouth for the admission of air; and by the time the dressing was over, the mother was ready to take him into the warm bed with herself. It is common, if there be much apparent weakness, to feed a child the first twelve hours after birth very frequently, yet, in this instance, although the child was weak, no feeding was attempted till beyond that time; the nourishing heat with the mother in bed was relied on. On the following day, the head, body, and extremities of the child were surrounded with fine cotton-wool, pressed to appear like cloth, to the thickness of two or three folds, and over that the flannel as before; and again the child was given to the mother in bed. His vital energy was so deficient, that even with this dress, of himself he was unable to support the degree of warmth which was necessary to his existence. The heat of a fire was evidently injurious, as he soon became weaker when exposed to it, whilst the warmth of the mother in bed enlivened and strengthened him. Too much heat induced a sickly paleness of his face, with an obvious expression of uneasiness in his countenance; and the abstraction of heat, even by tardily undressing his head, brought on a nervous affection, or starting of the muscles all over his body. From seeing how these morbid affections were induced, the child was kept regularly and comfortably warm, by the mother and two other females alternately lying in bed with him for more than two months. After this he could be left alone from time to time, but was still undressed

* Belloc, Cours de Médicine Légale, p. 77.

very cautiously and only partially at any one time. It was not till the child was three weeks old that the length or weight of the body could be ascertained. The *length* was found to be 13 *inches*, the *weight* 1*lb.* 13 *oz. avoirdupois*. It was extremely difficult to get the child to swallow nourishment the first week ; the yellow gum soon came on, and the thrush seized him severely on the eighth day, and was not cured till the end of the third week. During the first week he was fed with toasted loaf bread boiled with water, sweetened, and strained through fine linen ; in the second week twenty drops of beef-tea were added to the two or three teaspoonsful which he took of this nourishment, and small doses of castor oil were administered. At the end of three weeks he began to swallow teaspoonsful of his mother's milk, and in two days afterwards he made exertions to suck. His mother's milk was gradually substituted, at least in part for the panada, though this was still continued occasionally with a few drops of port wine. Under this careful management he attained the age of four months, at which time his health and excretory functions were peculiarly regular."

Five months after this, as we find from a second paper by Dr. Rodman,* this little child was still doing well. In this paper he confirms what he had stated in the first ; he describes the mother as tall, robust, and healthy, and states that she had a peculiarly accurate knowledge of the time of her previous gestations, and does not hesitate still to affirm, that the period in this instance was rather under nineteen weeks.†

Dr. James Hamilton, in his evidence given in the case of the Rev. Fergus Jardine, gives the following additional particulars and makes the following observations on Dr. Rodman's case :—"That an old pupil of his, who was a respectable medical practitioner at Paisley, recorded a case some years ago, where an infant, supposed to have been born between the fifth and sixth month, lived a year and nine months, and consequently was a viable infant ; but that the deponent, from the facts of the case, and some circumstances communicated in a correspondence with Dr. Rodman and himself, has always been impressed with the belief, that there was some mistake in the woman's reckoning, and that the infant was a dwarf." From a letter referred to in Dr. Hamilton's deposition, the following extract relating to Dr. Rodman's case is made : "It is incumbent on me to mention that an old pupil, Dr. Rodman, then a most respectable physician in Paisley, published, in the 11th volume of the Ed. Med. and Surg. Journal, an account of a case where an infant born (of parents who had had a family, and where there could be no inducement to mistake or misrepresent) at nineteen weeks after conception,

* Ed. Med. and Surg. Journal, vol. xii.

† Case of a child born between the fourth and fifth month, and brought up. By John Rodman, M.D., Paisley, Ed. Med. and Surg. Journal, vol. xi. p. 445. The facts of this case were attested by Mr. White of Paisley.

viz. April 19, 1815, was reared to a certain age. The printed account of the case does not record the issue; but by my private correspondence with Dr. Rodman, I find that the infant lived to a year and nine months old. According to Dr. Rodman's description, this infant was considerably smaller than those puny infants born within the six months, whom I had seen drag on a miserable existence for four or five days, having measured no more than 13 inches in length, and weighed, clothes and all, two and a half pounds avoirdupois. The clothes were found to weigh 11 oz."

It must be admitted at once that, in this instance, an extremely feeble and premature child was reared by very judicious treatment. It cannot be denied, too, that the estimate of the child's age, formed by the mother, was at least as likely to be correct as such estimates ever can be, and the degree of doubt which attaches to the case is only such as attaches to a mother's estimate of the age of a child. As this is always subject to error, it becomes necessary to test the age by other, and, if possible, more accurate means. Such are the length and weight. Now the length of this fœtus at three weeks after birth was thirteen inches, and at birth, according to a very rough measurement, eleven inches. Considering the little nourishment which the child took, the occurrence of the yellow gum in the first week, and of the thrush at the eighth day, which was not cured till the end of the third week, it is scarcely to be supposed that the child could have grown much either in length or weight during this period. A comparison, then, of the length and weight of this child with the length and weight of children of different degrees of maturity, will show the amount of probability which attaches to the estimate of age in this particular case. Now on making this comparison, the weight and length of the child are found to coincide with the extreme weight and length of the tables; so that although we have here a possibility that the child was five months old, it is a bare possibility, and not amounting to a probability, whilst there is not even a presumption in favour of the child having been less than five months old. The absence of any description of the appearances presented by the child prevents us from determining, with any approach to accuracy, its degree of immaturity.

The case related by Dr. Outrepont of Bamberg, is the most valuable of all, for it is the only quite unequivocal instance hitherto published, of the rearing of a six months' child. The particulars are given so fully, and with such precision, that even Hencke, who previously denied the possibility of such an incident, has candidly admitted that Outrepont's case is an unequivocal example.* The evidence is as complete as it is possible to be in any case of the kind. It is complete, both as derived from the date of the mother's impregnation, and as drawn from the structure and history of the child.

* Zeitschrift, vi. 27.

The mother, a young woman, whose catamenia had always been perfectly regular, menstruated as usual ten days after her marriage, and subsequently to this time was repeatedly connected with her husband. About a fortnight after this menstruation, she underwent a general change in appearance, and began to have frequent attacks of vomiting and fainting, symptoms which she never had in her life before. These symptoms continuing, the catamenia did not return; and about twenty weeks after their last appearance, she felt the first movements of the child. Five weeks after this, and twenty-seven weeks (twenty-five ?) after the last appearance of the catamenia, she was seized with labour-pains, and uterine hemorrhage; upon which Dr. Outrepont having discovered that the hemorrhage proceeded from the placenta being attached over the os uteri, encouraged the labour, and brought it forthwith to a prosperous conclusion. Here the evidence of the child being not more than twenty-five weeks old, is as strong as in the nature of things it is reasonable to expect. The state of the child at birth is still more unequivocal. It was a boy, and breathed immediately on being born. It measured thirteen and a half inches, and weighed one pound and a half. Its skin was covered with smooth lank down, and was much wrinkled. The whole extremities were extremely small in proportion to the trunk, and were kept constantly bent over the body, as during the existence of the fœtus in the womb. The nails of the fingers and toes were like mere white folds of skin, the testicles were still within the belly, and the pupillary membrane was entire. The child whined, but could not cry—slept almost constantly—awoke only once a day—seldom opened its eyelids, and was obviously insensible both to light and sound. The first excretion of urine took place on the seventh day, and the first evacuation of the bowels on the ninth. Subsequently the urine was voided once in forty-eight hours, and the fæces every two or three days. It was placed in a basket filled with wool, kept in a uniform temperature, and moved with great care. For some time it was fed with the spoon on diluted milk and sugar. In four weeks the down began to drop off from the skin. In fifteen weeks, it had made very little progress in any respect. The wrinkles had disappeared, however, from the skin, and the length was increased an inch and three quarters. But from this time, which corresponded with the fortieth or forty-second week after impregnation,—that is, with the full period of utero-gestation,— it made rapid advances; sleeping less, eating more, crying strongly, and becoming evidently sensible to sound, and pleased with the light. When fourteen months old, it was of the weight and stature of a child born at the full time. In the eighteenth month, the testicles descended into the scrotum, without causing him any annoyance. In like manner, the teeth began to appear early in his third year. He did not begin to walk till half a year later; and at that time differed from other children of the same age, not only in littleness, but likewise in the singular oldness of his

expression of countenance. When Dr. Outrepont saw him in 1816, he was eleven years of age, was as big as a boy of seven or eight, and had just began to read and write.*

The length and weight in this case are much within the extremes given in a former table, and the signs of immaturity are so well marked and so minutely described as to be quite decisive of the possibility of rearing a child born at the end of the sixth solar month, or in about twenty-six weeks.

In the foregoing cases, we recognize such a correspondence between the descriptions of immaturity given by authors, and their estimates and actual observations of length and weight, on the one hand, and the cases themselves on the other, that the possibility of a child being born and reared about the completion of the sixth month can scarcely be disallowed. As an abstract question, therefore, it is possible that the child of Mr. Jardine, born 174 days after marriage, may have been the fruit of sexual intercourse after the date of that marriage. But, at the same time, it must be recollected that in the case in point, (that of Mr. Jardine,) there was an entire absence of all those marks of immaturity which render the other cases so credible. The weight of the child (three pounds) was very large for the age, exceeding the estimates of authors, though within the limits of observation, and there is no single proof of any kind that the child required more than the degree of care bestowed upon delicate and feeble children; nothing like the wrappings in cotton, the artificial heat, or the drop by drop feeding, resorted to in the cases so minutely described by Drs. Rodman and Outrepont. It is scarcely necessary to add to this examination of facts an appeal to authorities. Suffice it to observe, that we have the usual discrepancies of opinion, and such names as those of Haller and Dr. James Hamilton, ranged against those of William Hunter and Christison. Dr. Christison, in the Jardine case, admitted the possibility of a child born after 174 days being reared.

Having discussed at length the two great questions connected with the subject of legitimacy, it will be necessary to say only a few words on some questions of less interest and importance.

The question of paternity, as has been already stated, may arise where a woman, soon after the death of her husband, marries a second time. Sometimes this question assumes the shape of the one last discussed. A child is born within five months, or thereabouts, of the death of the first husband, and the question of paternity becomes one of viability. Where the child is of such an age as that it might have had either husband for its father, the question of paternity must be decided by a reference to the state of health of the deceased husband

* This case is taken from Dr. Christison's evidence on the Jardine case, with alterations and additions suggested by the perusal of the case in the Zeitschrift, für die Staatsarz, vi. 19.

at the presumed time of conception. No general rules can be laid down for our guidance in such cases.

Another class of questions, of little importance and rare occurrence in this country, may arise in slave-holding states, where the reputed parents of a child are of different colours, and the offspring differs in appearance from the majority of children of mixed marriages.

Some discussion has taken place as to the state of the law with regard to inheritance. "When a man marries a woman seised of an estate of inheritance, and has by her issue born alive, which was capable of inheriting her estate. In this case he shall, on the death of his wife, hold the lands for his life, as tenant by the curtesy of England." It appears that the meaning of the expression *born alive*, is not the same in this case as in cases of infanticide. It has been decided that in questions of tenancy by the curtesy, any kind of motion is evidence of live-birth. Thus, in the case of Fish *v.* Palmer, tried in 1806, "a twitching and tremulous motion of the lips," was held to be sufficient evidence of the child having been born alive.

The question, how far monsters are capable of inheriting, has been raised. The law is thus laid down by Blackstone: — "A monster which hath not the shape of mankind, but in every part evidently bears the resemblance of the brute creation, hath no inheritable blood, and cannot be heir to any land, albeit he be brought forth in marriage; but although it hath deformity in any part of its body, yet if it hath human shape it may be an heir." This law gives rise to no question of a sufficiently definite nature to require discussion.

CHAPTER V.

LIFE-ASSURANCE. FEIGNED DISEASES.

These two subjects are placed in the same chapter for the sake of convenience, and not on account of any great similarity which they bear to each other.

LIFE-ASSURANCE.

Definition.—Modes of Death excepted.—Policies vitiated by Omissions or fraudulent Concealments.—Questions as to the Influence of Disease and Habits of living on the Duration of Life.—Case in illustration.

Life-assurance is thus defined: "An insurance upon life is a contract by which the underwriter for a certain sum, proportioned to the age, health, profession, and other circumstances of that person whose life is the object of insurance, engages that the person shall not die within the time limited in the policy; or if he do, that he will pay a sum of money to him in whose favour the policy was granted."* When the insurance is for the whole period of life, the annual payment will of course depend upon the number of years the insured party may be expected to live, and this is a matter of calculation deduced from registers of mortality.

Annuities are granted on the same principles as insurances, the only difference being that the underwriter, for a sum paid at once, agrees to pay the annuitant a certain sum annually during his life.

In policies of insurance, exceptions are generally made of *death by suicide* or *by the hands of justice;* and higher premiums are required where life is exposed to extraordinary risks, as during long voyages, military service, or residence in unhealthy climates. An increased payment is also demanded from those who labour under diseases tending to shorten life; and within a recent period the principle of life-assurance has been extended to persons actually suffering from acute disease.

Assurance offices employ a physician or surgeon, or both, to examine and report upon the state of health of all persons applying to the office, and information is also sought from the ordinary medical attendant, or from some medical man chosen as referee.

The offices are in the habit of addressing to the medical referee a

* Park on Insurance.

long list of questions relating to his own opportunities of knowing the party, his present and past state of health, his hereditary predispositions, his habits of life, the diseases with which he may have been attacked. Has he suffered from gout, spitting of blood, asthma, consumption, or other pulmonary complaint; from fits, or mental derangement? Has he had the small-pox or cow-pox? These questions are so framed as to elicit all the information necessary in order to determine the degree of risk attending the contemplated insurance.

The contract entered into in the policy of insurance may be rendered void by a variety of causes; among which may be mentioned, an omission on the part of the person whose life is the subject of insurance to name his medical attendants, or the attacks of illness which he may have had; and fraudulent concealments on his part, or on that of his medical attendant or referee. Questions are also frequently raised as to the tendency of particular diseases, such as gout, indigestion, affections of the chest, mental imbecility, &c. to shorten life. The effect of certain habits and modes of living, such as intoxication, opium-eating, &c., have, in like manner, been subjects of litigation.

The effects of disease and of habits of living on the duration of life, belong to the subject of hygiène, and the reader is referred for information concerning them to works on that science.

The subject of life-assurance is not one which admits of the establishment of any general principles, and each case must rest on its own merits. A single example, quoted from Paris and Fonblanque,* will illustrate the nature of the questions which are likely to arise in courts of law in reference to policies of insurance.

The life of Sir James Ross was insured for one year, from October 1759 to October 1760, and *he was warranted in good health at the time of making the policy.* One fact, however, was not mentioned to the insurer, viz. that Sir James had received a wound in battle, twelve years before the date of the insurance. The wound was in the loins, and had occasioned a partial relaxation or palsy, so that he could not retain his urine or fæces. Sir James died of a malignant fever, within the time of the insurance. All the physicians and surgeons who were examined for the plaintiff swore, that the wound had no sort of connexion with the fever; and that the want of retention was not a disorder which shortened life, but he might, notwithstanding that, have lived to the common age of man; and the surgeons who opened him said, that his intestines were all sound. There was one physician examined, for the defendant, who said that the retention was paralytic; but being asked to explain, he said it was only a local palsy, arising from the wound, but did not affect life; but, on the whole, he did not look upon him as a good life.

Lord Mansfield, before whom the case was tried, observed, "The

* Medical Jurisprudence, vol. i. p. 383.

question of fraud cannot exist in this case. When a man makes insurance upon a life generally, without any representation of the state of the life insured, the insurer takes all the risk, unless there was some fraud in the person insuring, either by his suppressing some circumstance which he knew, or alleging what was false. But if the person insuring knew no more than the insurer, the latter takes the risk. When an insurance is upon a representation, every material circumstance should be mentioned, such as age, way of life, &c. But where there is a warranty, then nothing need be told, but it must, in general, be proved if litigated, that *the life was in fact a good one, and so it may be, though he have a particular infirmity.* The only question is, *whether he was in a reasonable good state of health, and such a life as ought to be insured on common terms?*" The jury, upon this direction, without going out of court, found a verdict for the plaintiff.

This case will suffice to show the general nature of the questions which are apt to arise, where a life is insured upon a general warranty, no detailed list of questions having been submitted to the referee.

The definite questions now addressed to the referee tend to limit the number of actions brought on the ground of unintentional concealment ; but among the questions contained in the printed papers of the insurance offices there are not a few which the medical man may answer in perfect good faith, but concerning which disputes may arise. Thus the party effecting an insurance may suffer from indigestion, or some other trifling disorder ; and yet the medical referee may make no mention of the fact, simply because he does not think it has a tendency to shorten life. Nevertheless, this may become a question in a court of law, and may have to be decided by the evidence of medical men.

On this subject of life-assurance it is only necessary to add, that the medical referee should be very careful not to withhold any statement which may seem to him at all important. Otherwise his reputation for knowledge or integrity may suffer injury.

FEIGNED DISEASES.

Motives to this form of Imposition.—Classified List of Feigned Diseases.—1. *Diseases and Defects palpable to the Senses.*—2. *Diseases and Defects not palpable to the Senses.*—3. *Diseases consisting of Groups of Symptoms.—General Rules for the Detection of Feigned Diseases.—Cases in illustration of the Skill with which Diseases are sometimes imitated.*

Of the many inquiries which the medical man may be called upon to institute, none are more difficult than those relating to diseases supposed to be feigned. The occasions for such examinations are

also of frequent occurrence, for the motives to this form of deceit are very numerous. Of these motives, the following are the principal:

1. *Release from Obligations.*—Thus the soldier will pretend to be ill to escape severe military duty, or to obtain his discharge from the service; and the mendicant to avoid labour.

2. *The hope of Gain.*—Some, for instance, feign illness to obtain parochial relief, or to impose on the benevolence of private persons, others to defraud benefit societies, to procure the comforts of an hospital, or to obtain compensation for some pretended injury.

3. *To procure a release from Confinement, or an exemption from Punishment.*

And, 4. There are many persons, particularly females, who without hope of gain, feign diseases in order to excite public interest and curiosity, or private sympathy. Such deceptions are often practised by young and unmarried females, even of the better orders.

The persons most prone to feign diseases are those who congregate much; as soldiers, sailors, beggars, and school boys and girls. But the best school for feigned diseases is the army, and military impositions practised by soldiers have appropriated to themselves the name of *Malingery.* This art has been brought to a high state of perfection in France, where it is a great object for a man to escape the conscription, and Foderé observes of the time when the conscription was in full force in that country, "that it was brought to such perfection, as to render it as difficult to detect a feigned disease, as to cure a real one."*

Feigned diseases and defects are extremely numerous, and the subject involves so many details, that some arrangement is absolutely necessary. It is proposed to treat it in the following order. In the first place, a classified list will be given of the principal diseases and defects which have been feigned; this will be followed by rules for the detection of these impositions; to which will be added a few cases illustrative of the difficulty which the medical man occasionally encounters.

CLASSIFIED LIST OF FEIGNED DISEASES AND DEFECTS.

It is difficult to form any classification of feigned diseases which shall be free from many objections. The most obvious is into, 1. Diseases obvious to the senses; 2. Diseases and defects of a simple kind, not obvious to the senses, but depending upon the description of the impostor; and, 3. Diseases of a more complicated nature, consisting of groups of symptoms.

1. *Diseases obvious to the Senses.*

This class contains the following subdivisions. *a.* Increased and diminished size of parts. *b.* Malformations. *c.* Wounds, ulcers, and

* Vol. ii., p. 452.

superficial inflammations. *d.* Discharges. *e.* Spasmodic affections. *f.* Paralytic affections, and those accompanied with loss of power.

a. Increased and diminished Size of Parts.—This head includes *tumours* of various kinds. A favourite mode of producing tumours is the injection of air beneath the cellular membrane. It has been injected beneath the skin of the abdomen to imitate *ascites*, into that of the scrotum to imitate *hydrocele* and *hernia*, under the scalp to give the appearance of *hydrocephalus*, into various parts of the limbs, with the assistance of ligatures, to imitate local swellings. This mode of imposition may be detected by the touch, and by uncovering the tumour and searching for the aperture through which the air has been introduced, which aperture is generally found covered by a small piece of plaster. Pressure is another means by which tumours are produced. Swellings on various parts of the limbs, *anasarca*, *varicose veins*, and an appearance resembling *elephantiasis*, have been produced by ligatures; and *œdema* of the upper extremity by hanging the limb over the back of a chair previous to the medical visits. In such cases search must be made for the marks of the pressure which has been used. *Tympanites* has been imitated by swallowing air, or by taking large quantities of chalk and vinegar. In such cases, a solution of Glauber's salts with weak tobacco-water has proved very efficacious in the hands of Dr. O'Hara. The appearance of an abdominal tumour has also been produced by forcibly elevating the spine at the loins whilst lying on the back. Tumours in different situations have been imitated by the use of substances extraneous to the body, as *polypus of the nose*, by means of the testes of a cock, or the kidneys of a rabbit retained in the nostril, and sometimes impregnated with fœtid juices. Strong sternutatories will assist us in unmasking these cases. *Prolapsus ani* has been imitated by the gut of an ox or of a sheep, or by the everted anal extremity of the bowel of a colt or hog. In one case mentioned by Percy and Laurent, prolapsus ani was actually produced by introducing into the anus the bladder of a sheep, distending it with air and forcibly retracting it. *Prolapsus uteri* has been imitated by similar means; *Hydatids* of the uterus by vesicles prepared from the intestines of a pig; *malignant tumours* by a sponge soaked in various colouring matters; and *Hæmorrhoids* by the bladders of rats or small fish partly introduced into the rectum. *Hernia* has been feigned by the injection of air, by the forcible retraction of the testicles towards the rings, and, in one case, the sac was imitated by the bladder of an ox. *Cancer* has been imitated by a cow's spleen, and by a sponge moistened with milk, and fixed under the armpit. *Swellings of the Joints*, intended to represent white swellings, have been produced by various acrid plants, as the ranunculus acris and sceleratus applied to the part. Enlargement of the abdomen in the female has been simulated by a pad. *Partial Atrophy* may be produced by pressure.

The frauds contained under this head require, for their detection, a careful examination of the part itself, by the eye and by the touch.

b. Malformations.—Lateral curvature of the spine has been imitated. The characters of this simulated deformity are, that it is always in the dorso-lumbar region, the curve always single, the convex side free from gibbosity, there are folds of skin, generally two in number, on the concave side, the haunch of which is raised so as to give to the extremity the appearance of being shortened. In morbid deviations, on the contrary, the seat of curvature is variable, there is more than one curvature, the convex side is gibbous, the folds of skin, if present, are very slightly marked, there is little or no inclination of the trunk, or elevation of the haunch.* *Gibbosity*, or *elevation of the shoulders*, *wry neck*, and *various contractions of the limbs or joints*, have also been feigned. This is done by obstinate and long-continued flexion of the part, aided by inaction and the use of tight bandages. Sometimes the contraction is attributed to a burn or previous injury, in which case a wound is made to bear out the assertion. More commonly these contractions are attributed to a previous attack of rheumatism. In cases of contraction, there is generally ground for suspicion when there is no cicatrix, and no atrophy of the limb, but on the contrary, tension, hardness, and swelling of the contracted muscles. Many means have been proposed for the detection of this class of impositions, such as compressing by a tourniquet the nerves supplying the contracted muscles; applying a wet bandage tightly round the limb, which when dry, may so compress the muscles as to prevent the continuance of their contraction; endeavouring to move the limb during natural sleep, or during that produced by narcotics; the examination of the limb during the sickness and weakness produced by an emetic, or by intoxication; the electric shock; gradual and repeated tension of the contracted limb by means of a pulley or weights; making a sudden extension whilst the attention is engaged; recommending the warm climate of the coast of Africa as a cure, &c. *Dislocations* may be effected intentionally. Those of the shoulder-joint and patella are the most easily accomplished. *Fractures*, when real, are often prevented from healing by frequent motion, leading to the formation of false joints. Their effects are also greatly aggravated. *Hip Disease* has also been feigned, the apparent shortening of the limb being produced by strong contraction of the muscles. The actual cautery which would be properly resorted to in the real disease, will probably detect the false one.

c. Wounds, Ulcers, and Superficial Inflammations. Mutilation is a very common practice in the army, and especially in regiments submitted to very strict and harassing duties. In countries in which the conscription is in force, the practice is carried to an extraordinary extent. This is the case in France, and to a still greater extent in Egypt, in which unhappy country, it is stated to be difficult to meet

* On Feigned and Fictitious Diseases. By Hector Gavin, M.D. These marks of distinction are quoted from Dr. Jules Guérin.

with a single unmutilated male adult.* *Wounds.*—The distinction between wounds self-inflicted and inflicted by others, or taking place accidentally, will be considered under the head of wounds. *Bruises* have been imitated by colouring materials, but not being true to nature they are easily detected by the experienced eye. *Ulcers* are among the most common of feigned diseases, and when they exist naturally they are often intentionally increased. The means, most commonly resorted to are corrosive acids and alkalies, caustics, corrosive sublimate, arsenic and its sulphuret, acetate of copper, blistering plaster, quicklime, the flame of burning bodies, the ashes and chewed leaves of tobacco, the vegetable acids, especially the ranunculus acris and sceleratus, the mezereon or spurge-laurel, the euphorbium, the arum maculatum, and the juniper. Ulcers are also excited by mechanical means, as by pressure and friction. Pressure is often produced by means of pieces of copper coin, and friction by sand. Occasionally in place of being produced or increased by the use of irritants, ulcers are merely feigned, as, by gluing a portion of a spleen or the skin of a frog on the part, the surface being kept moist by a sponge dipped in blood and water. The most common situation of these fictitious ulcers is the lower extremities. Ulcers artificially produced may often be detected by simple inspection of the surface and dressings; the sudden increase of the appearance of inflammation on and about the ulcer will naturally excite a suspicion of the use of irritants; and the healthy appearance of the impostor will often be found at variance with the extent of ulceration. In hospitals, when there is ground for suspicion, that an ulcer is prevented from healing by the use of irritants, a wooden box completely enclosing the leg has been used with the best effect. *Fistula in Ano and in Perineo* have been imitated by a punctured wound into which a tent covered with some irritating substance, or made of the root of the milk thistle, or of white hellebore, is introduced. A variety of *cutaneous diseases* have been feigned, or intentionally produced, as *lupus* by the application of pounded garlic, and the juice of the euphorbium; *erysipelas* by a short application of blisters; *urticaria*, by eating shell-fish; *psoriasis* and *impetigo*, by the use of strong rubefacients; *pompholyx*, by blistering plaster; *scabies*, by punctures, irritated with gunpowder; *porrigo*, by nitric acid dropped upon the hand, and by other irritants, as also by a paste composed of rancid butter, honey, sulphur, and a small quantity of the powder of cantharides; *baldness* has been effected by the use of nitric acid. *Variola* in its eruptive stage has been imitated by punctures into which baysalt and gunpowder were afterwards rubbed. The discolouration of the skin in jaundice has been imitated by a variety of colouring materials.

To this division belong certain affections of the eyes, which are ob-

* Gavin, Op. cit. p. 344.

vious to the senses. *Ophthalmia* is a very important disease, as it is of frequent occurrence, and is very often artificially produced. The means employed for this purpose are gonorrhœal matter, nitric acid, corrosive sublimate, sulphate of copper, nitrate of silver, lime, pepper, snuff, the smoke and juice of tobacco, salt, alum, the powdered root of euphorbium, a blast of cold air, cantharides, friction, the introduction of fragments of cloth or muslin, &c. The counterfeit disease differs from the real chiefly in being confined to one eye, and that generally the right, in being rapid in its progress, the swelling and inflammation being chiefly in the conjunctiva, and ceasing when the vision becomes imperfect. The eye also is rarely so much disorganized as in the real ophthalmia. Another distinction between the factitious and epidemic ophthalmia, when it occurs in the army, is, that the former attacks only the privates and non-commissioned officers. The use of irritants in the form of powder can often be detected, as in the case of ulcers, by simple inspection. *Ophthalmia tarsi* has been simulated by the use of strong irritants, or by the extraction of the eyelashes. A healthy aspect of countenance would at once lead us to suspect the fraud which had been practised, as ophthalmia tarsi rarely occurs in any but the scrofulous and cachectic. *Opacity of the cornea* has been caused by dropping strong acid into the eye, or by introducing a fragment of lime or of some other strong irritant. *Cataract*, too, has been produced by the introduction of a fine needle through the cornea to the lens. The operation of extraction should be performed in such cases.

d. Discharges. *Vomiting* is a frequent factitious symptom of disease. It is effected by pressing on the pit of the stomach, by swallowing air, by a strong and sudden action of the abdominal muscles, assisted by tickling the fauces, and by the use of emetics. Vomiting produced by these means is generally unaccompanied by that emaciation which results in disease from its long continuance. The fraud is often readily detected by the absence of the other concomitants of those diseases of which vomiting is a symptom. Various substances have been rejected from the stomach, as common water, urine, and even fæces, all of which had been previously swallowed. The larva of insects and reptiles have also been mixed with substances stated to have been vomited. *Diarrhœa* and *dysentery*, too, are often feigned or produced at will; feigned, by breaking down an ordinary evacuation and mixing it with urine; produced, by a mixture of vinegar and burnt cork, by a solution of the sulphate of iron, by drastic purgatives, or by the introduction of irritating substances into the rectum. The evacuations are sometimes tinged with blood, procured from puncture, laceration, or strong suction of the gums, or they are coloured of a dark red by logwood, green by senna, black by the deep-coloured wines of Portugal, &c. A careful examination of the evacuations, the use of a separate close-stool, the inspection of the linen, and a comparison of the symptoms present with those of the simulated disease, will assist

us in discovering the fraud. *Ascarides* have been clumsily imitated, as in an out-patient of the King's College Hospital, by small fragments of thread, one of which was red. Animals have been placed in the evacuations, as a species of lizard, in a case related by Dr. Spence. Alterations in the secretion of *urine* belong to this division. Alleged urinary concretions have been found to consist of sand, pebbles, pieces of quartz and flint. Fragments of brick or slate, small pebbles, &c., have been introduced into the urethra to bear out the alleged existence of urinary calculus. Calcined bricks, coals and fragments of bone have been introduced into the vagina with the like intention. Chemical analysis, and, in most cases, mere inspection will serve to unmask such impositions. *Hæmaturia* has been simulated by the use of beet-root, madder, cochineal, the Indian fig, the fruit of the prickly pear, logwood, &c.; blood has also been injected into the bladder, or mixed with the urine after it has been passed, or it has been obtained from the mucous membrane of the urethra by scratching. Hæmaturia may also be caused by substances taken internally, as savin, cantharides, and turpentine. The urine may be tinged of different colours by substances taken internally, such as madder, logwood, indigo, rhubarb, black cherries, the whortle-berry, the pulp of cassia fistula, elder rob, and ferrocyanate of potass, or iron. Milk has been added to the urine to give it a white colour. In suspected cases, the patient should be made to urinate in the presence of the medical man. The absence of the local and constitutional symptoms attending the more severe affections of the kidney and bladder would naturally excite suspicion, and assist the diagnosis. *Gonorrhœa* has been imitated by the use of caustics. The *menstrual discharge* by staining the linen with bullock's blood. *Epistaxis* has been produced by incisions. *Hæmoptysis* is a favourite factitious disease. It is imitated by swallowing bullock's blood, by holding in the mouth a sponge filled with blood, by incisions on the inside of the mouth or back of the throat, by pricking the gums, by blood sucked from other parts of the body. In other cases pastilles coloured with carmine, Armenian bole, brick-dust, and vermilion have been used for this purpose. In suspicious cases, the mouth should be carefully examined, and rinsed out with water, the rejected fluid inspected, and, if necessary, analysed: the chest also should be examined. *Otorrhœa* is simulated by honey, pus, rancid tallow, asafœtida, or old cheese, introduced into the meatus; it has been excited by cantharides, or by various irritating liquids. *Ozœna* has been imitated and excited by similar means. *Fœtid breath and perspiration* have been produced by oil of dippel, asafœtida, old cheese, putrifying fish, and the rancid oil from a cart wheel. Emetics in the one case, and ablutions in the other, with careful watching, will serve to detect the imposture.

e. Spasmodic affections. This class of diseases is frequently and successfully feigned. *Epilepsy*, for various reasons, is the favourite subject or imitation, and it has the peculiar recommendation that

the impostor may be well at intervals, and assume his fits at such times as suit his convenience. In addition to the violent struggles which form the prominent feature of the true disease, impostors have contrived to inflict bruises upon different parts of their persons as evidence of former attacks, to vomit blood previously swallowed, to imitate the foam at the mouth by chewing soap, and to discharge the urine as if involuntarily. To point out the means of distinguishing the factitious from the real disease, would be to give a minute description of the characters of an epileptic seizure. For them the reader is referred to works on the practice of medicine, and to the more voluminous monographs on feigned diseases. In these works, however, many means of diagnosis are pointed out which cannot be depended on. The best criterion is the entire absence of sensibility in the true epileptic seizure; while in attacks of feigned epilepsy, the use of appropriate stimulants will elicit some sign of sensibility. The stimulants recommended are, the vapours of hartshorn, or sulphurous acid gas applied to the nose; snuff, or other sternutatories; a morsel of asafœtida introduced into the nostrils; a few drops of alcohol or turpentine poured into the eye; aloes and salt in solution, mustard, or common salt, placed in the mouth. The sudden application of hot water, or of actual flame, to the skin, has been recommended. Sharp-pointed instruments have sometimes been introduced into the flesh, but without detecting the imposition. If any mechanical stimulus must be resorted to, the author would strongly recommend, as free from the objection to which sharp-pointed instruments are open, flecking the feet with a wet towel. He is in the habit of employing this with advantage in cases of poisoning with opium, and has by its means roused a patient from a mesmeric slumber, when all other mechanical stimulants and cold effusions had failed. Though he has not tried it in any case of epilepsy supposed to be feigned, he believes that it would infallibly succeed. The aspect of the epileptic is so peculiar, that a natural expression of countenance would excite suspicion. The time of the occurrence of the fits, the little injury attending them, the absence of the shame with which the true epileptic speaks of his disease, the history of the case,—these, and many other points that might be mentioned, will assist in distinguishing the feigned from the true disease. *Convulsions.* These irregular actions of the muscles have been rife in all ages, partly as the result of involuntary imitation, and partly as the consequence of imposition. They are most frequent in females; but are by no means confined to that sex. The chief difference between real and feigned convulsions is the possibility of the long continuance of the former, and that with comparatively little exhaustion, the reverse being the case with the factitious. To discover the fraud "it is sufficient to act with force on the antagonist muscles."* The impostor may be tired out by long watching. Local convulsive move-

* Orfila, Léçons de Méd. Lég., vol. i. p. 410.

ments are often feigned. I saw a case at the hospital of constant and violent convulsive action of the muscles of the abdomen, in a discharged soldier of the Spanish Legion. Having informed him at once of my suspicions, I desired him to call the next day, when I would examine him with more care. He did not repeat his visit, but two days afterwards I met him, quite free from his convulsions, taking an active and boisterous part in an election. *Chorea.* This, like other forms of convulsion, has often been the offspring of fanaticism, involuntary imitation, and voluntary deception. It is more easily feigned than epilepsy. When skilfully imitated the diagnosis is not easy, and many of the distinctions laid down in books are without foundation. Cold affusions and electricity, which may be used with propriety in true chorea, are not pleasant remedies for impostors, and are therefore greatly to be commended. *Hysteria.* It is of little consequence whether an attack of hysteria be feigned or not ; cold affusion, which is the best remedy for the real disease, is not a pleasant application in feigned attacks. Whether it cures it or leads to its being laid aside is a matter of little moment. *Catalepsy* is a very rare disease, and its existence, especially in a male, may fairly justify some degree of suspicion. I have myself met with one well-marked case of it. It occurred in a young gentleman whom I have repeatedly seen arrested in the midst of his sports, and in attitudes most difficult to sustain. He would remain motionless for the space of one or two minutes, and then resume his play with an air of slight and transient surprise. He died in a bath, as it was thought, during a fit. Powerful stimulants, the proposal of the actual cautery while the finger is on the pulse, appending a weight to the extended limb, and cutting the string suddenly, have been recommended and practised with effect in feigned cases. In the trance which follows the manipulations of the magnetizer, I have, as I have stated, resorted to flecking of the feet with success. *Tetanus* and *hydrophobia* have been on rare occasions feigned, but so unsuccessfully that no more need be said about them. Some forms of *tonic spasm* have been feigned. Thus the fingers have been forcibly contracted, and the nails driven into the palm of the hand. By introducing a conical piece of wood, and gradually wearying the muscles, the imposition is readily detected. *Stammering* is often feigned. Sometimes the real defect depends upon malformation of the tongue or palate ; but in other instances these parts are well formed. The examination of these organs, as recommended by some authors, will not, therefore, serve as a distinction. The best distinction is founded on the fact, that stammerers hesitate little or not at all in repeating what they know by heart, and in singing. The contortions of the impostor while repeating such passages will betray him. *Strabismus* is easily feigned. The proposal of the modern operation would often serve to unmask imposture. *Nictitation and Blepharospasmus* are unimportant and easily pretended. *Dysphagia*, when feigned, may be cured by the persevering use of the probang; low diet

and watching will complete the cure, or soon lead to detection. *Stricture of the urethra* has been feigned, but as the treatment of the real disease is not agreeable, the imposture is not likely to be persevered in.

f. Paralytic affections, and those accompanied by loss of power.—These affections are frequently simulated. General *paralysis* is too difficult to assume; but every form of partial paralysis has been feigned. *Hemiplegia* has been successfully imitated in a great number of instances. The previous history of the case, and a careful examination of the existing symptoms and appearances, will generally enable us to unmask the imposture. The same remarks apply to *Paraplegia*, in which we have the additional negative evidence from the state of the urine, the degree of emaciation of the limb, and the state of the sensation. *Local paralysis* has also in many cases been successfully feigned, and here we have the additional means of diagnosis afforded by the temperature of the affected extremity. In true cases of local paralysis the palsied limb has its temperature much reduced. In cases of paralysis of the fore-arm and hand, and more rarely of the entire upper or lower extremity, the discovery of a blue line on the gums will give good grounds for believing the paralysis real. *Paralysis agitans.* In attempting to imitate this disease the impostor generally overdoes his part. It is considered characteristic of the real disease that the patient in attempting to walk "is impelled unwillingly to adopt a running pace." The pretender on the other hand is apt to hesitate in his movements and to advance with difficulty. It happens fortunately in this, as in most diseases of this class, that the remedies proper for the disease are not agreeable ones, and where there is a good ground for suspicion, low diet will be found a useful auxiliary. *Ptosis.* The impostor generally makes attempts to prevent the raising of the eyelid, and this leads to detection. *Insensibility*, when feigned, may be detected by the use of stimulants, and the imposition will often be discovered by the inconsistent statements as to the cause.* *Coma and Lethargy* have been very successfully feigned, and in one or two instances the impostor has resisted every stimulant that could be thought of: in one case the operation of trephining caused merely a single groan.† The treatment which we should be justified in resorting to if the complaint were real would prove a trying discipline to most impostors. *Syncope.* This scarcely admits of being feigned, for if the impostor can contrive to grow pale, he can scarcely control the action of the heart and arteries. More than one case, however, of this voluntary control over the circulation is on record, of which the best authenticated—that of Colonel Townshend—will be elsewhere referred to.‡ Death itself has been feigned, and in one or two cases with such success as to deceive the common observer, and, in the solitary case of

* See medical arguments in the case of the Queen *versus* Bolam, tried at Newcastle, July 29, 1838; drawn up for the use of the solicitor and counsel for the prosecution, by Dr. Lynch.—Lancet, August 17, 1839.

† Case of Phineas Adams, p. 203. ‡ See Real and Apparent Death.

Colonel Townshend, so as to deceive medical men themselves. Cases of feigned hanging, drowning, poisoning, &c., will be referred to under their appropriate heads.

2. DISEASES AND DEFECTS NOT OBVIOUS TO THE SENSES, BUT DEPENDING CHIEFLY UPON THE DESCRIPTION OF THE IMPOSTOR.

The principal diseases belonging to this class consist in, *a*, increased, and *b*, diminished sensation.

a. Increased Sensation.—Pain. This common symptom of disease is frequently pretended. It is easily assumed and not easily detected. There are many external pains, such as tic-douloureux, which occur in persons otherwise, to all appearance, healthy; and there are many pains of a severe character, of which the cause is extremely obscure. Many cases also are on record in which severe pain has arisen from a cause that has escaped observation, and the sufferers have been treated as if the pain were pretended. The nature of the pain, the presence or absence of the symptoms of disease with which it is ordinarily associated, the appearance of the patient, the consistent account which he gives of its origin, and progress, will assist us in distinguishing real from pretended suffering. But we must guard against a hasty decision, and trust rather to time, than to experience and the rules of diagnosis, for a decision. Remarkable examples of endurance of pain are recorded. Thus, a case is related by Lentin, of a female beggar who succeeded in having both her breasts removed, and then solicited the removal of one of her hands for a pretended pain in that part.* Cases are also related by Percy and Laurent,† and by Foderé,‡ of simulated pains, for the cure of which the patients submitted to the most severe and trying remedies. *Pain in the head*, and the giddiness which often accompany it, are also easily feigned, and not easily proved to be so. Most persons have suffered more or less from these symptoms, which renders it the more easy to put on an expression of countenance corresponding to them. No certain rules can be laid down for distinguishing the true from the false; and in the case of pains in the head, as in pains in other parts of the body, real sufferings have been mistaken for pretended ones. *Rheumatic pains* in various parts of the body, especially in the loins and thighs, are often feigned. The same remarks apply to these pains as to others which are not necessarily accompanied by change in the parts affected, or by any well-marked constitutional symptom. In many works on feigned diseases, long rules are given for detecting feigned pain, and the symptoms of almost every disease accompanied by pain are detected. All this detail is unnecessary, and of little use. Such feigned diseases can-

* Beyträge zur ausübenden Arzneiwissenschaft. Leipzig, 1797.
† Dictionaire des Sciences Méd., *art.* Simulation des Maladies.
‡ Léçons de Méd. Lég., vol. ii. pp. 473-4.

not be detected by any but those who have extensive experience of real ones, and of accompaniments which no description can adequately convey, such as the expression and gesture of the countenance, and the attitude of the body.

b. Diminished sensation.—A diminution or entire absence of sensation is frequently pretended. *Amaurosis* is a favourite feigned disease. It is also often produced intentionally. The substances employed are the juice or extract of belladonna, hyoscyamus, or henbane, the distilled water of the spurge laurel, and the datura metel, and snuff moistened with a decoction of belladonna. The amaurosis produced by these means is not at first distinguishable from the real; but it disappears if the impostor be carefully isolated and watched. The disease has been very successfully feigned, and the imposture most perseveringly carried out. In one instance, related by Mahon, a recruit feigned blindness, and, after all other means had been tried without success, he was placed on the bank of a river, and ordered to walk forward, which he did. He afterwards confessed the imposture.* This was the case in reference to which Foderé made the somewhat curious remark, that the proof would have been complete if, instead of a river, the man had been placed on the edge of a precipice,—a dangerous experiment, "if he had been really blind." *Myopia.*—Short-sightedness being a disability in the army is often feigned. It may be detected by placing an open book close to the nose, or by requiring the suspected person to read print at some distance by the aid of glasses for the near-sighted. If the individual cannot read the book when thus placed, or when such glasses are used, we may be sure that the defect is feigned. *Presbyopia* is rarely feigned. The mode of detection is the converse of the preceding. *Amblyopia*, or weakness of sight, is also rarely pretended. In the army, the surest way to put a stop to these pretended defects, is to employ the subjects of them in some service for which the real defect would not unfit them. *Nyctalopia.*—Night-blindness. This disease is peculiar to warm climates, in which the sun's rays have great power. There are no satisfactory means of distinguishing the true from the feigned disease, as opposite states of pupil may exist in different cases. Here, too, it is useful to find for the real or pretended nyctalope some employment for which the affection, if real, does not incapacitate him. *Hemeralopia*, or day-blindness. This disease is not of much importance. It sometimes occurs for a short time as a symptom of worms, or of other intestinal irritation. The diagnosis will depend upon our knowledge of the diseases of which it is a symptom. *Deafness.*—As this may occur without any change in the appearance of the external ear, it is a favourite imposition. The modes of detecting it are obvious. A watch should be set on the suspected person day and night, things calculated to excite interest or apprehension should be said in his presence, and the effect be carefully watched. It has been recom-

* Mahon, Méd. Lég., vol. i. p. 366.

mended to place the hand on the pulse while any bad news, or threat of punishment, is being uttered. He should be called sharply or unexpectedly by name, or in a whisper, or he should be roused from sleep and spoken to, or a piece of money should be let fall close to him. All these, and similar tests, have often been applied in vain; sometimes, too, the loudest noises have not produced any apparent effect. In one case, related by Dunlop, a pistol was fired off close to the ear without effect; but upon the man being sent to sleep by opium, the imposition was detected on the repetition of the firing.*

Dumbness. This is sometimes assumed with great perseverance. As a general rule it may be stated, that if a man not deaf can move his tongue he is not dumb. Nothing but complete paralysis can account for his being dumb. Some mutes add to pretended dumbness a feigned mutilation of the organ, which they effect by rolling the tongue back into the throat, and scratching it so as to make it bleed. A relative of the author's detected such an imposition in the case of a man who, by means of a written paper describing his captivity among the Algerines and his mutilation by them, had excited great commiseration. Pretending to give entire credence to the man's tale, and taking a half-crown out of his pocket, he requested the man to show him his tongue once more, upon which he thrust his finger suddenly against the root, and the tongue rolled out. *Deaf-dumbness.* The combination of deafness and dumbness, though never occurring in a person previously in possession of both these faculties, is sometimes obstinately pretended. The impostor is best made to lay aside his imposture by solitary confinement and low diet. In one or two remarkable instances, men who have pretended that they were born deaf and dumb, have resisted every test, and have been discovered only by those having personal experience of the really deaf and dumb.†

3. DISEASES OF A MORE COMPLICATED KIND, CONSISTING OF GROUPS OF SYMPTOMS.

In the two foregoing divisions, those impositions have been considered which consist of a single appearance or outward manifestation, tangible or visible to the senses; or of a single alleged symptom or defect, not necessarily combined with other symptoms, or which, if sometimes forming part of a disease, deserve separate consideration. It now remains to speak of instances in which whole trains of symptoms proper to certain diseases have been assumed, with more or less success. This division may be made to consist of two classes: *a*. Diseases of the body. *b*. Diseases of the mind.

a. Diseases of the Body.—Fever has been partly feigned and partly produced. Foderé states, that he has often seen impostors produce an extraordinary frequency of pulse, accompanied with chattering of the teeth and profound sighs. One of the marked symptoms of the

* Beck's Med. Jur. p. 17.

† See the cases of Victor Foy, or Travanait, p. 203.

typhoid type of fever, the brown tongue, has been artificially produced. Febrile symptoms may be excited by strong stimulants, such as wine, brandy, cantharides; and by the internal use of tobacco, which drug has a remarkable effect on the pulse; also by the introduction of a clove of garlic into the rectum. Violent exercise, or the strong contraction of the limbs before the visit of the physician, has been resorted to as a means of imitating fever. The tongue has been whitened by chalk, pipeclay, soap, flour, or whiting; and tinged brown by tobacco, brick-dust, liquorice, or gingerbread. Pallor of the skin has been imitated by the use of emetics, by smoking, by digitalis, or by drinking an infusion of cumin seeds. A flush, on the other hand, is produced by friction. The detection of cases of simulated fever is easy. The effects are always ephemeral, and all that is necessary is to have the patient watched for a few hours. *Ague* is often feigned, but not with much success. The effort necessary to imitate the rigors throws the impostor into a perspiration, which leads to detection. The shivering fit is not followed by the other stages. *Rheumatism.* The acute form is not easily feigned; but the chronic, consisting chiefly in pain, and having no strongly marked accompanying symptoms, has been often imitated with success. The same remarks, therefore, apply to this disease as to pain in general. Various affections of the *chest* are assumed by impostors. *Pneumonia.*—One instance of feigned pneumonia is mentioned by Dr. Gavin.* It was not very successfully assumed. The stethescope would serve at once to prove its non-existence. *Phthisis.*—It would be difficult to deceive a careful observer, or one skilled in the use of the stethescope; but many symptoms of the disease have been successfully assumed. Hæmoptysis and mucous expectoration have been imitated in the manner already described. Emaciation may be produced by abstinence, by drinking vinegar, or by sucking a copper coin; febrile symptoms by the means just pointed out. *Asthma*, also, has been imitated, but here the stethescope will assist in the detection of the imposition. *Apoplexy* cannot be successfully feigned. The fraud is easily detected by sternutatories, or by strong stimulants. *Dyspepsia.* This disease is often feigned, and sometimes with success. Vomiting, gastralgia, pyrosis, and in fact all the symptoms of dyspepsia have been assumed, and the imposition has been detected only by careful watching. *Gastritis*, or acute dyspepsia has also been assumed, but it is difficult to imitate it with success. Constant vomiting is not easily feigned, nor is the bright red tongue, often present in acute gastritis. *Peritonitis*, too, has been imitated, but rarely with much success. In one case in which there was a pretence of great pain increased by pressure, a dose of opium was given, and the man bore very strong pressure without being roused from sleep. *Hepatitis* in its chronic form is a favourite feigned disease, as it is very prevalent in hot climates, and is supposed to be of very frequent occurrence in this

* Dr. Gavin on Feigned and Factitious Diseases, p. 257.

country. As, however, liver diseases are now getting out of fashion at home, they are less likely to be feigned; but among soldiers who have served in hot climates they are still common. The dull heavy pain in the right side is easily assumed, and the pain in the shoulder, but the discoloured eye and skin, the unhealthy aspect of the countenance, and the mental depression and listlessness not so readily. *Jaundice* has been imitated by staining the skin with an infusion of the root of curcuma longa, or of saffron, with tincture of rhubarb, the bruised seeds of the broom, the stamina of the iris, &c. Clay-coloured stools have been produced by taking a small quantity of muriatic acid, and the colour of the urine has been heightened by rhubarb. Pebbles, too, have been produced as gall-stones. It is not easy to tinge the conjunctiva yellow, nor to produce at one and the same time the yellow skin, the pale stools, and the high-coloured urine. It must be borne in mind, however, that in the real disease the fæces are not always pale, but that occasionally they contain an excess of bile. *Scurvy.*—One prominent symptom of this affection is often imitated, viz., the spongy and bleeding gums. For this purpose, various irritating substances are used, or the gums are punctured previously to the visit. As this is but one symptom, and the others are not easily feigned, this imposition will present but little difficulty. *Nephritis.*—The pain which accompanies this disease has been assumed, and the assertion has been borne out by the exhibition of pebbles or fragments of brick, &c. This fraud has been mentioned under the head of urinary concretions. It is scarcely necessary to state that it is almost impossible for an impostor to assume all the symptoms of nephritis.

Much more might have been said on this division of feigned diseases, and minute rules for diagnosis might have been laid down: but want of space, and the assurance that it is not by descriptions of diseases, but by actual experience of them, that the true are to be distinguished from the false, has led to its being thus briefly handled. Those who are familiar with treatises on this subject will know how much of false diagnosis they contain. In doubtful cases, a reference to the best description of the disease supposed to be assumed is strongly recommended, but it must be borne in mind that symptoms commonly considered as of high diagnostic value may be absent in the real affection, and may lead to unjust suspicions.

b. Mental Disorders.—Feigned insanity is of so much importance that it will be treated in the next chapter under the head of unsoundness of mind.

The subject of feigned diseases, as has been already stated, contains so many details, that it is impossible to treat it at length within the limits of a work on Forensic Medicine.* The following general rules will be of use to those who are engaged in deciding on the reality of diseases supposed to be feigned.

* For more detailed information, the reader may consult with advantage Dr. Gavin's work already quoted.

RULES FOR THE DETECTION OF FEIGNED AND FACTITIOUS DISEASES.

1. Inquire, in all cases, into the existence of motives for deception. Will the suspected person, by imposition, gain any thing he desires, or escape any thing he dreads? Is he in a position to profit in any way by deception? It is necessary, in this place, to caution the medical man against concluding that a malady is real, because there is no obvious advantage in simulating it. Both men and women are in the habit of feigning from other motives than those of gain, such as sympathy; and occasionally there is so complete an absence of reasonable motive, that we are forced to believe in the existence of a moral insanity displaying itself in this way.

2. Inquire into the previous history of the patient, and the character which he bears among those who know him best, as his comrades, or companions. It often happens that the impostor has been previously noted for dishonesty, and for practices similar to those of which he is suspected. But, in other instances, men of the best character, and who have for years filled their situations with credit, have been convicted of malingering.

3. In the case of external diseases palpable to the senses, make a minute and careful inspection of the part itself, and examine it by the eye and by the touch. When there is a suspicion of the use of irritating substances, examine the part with care, and search the pockets, boxes, or bed of the suspected party, and if necessary isolate him so as to deprive him of the assistance of others, and of his means of deception. Use equal care in inspecting substances alleged to have been discharged, and examine them, if necessary, by the microscope or by chemical tests.

4. When some defect, or disability not palpable to the senses, but depending entirely upon the assertion of the person himself, as pain, deafness, &c., is assumed, we must endeavour to take him by surprise. In the case of pretended deafness, for instance, we must try to discover the imposition by sudden and unexpected noises, and by speaking to the party immediately on his being roused from sleep.

5. In cases of feigned diseases, properly so called, consisting of assemblages of several symptoms, we must examine minutely into the history and alleged causes of the disease; compare the age, temperament, and mode of life of the suspected person with the symptoms present; watch narrowly the course of the symptoms, and contrast it with the known march of the disease itself.

6. The suspected person should be visited at all hours of the day, and at times at which he does not expect to be seen. He should also be watched by those whom he is not likely to suspect.

7. No questions should be put of a nature to instruct the patient as to what we wish to know, but our inquiries should be so directed as

to lead him into incongruous statements. He should be thrown on his own invention, and be allowed to talk in his own way. The suspicions which we may entertain should be carefully concealed ; we must ourselves become dissemblers, and meet the malingerer with his own weapons.

8. Observe whether the suspected person be willing to make use of the medicines and measures prescribed for his relief. The impostor is generally less disposed to resort to the necessary means than he who is really ill.

9. Great caution is necessary in the treatment of suspicious cases. As a general rule, no measures ought to be employed which would not be justifiable on the supposition of the disease being real. But when the suspicion is very strong, low diet, isolation, and nauseous medicines, may be fairly resorted to.

Two cases illustrative of the success and perseverance with which diseases are sometimes feigned, and of the difficulty of detection, will form a fitting conclusion to this subject.

Phineas Adams, a soldier in the Somerset militia, aged eighteen years, was confined in gaol for desertion. From the 26th of April to the 8th of July, 1811, he lay in a state of insensibility, resisting every remedy, such as thrusting snuff up the nostrils, electric shocks, powerful medicines, &c. When any of his limbs were raised, they fell with the leaden weight of total inanimation. His eyes were closed, and his countenance extremely pale ; but his respiration continued free, and his pulse was of a healthy tone. The sustenance he received was eggs diluted with wine, and occasionally tea, which he sucked in through his teeth, as all attempts to open his mouth were fruitless. Pins were thrust under his finger-nails to excite sensation, but in vain. It was conjectured that his illness might be owing to a fall ; and a proposal was consequently made by the surgeon to perform the operation of scalping, in order to ascertain whether there was not a depression of the bone. The operation was described by him to the parents at the bedside of their son, and it was performed—the incisions were made, the scalp drawn up, and the head examined. During all this time he manifested no audible sign of pain or sensibility, except when the instrument with which the head was scraped was applied. He then, but only once, uttered a groan. As no beneficial result appeared, and as the case seemed hopeless, a discharge was obtained, and he was taken to the house of his father. The next day he was seen sitting at the door talking to his parent ; and, the day after, was observed at two miles from home, cutting spars, carrying reeds up a ladder, and assisting his father in thatching a rick.*

Victor Foy, *alias* Victor Travanait, from Luzarche, near Paris, under the pretence of travelling in search of his father, and, by pretending to be deaf and dumb, endeavoured to avoid military

* Edinburgh Annual Register, vol. iv. part ii. p. 159. Beck's Medical Jurisprudence, 7th edit. p. 19.

duty. He was imprisoned in various countries, watched closely, and examined most rigidly, without being detected. So perfectly indeed had he accustomed himself to his part, that when he avowed the fraud, to use his own expression, he had unlearnt how to hear. In Switzerland, he was tempted by a young and beautiful woman, who offered him her hand, but without effect. In the prison at Rochelle, the turnkey was ordered to sleep with him, to watch, and never to quit him. He was repeatedly awakened in a violent manner, but his fright was expressed by a plaintive noise, and in his dreams guttural sounds alone were heard; and the hundred prisoners, who were all ordered to detect him if possible, could discover nothing from which they could imagine deceit. At last the officer charged with the police of the prison of Rochelle became satisfied, after many examinations, that he was really deaf and dumb, and declared this in the public journals, so as to obtain his liberty. Victor unhappily, at this period, went beyond his capacity. He stated himself in writing to be an *élève* of the Abbé Sicard. This ingenious and worthy individual denied the fact without seeing him, and proved it from the writing. "I cannot tell," said he, in a letter to the counsellor of state, Real, "whether this person, confined at Rochelle, be really Victor Travanait, or not; but I can say positively, that he was not born deaf and dumb." The reason which he assigned for this opinion was, that he wrote from sound, while the deaf and dumb write only as they see. In his letters he appeared so ignorant as to divide some words, and annex prepositions to others, as if they were constituent parts. The following extract will serve as a specimen: "*Je jur de vandieux, ma mer et né en Nautriche, quhonduit* (pour *conduit*) *essepoise* (pour *espoir*); *torre* (pour *tort*); *ru S. Honoret, jai tas present* (pour *j'étais présent*); *jean porte en core les marque* (pour *j'en porte encore les marques*)." It will be observed, that in this letter, Victor uses *q* instead of *c*: and from this Sicard inferred that he had heard, and knew that the sound of these gutturals was similar. He concluded by stating his conviction that Victor was not born deaf, and of course was not dumb.

The criminal was now brought to the institution for the deaf and dumb at Paris, and placed before the black board. He was ordered to write answers to questions put to him by Sicard, which he did in so able a manner, and eluded the most embarrassing questions so ingeniously, that nothing but his orthography could yet be adduced against him. Sicard had taught his pupils to articulate sounds, and he had done this by showing them the words, as it were, by the apparent effects of touches on a musical instrument, and then pressing their arms more or less strongly. During this operation, he obtains at pleasure the hard or soft consonant, which serves as a sign for the required articulation. Victor, when put to this proof, instead of the syllable *pa*, pronounced only the vowel *a*, and never uttered the labial consonant, which all the deaf and dumb easily articulate. He was

then put to the last test. When asked how he had been instructed, he answered by signs, and promised to explain by them such words as they might write on the black board, but could not do so. He was then placed among those who were really deaf and dumb, but understood nothing from them, nor could they comprehend him. Frightened at this detection, and still more so at the threat he had heard, that he would be confronted with the pastrycook to whom he had been an apprentice, he at last took up a book and read.*

Closely connected with the subject of feigned diseases is that of disqualifying diseases. It is chiefly interesting to military and naval surgeons; but cases occasionally occur in civil life in which the medical man is required to state his opinion. He may be directed to ascertain whether an individual is fit to serve on a jury; whether he is able to attend as a witness; whether he is competent to take on him certain offices or duties; or whether he can bear hard labour, or other severe punishment, which he may be sentenced to undergo. The medical man may also be called upon to ascertain the state of health of persons wishing to effect insurances upon their lives, and of children presenting themselves for admission into some of our public schools. The subject of exemption on the ground of disqualifications in civil and criminal cases scarcely requires, or admits of, any precise rules. Disqualification for military service is a subject of too great extent to be treated of usefully in this place. There is the less necessity for its introduction here, inasmuch as the military surgeon is required to possess some work on his recruiting duties. The whole subject, indeed, belongs more properly to a work on Hygiène, than to Forensic Medicine.†

* Foderé, vol. ii. pp. 478. Beck, p. 26.

† Marshall's Hints on the Examination of Recruits, &c., is the standard work on this subject. To this the reader is referred.

CHAPTER VI.

UNSOUNDNESS OF MIND.

Preliminary Observations.—The Mind a Compound of many distinct Faculties.—Choice of Terms.—Unsoundness of Mind.—Non Compos Mentis.—Subdivisions.—Author's Arrangement.—Spectral Illusions.—Dreaming.—Somnambulism.—Legal Relations of Somnambulism.—Delirium.—Delirium Tremens.—Drunkenness.—Their Legal Relations.—AMENTIA.—*Idiocy.—Cretenism.—Imbecility.—Their Legal Relations.*—DEMENTIA.—*Varieties.—Legal Relations.*—MANIA.—*Intellectual (general, and partial).—Moral (general, and partial).—Legal Relations of Mania.—Mania with Lucid Intervals.—Legal Relations.—Of some of the more important Characters of Mental Unsoundness.—Tests.—Plea of Insanity in Criminal Cases.—Feigned Unsoundness of Mind.—Idiocy, Imbecility, Dementia, Mania (general, and partial).—Moral Insanity.—Concealed Insanity.—Rules for the Examination of Persons supposed to be of Unsound Mind.*

OF the many subjects treated in works on Forensic Medicine, there is none more important, more interesting, or more difficult than this; and within a very recent period, more especially, one question connected with it has assumed a grave importance.

The occasions on which the medical man may be required to give evidence as to the condition of the mind are numerous. A man makes a will; and his relations dispute the validity of it. Was the testator, at the time of making the will, in full possession of his faculties? A criminal makes a confession. The confidence to be placed in his statement may involve the question of the state of his mind at the time of making it. A man squanders his property, or is accused of doing so; and the question arises—is he competent to manage his affairs? An act of great atrocity is committed. Was the man who committed it in a sound state of mind,—in such a state as to make him responsible for his act? A criminal is supposed to feign insanity to escape from the consequences of his crime. Is he really mad?

Such are some of the questions relating to the mind that arise in courts of law, and concerning which the opinion of the medical man is required. Without a written certificate from him, moreover, no man supposed to be mad can be placed under restraint.

The importance of the duties which the medical man has to perform is only exceeded by their difficulty, which difficulty is partly inherent in the subject itself, and partly due to the requirements of the law.

It may be well to premise, that one source of the difficulties connected with this subject may be traced to the prominence and im-

portance formerly given, in works on the human mind, to one or two of its higher faculties. The reason and the imagination were put so prominently forward, and the emotions and passions were made to play so subordinate a part, that soundness and unsoundness of mind came to be regarded as almost synonymous with a sound or erring reason; imagination had to bear all the blame of misleading the judgment, and delusion became the favourite test of insanity. It is not intended to assert that the metaphysicians were ignorant of the power of the emotions and passions, but merely that they were led to attach a higher importance to those faculties of the mind, which give the widest scope to the speculations of the philosopher. To Gall and Spurzheim, and their followers, is due the great merit of having directed attention to those faculties which are the real source of action, —the emotions and passions; and to them must be ascribed the praise of having originated the simplest, and by far the most practical, theory of the human mind. The phrenological question of the mutual relation existing between certain parts of the brain, certain faculties of the mind, and certain developments of the cranium, may be still a matter of doubt, and the practical advantages accruing from a knowledge of those relations a subject of controversy; but of the soundness of the theory, that the mind is a compound of several faculties, capable of acting either alone or in combination, varying greatly in power in different persons, and in the same person at different times, there can be no longer any reasonable doubt. Admit the theory of the separate existence, and possible separate action, of the several faculties of the mind,—the reasoning faculties, the emotions or sentiments, and the passions,—and it is not more difficult to imagine a moral than an intellectual insanity; allow that the several faculties, originally of different power in different persons, may combine in many different ways, and we have the materials of an almost infinite variety of character; the key to endless diversities of opinion, and the explanation of all that is most obscure in the motives and conduct of mankind.

The theory, then, of separate faculties, originally of different power, susceptible of improvement by education and habit, and of different degrees of excitement, from causes acting within the body itself or from without, manifesting themselves sometimes alone and sometimes in combination with other faculties,—is the theory which is here assumed, as best agreeing with reason and experience. Thus much it was thought necessary to premise.

As the members of the medical and of the legal profession are, so to speak, brought more closely into contact in inquiries touching the mind than in other medico-legal investigations, it is of the first importance that the two professions should make use of the same or similar terms, or, at least, that each should understand the terms used by the other. If either profession is bound to prefer the expressions of the other to its own, it is the medical profession, whose duties spring out of the requirements of the law. Wherever, then, the law defines with preci-

sion the meaning of the terms it uses, those terms will be preferred, and where no fitting word has been provided characteristic of a given state of the unsound mind, that will be employed which is in most common use by the best medical authorities.

In searching for a term proper to designate all departures from the more usual state of the mind, we necessarily encounter that of *Insanity*. This is the word with which the medical man is most familiar, and it is one in general use in society. It would be open to no objection if it could be used in its original signification, as the opposite of that state of mind which we call *sane*. But the term insanity, like many other words which we are in the constant habit of using, seems to have lost its original meaning, and to be now generally taken in too restricted a sense, implying those deviations from the natural and healthy condition of the mind which consist in excessive and disproportioned activity of all or of some only of its faculties, and being rarely if ever applied to those states of mind characterized by deficient energy of action, whether original or acquired. The term Insanity, therefore, does not include all possible deviations from the sound and healthy condition of the mind, and is therefore inapplicable to the present purpose. There are only two terms, indeed, which can be made to answer this purpose—the one is *unsoundness of mind*, applied to the condition of the *mind* itself; the other, *non compos mentis*, applied to the *person* whose mind is affected. But even these, though the best, are not free from objections.

Thus, the term *unsoundness of mind*, though perfectly simple and intelligible, has not been always, or even often, employed by legal authorities in a strict and limited sense. "For instance, it has been used to discriminate one form of itself, Idiocy, from another form of itself, Lunacy, and the reverse;" and Lord Eldon* has more lately defined it as being "some such state as was to be contradistinguished from idiocy, and as was to be contradistinguished from lunacy, and yet such as made one a proper object for a commission, in the nature of a commission to inquire of idiocy, or a commission to inquire of lunacy." "There is only one statute of importance, namely, that for the safe custody of insane persons charged with offences,† where *unsound* mind is used as a term comprehensive enough to include all persons styled *non compotes mentis*. Whereas, in very many statutes it is associated with the words Idiot and Lunatic, as if it were intended to denote something different from either."‡

The term *unsoundness of mind*, then, which seemed so simple and intelligible, is nevertheless open to serious objection; but as it is preferable to the term Insanity, or to any other in common use, it has been placed at the head of this chapter.

* In the Portsmouth Case.

† 39 and 40 G. iii. c. 94.

‡ A Practical Treatise on the Law of Non Compotes Mentis, or Persons of Unsound Mind. By John Shapland Stock.

The other term, *non compos mentis*, applied to persons who are of unsound mind, or *memory*, as the old statutes have it, is far less objectionable, for it "has not been so irregularly used, but has generally been allowed to retain its natural signification, or at least has not plainly and materially departed from it."* Where then it is possible to make use of the term *non compos mentis*, it should be employed in preference to all others; but when we are obliged to speak of the condition of the mind, and not of the person affected, *unsoundness of mind* should be used as the least objectionable in a legal sense, and most free from ambiguity. As it will not be possible to avoid the use of the terms *madness* and *insanity*, it may be well to state that they are employed to designate mental unsoundness arising from unusual excitement or activity of the faculties.

Having thus made choice of a term comprehensive enough to include all deviations from the more usual and sound condition of the mind, we have next to inquire what the law includes under this term—*non compos mentis*—what forms of unsoundness it recognizes, and how far it may be consistent with our knowledge as medical men to adopt a sub-division in accordance with the legal terms in most common use.

The common law of England originally included under this term only two forms of unsoundness, viz., Idiocy and Lunacy, but the highest legal authorities of more modern times have busied themselves in forming more minute sub-divisions. Lord Coke says,

"*Non compos mentis* is of four sorts. 1. *Idiota*, which from his nativity by a perpetual infirmity is *non compos mentis*. 2. He that by sickness, grief, or other accident wholly loseth his memory and understanding. 3. A lunatic that hath sometime his understanding, and sometime not, *aliquando gaudet lucidis intervallis*, and therefore he is called *non compos mentis*, so long as he hath not understanding. Lastly, he that by his own vitious act for a time depriveth himself of his memory and understanding, as he that is drunken."

We have here distinctly recognized only three forms of unsoundness of mind, *Idiocy*, *Dementia*, and *Lunacy*, of which the first two alone are sufficiently well defined and understood to admit of being employed both by lawyers and physicians as part of a classification of the forms of mental unsoundness. The term lunacy is objectionable, inasmuch as it directs attention only to one feature of certain forms of unsound mind,—the occasional enjoyment of lucid intervals. Since Lord Coke's time, little has been done towards a classification of the several varieties of unsound mind, though Lord Hale has plainly recognized the distinction between general or total, and partial, unsoundness. A late legal writer, already quoted, suggests a natural and obvious division. Adopting the general term *non compos mentis* as including all forms of mental unsoundness, he establishes at once a broad distinction "between those persons in whom the malady is the result of an improper inertness of the intellectual powers, whereby the

* Stock, op. cit. p. 2.

mind fails to receive impressions; and those in whom it is the result of an improper activity, whereby the mind receives false impressions; a distinction between those in whom some most important mental functions, as perception and memory, are to a great extent or wholly wanting, and those in whom others equally remarkable, as the imagination and the feelings, are under excessive or misdirected excitement; a distinction in other words between that state which is well enough described by the term Fatuity, and that which is less accurately designated by the names of Madness, Delirium, Insanity, Mania, Lunacy, and many other words of very unsettled meaning." *

This distinction between unsoundness arising from defective development or activity of the faculties, on the one hand, and unsoundness from undue excitement on the other, is so in accordance with observation, and so convenient, that it may be fairly adopted as the basis of our classification.

The subdivisions of these principal classes are presented in the following table, which has been constructed after a careful comparison of the classifications adopted by different authorities, and with the assistance afforded by the prize thesis of Dr. Johnson recently published.† It bears the nearest resemblance to the arrangement adopted by Dr. Ray.‡

UNSOUNDNESS OF MIND.	FROM DEFECTIVE DEVELOPMENT, OR, DIMINISHED ACTIVITY OF THE FACULTIES.	Congenital, or occurring in childhood . . .	Amentia . .	1. Idiocy (including Cretenism). 2. Imbecility.
		Occurring subsequent to the development of the faculties . .	Dementia . .	1. Consequent on Mania, mental shocks, or injuries of the brain. 2. Senile.
	FROM UNDUE EXCITEMENT.		Mania . . .	1. General. 2. Intellectual { *a.* General. *b.* Partial. 3. Moral . { *a.* General. *b.* Partial.

* Stock, op. cit. p. 3. † On the Arrangement and Nomenclature of Mental Disorders. By Henry Johnson, M.D. Edin.
‡ A Treatise on the Medical Jurisprudence of Insanity, by J. Ray, M.D. p. 48.

This scheme corresponds closely with the actual state of our knowledge, and has the advantage of following as nearly as possible the order of nature. It has been preferred to any division founded on the assumption, that unsoundness of mind is always dependent upon inflammation or organic disease of the brain. Such an arrangement, though useful for medical purposes, is altogether inapplicable to questions of a medico-legal nature, which have little to do with pathology, but regard the mind in its outward manifestations, and not in the morbid changes which its organ may be presumed to undergo.

As the subject of unsoundness of mind is one of vast extent, and embraces a great amount of details, a methodical arrangement of it is absolutely requisite. It is proposed to treat it under the following heads:—1st. Of certain unusual conditions of the mind not included under the general term mental unsoundness, and of the phenomena of dreaming. 2. Of certain conditions of the mind allied to mental unsoundness, but produced by temporary causes, viz. delirium, delirium tremens, and drunkenness. 3. Of the several forms of unsound mind, treated in the order in which they stand in the foregoing table. 4. Of some of the more important characters of the unsound mind, and of the medical and legal tests of that unsoundness. 5. Of feigned unsoundness of mind. And, lastly, Rules for the examination of persons supposed to be of unsound mind.

1. OF CERTAIN UNUSUAL CONDITIONS OF THE MIND NOT INCLUDED UNDER THE GENERAL TERM MENTAL UNSOUNDNESS, AND OF THE PHENOMENA OF DREAMING.

There is more than one reason why the subjects included under this head should form a part of a treatise on unsoundness of mind. Spectral illusions, dreaming, and somnambulism, have a close analogy to mental unsoundness; dreaming nearly resembles one of its forms; spectral illusions exist in a great proportion of those cases in which there is undue activity of the faculties; and somnambulism deserves notice, inasmuch as the acts of the somnambulist are such as to originate questions of a medico-legal nature. These subjects will be treated as briefly as possible.

Spectral illusions.—Some individuals have possessed the power of recalling at will impressions made on the senses, so as to place the objects before them afresh; others have enjoyed a still more enviable power of converting thoughts into sensations, if such an expression may be allowed; and others again, in moments of intense excitement, or under the influence of slight derangements of their health, have seemed to see or hear things which had no existence but in their own imaginations. A singular example of this visual deception is related by Sir David Brewster.* It occurred in the case of Mrs. A. a delicate valetudinarian. The sense of hearing was first affected, her

* Letters on Natural Magic.

husband seeming to speak to her though he was not near her, and this occurred several times in the course of her malady. The sense of sight next became the subject of deception. At one time she saw the spectre of her husband, at another that of a near relation, enveloped in grave-clothes, at a third, that of a deceased friend. A spectral cat sometimes introduced a little variety into her visions. But in all these cases, whether the ear or the eye was the subject of the illusion, the mind was fully aware of the real seat of the deception. The same consciousness of the unreality of the impressions on the senses occurred in the case of Nicolai, the bookseller of Berlin, and in some cases related by Sir Walter Scott.*

Spectral illusions, as has been stated, are of common occurrence in some forms of mental unsoundness. It is important to bear this fact in mind as it serves to explain the obstinate belief by which the mind, in such cases, is possessed. Thus the author of a curious and interesting autobiography, of which I propose to make frequent use, partly on account of the internal evidence of truth which it bears, and partly from the strong confirmation given to all its statements by one who had been similarly afflicted, after alluding to one of his many spectral illusions, says, "I imagined I was really present to *them*; and that my not acknowledging it was a delusion, an obstinate resistance of the divine will on my part. That of the two, the appearance of the bed, walls, and furniture, was false, *not* my preternatural impressions."†

Spectral illusions then are common to men of sound and of unsound mind, the difference being, that the former do not believe in their reality, the latter do. The sane man corrects these false impressions by the use of the other senses, or by some effort of comparison, while the man of unsound mind neglects these simple means of undeceiving himself, or cannot use them; or if he is led to entertain any doubt, he dispels it by the help of his delusion. Thus, the author of the auto-biography, whose unsoundness of mind took a strong religious turn, thought it *impious* to doubt.

Dreaming.—The phenomena of dreaming have so striking an analogy to those of some forms of unsound mind, that a brief allusion to them may be useful in this place.

In dreams, objects of sense have all the vivid impress of reality, and the thoughts which pass through the mind produce the same impression, as in our waking state; the belief in their reality not being corrected by a comparison with the things of the external world. The images or ideas which arise in the mind, also follow each other according to associations over which we have no controul. We cannot, as in the waking state, vary the series, or stop it at our will.

* Demonology and Witchcraft.

† A Narrative of the treatment experienced by a Gentleman, during a state of Mental Derangement; designed to explain the Causes and the Nature of Insanity, p. 63.

Dr. Abercrombie has classified the phenomena of dreaming as follows:—"1. Recent events, and recent mental emotions, mingled up into one continuous series, with each other, or with old events,—by means of some feeling which had been in a greater or less degree allied to each of them, though, in other respects, they were entirely unconnected. We hear, perhaps, of a distressing accident; we have received some unpleasant news of an absent friend; and we have been concerned in some business which gave rise to anxiety: a dream takes place in which all these are combined together; we are ourselves connected with the accident; the absent friend is in our company; and the person with whom the business is transacted also appears on the scene. The only bond of union among these occurrences was, that each of them gave rise to a similar kind of emotion; and the train was probably excited by some bodily feeling of uneasiness,—perhaps an oppression at the stomach—at the time when the dream occurred.

"2. Trains of images brought up by associations with bodily sensations." Examples of this kind are of frequent occurrence. Thus, "Dr. Reid relates of himself, that the dressing applied after a blister on his head, having become ruffled so as to produce considerable uneasiness, he dreamt of falling into the hands of savages, and being scalped by them." Another curious fact has been observed with regard to dreams excited by bodily sensations, and especially by loud noises, "viz. that the same sound awakes the person, and produces a dream which appears to him to occupy a considerable time." Thus, "a gentleman dreamed that he had enlisted as a soldier, joined his regiment, deserted, was apprehended, carried back, tried, condemned to be shot, and at last led out for execution. After all the usual preparations, a gun was fired; he awoke with the report, and found that a noise in an adjoining room had both produced the dream and awakened him."

"3. Dreams consisting of the revival of old associations respecting things which had entirely passed out of the mind, and which seemed to have been forgotten." It is this revival of old associations which has led to the belief that dreams have providentially pointed out some important fact, which had been forgotten in the waking state.

"4. The fourth class of dreams consists of an embodyment of some strong propensity of character, or some strong mental emotion, and in this case, the dream has been more than once, by some extraordinary coincidence, fulfilled."*

The strong analogy existing between the phenomena of dreaming, and those of certain forms of unsound mind, is shown in almost every page of the autobiography already quoted. Thus the cold air blowing upon him, as he is attempting to suffocate himself, in obedience to the spirits which speak within him, becomes the breath of the spirits of his sisters

* Inquiries concerning the Intellectual Powers, and the Investigation of Truth. By John Abercrombie, M.D., 9th edit., p. 260, et seq. The reader is referred to this work for many instructive anecdotes referring to this subject.

breathing on him to cool him, and encouraging him to go through with his task. The familiar sensation of water trickling down the back is at once converted into the crystal tears of his father, whose venerable countenance he sees bending over him. At the commencement of his illness his head was shaved, and he says, "My chief grief at that time was, that I had received the tonsure of the Roman Catholic priesthood, a mark of the beast." The jets of gas from the fireplace became the utterance of his father's spirit, which was continually within him, attempting to save him, and continually obliged to return to be purified in hell-fire, in consequence of the contamination it received from his foul thoughts. The lowing of the cattle conveyed to him articulate sounds and sentences, and the grating of the chair against the wall spoke to him in his father's voice.* It is impossible not to recognize the marked analogy between this form of unsoundness and that of dreams belonging to the second class. It would not be difficult to adduce examples of the other subdivisions from many parts of this curious autobiography.†

The remarkable analogy between dreaming and insanity is well illustrated by the case of a maniac, mentioned by Dr. Gregory. He had been for some time under his care, and entirely recovered. For a week after his recovery, he was harassed during his dreams, by the same rapid and tumultuous thoughts ; and the same violent passions, by which he had been agitated during his insanity.‡

The difference between dreaming and insanity is, that in the one, the senses are closed to outward objects; in the other, the evidence of sense is disregarded, or the senses merely serve to suggest trains of wild and fanciful association. In dreaming, as soon as the person is roused from sleep, and the external world is again brought before him, all his delusions vanish. But the madman is in a waking dream, from which he is not to be roused, and the external world is to him as if it existed not; or, if it mix itself up with his morbid fancies, it is to become strangely perverted and misinterpreted by the help of his prevailing delusion.

The dreams of the madman take their shape from his delusion, and he believes his dreams as he believes the delusion by which they are both produced and interpreted. If a sane man were to dream the same dreams night after night, it is not improbable, as is observed by Paschal, that he would believe them as firmly as the madman does his waking dreams.

* Op. cit., p. 60, et seq.

† Abercrombie on the Intellectual Powers, p. 294.

‡ The case of M'Naughton may perhaps be cited as bearing a close resemblance to the first class of dreams. The refusal of his father to take him into partnership originated in his mind a sense of hardship and injury; the Roman Catholics, the Police, and the Tories, being successively the theme of newspaper abuse, and being also represented as guilty of acts of injustice, impressed his mind with the same feeling. Hence the long dream of years, in which the sense of public injury was transferred to himself, till he became the fancied object of political persecution.

A question of criminal responsibility arises in those rare cases in which a man suddenly aroused from sleep has killed another. A case is given on the authority of Dr. Pagan, of one Bernard Schedmaizig, who suddenly awaking at midnight thought he saw a frightful phantom. He twice called out "Who is that?" but receiving no answer, and imagining that the phantom was advancing upon him, and having altogether lost his self-possession, he raised a hatchet which was beside him and attacked the spectre. It was found that he had murdered his wife.* A case is also related of two individuals, who finding themselves out over night in a place infested with robbers, engaged that one should watch while the other slept; but the former falling asleep, and dreaming of being pursued, shot his friend through the heart.† A pedlar, who was rudely aroused from sleep by a passer-by, ran him through the body with the sword of a sword stick. He was found guilty.‡ In all such cases the confused state of the mind on being suddenly aroused from sleep ought certainly to be considered as a mitigating circumstance.

Somnambulism.—This is a form of dreaming in which the senses and voluntary muscles participate; the one exercised with extraordinary acuteness on the subject matter of the dream, the other obeying the mandates of the sleeper's will with unwonted precision. The somnambulist's mind during the dream is concentrated upon one object: hence his reason or fancy will accomplish that to which it was unequal during his waking hours. It is this complete attention to one object, too, which probably accounts for that extraordinary acuteness of the senses, and precision of movement just mentioned. Sometimes the sleep-walker goes, with all the precision of his waking hours, through some routine duty; at others, he does that to which he is quite unaccustomed, and accomplishes that which awake he would not dare to undertake. Thus, he will walk on the edge of a precipice, swim a rapid stream, or ride at full gallop, in safety, because fear, being asleep, does not check or paralyze those faculties of the mind which are awake.

Objects of sense presented to the sleep-walker, either produce no effect, or they are mixed up indistinctly with the dream which he is acting. In some cases, so complete is the mind's abstraction, that the loudest noises are unheeded; in others, those things only are attended to which harmonize with the existing train of thought. The somnambulist is either unconscious of what has occurred, or he remembers it as a dream. In some cases, that which has transpired in one fit of sleep-walking is distinctly remembered in subsequent ones, but quite forgotten in the intervals.

As there is a strong analogy between dreaming and insanity, so is

* This case is quoted by Mr. Forbes Winslow in his "Plea of Insanity in Criminal Cases," p. 72.

† Ray, op. cit. p. 268.

‡ This case is also quoted by Mr. Winslow, from the British and Foreign Medical Review.

there a still more close correspondence between the phenomena of somnambulism and insanity. The chief difference between them is, that the former occurs only during sleep, and ceases as soon as the patient is roused from it,—the latter is permanent, but both, when remembered, appear as confused dreams. The analogy, indeed, may be carried much further; for in certain forms of both these affections there is a remarkable increase of talent; in both there may be a complete change of character; and it would not be incorrect to state, that there is an intellectual and moral somnambulism, as there is an intellectual and moral insanity.

The following cases are both interesting and instructive:—A Carthusian monk who, while awake, was remarkable for his simplicity, candour, and probity, walked almost every night in his sleep, and was a thief, a robber, and a plunderer of the dead. A pious clergyman, in his fits of somnambulism, would steal and secrete whatever he could lay his hands upon, and on one occasion he even plundered his own church. Ray, in addition to the foregoing cases, quotes one which occurred a few years since in the state of Maine in America, in which there was a strong disposition to commit suicide. "The paroxysms appeared every night, and watchers were required, as if the somnambulist had been labouring under an acute disease. He always attempted to escape from his keepers; and having succeeded one night, an outcry was heard from a neighbouring pasture, and he was found suspended by a rope from the limb of a high tree. Fortunately, he had attached the rope to his feet instead of his neck, and consequently was but little injured."* The following curious case is quoted by Georget from an anonymous work. It occurred in the person of a monk, who late one evening entered the room of the prior of the convent, his eyes open, but fixed, his features contracted into a frown, and with a knife in his hand. He walked straight up to the bed, as if to ascertain if the prior were there, and then gave three stabs, which penetrated the bed-clothes and a mat, which served the purpose of a mattress. He then returned, his features relaxed, and an air of satisfaction on his countenance. The next day, the prior asked him what he had dreamed about the preceding night. The monk confessed, that having dreamed that his mother had been murdered by the prior, and that her spirit had appeared to him and cried for vengeance, he was transported with fury at the sight, and ran directly to stab her assassin. Shortly after he awoke, covered with perspiration, and rejoiced to find that it was only a dream."†

Legal Relations of Somnambulism.—An unnecessary question has been raised as to the responsibility of the somnambulist for acts committed during the paroxysm, and it has been attempted to be shown that, as that which is done during the fit is often only the accomplish-

* A Treatise on the Medical Jurisprudence of Insanity. By J. Ray, M D.
† Georget, des Maladies Mentales, p. 127.

ment of a project formed whilst the party was awake, he ought to be held responsible. If this assumption were true, it would scarcely make the man responsible, unless it could be shown, that, as a somnambulist, he was voluntarily accomplishing that which he had previously thought about. That he might do so, he must be able to become a sleep-walker at will, which is an absurd supposition. If the question of responsibility should arise, it would be necessary to ascertain that the sleep-walking was real and not feigned, and it ought to be shown that, at some previous time, the person in question had been a somnambulist.

Ecstasis, or cataleptic somnambulism, which is nearly allied to hysteria, and almost invariably occurs in females, may be noticed in this place. For some interesting cases of it, the reader is referred to Dr. Abercrombie's work.*

2. OF CERTAIN CONDITIONS OF THE MIND, ALLIED TO MENTAL UNSOUNDNESS, BUT PRODUCED BY TEMPORARY CAUSES, VIZ. DELIRIUM, DELIRIUM TREMENS, AND DRUNKENNESS.

Delirium.—This state of mind is present in almost all diseases which have attained a certain degree of severity, especially in febrile affections, and those accompanied by high febrile action. Thus, it is a common consequence of severe accidents, of surgical operations, and of inflammatory affections of the internal viscera. More rarely it accompanies the last stage of chronic diseases, and ushers in the fatal termination. Sometimes it occurs suddenly, but more frequently it comes on by degrees, being preceded by pain and throbbing in the head, heat of the scalp, and flushing of the cheeks. It first shows itself by a propensity to talk during sleep, and, on awaking, the patient evinces a momentary forgetfulness of his situation and of things about him. When fully aroused, however, he is collected, and the mind remains comparatively clear and tranquil, till the next slumber. By degrees the disorder of the mind increases, the intervals of tranquillity become of shorter duration, till at length the delirium becomes constant. The patient lies on his back, dull and listless, his eyes half open, muttering to himself, unconscious of persons or things around him, and when aroused scarcely recognising them. The scenes and events of the past seem to pass before his mind in wild and disorderly array, and form the subject of his incoherent discourse. As the disorder increases and the strength fails, the voice becomes more indistinct, the fingers are constantly picking at the bed-clothes, the evacuations are passed insensibly, and the patient can no longer be aroused to any effort of attention.

If delirium occurs in an earlier stage of the disease, or when the patient is stronger, these symptoms are somewhat modified. The eyes are bloodshot, intently fixed, as if on some object really present, the skin hot and dry. The patient talks loudly, breaks out into cries

* On the Intellectual Powers, pp. 298—312.

and vociferations, tosses restlessly about in bed, and makes repeated attempts to get up. Sometimes, under the influence of the delirium, the memory of things long past becomes wonderfully active, and languages which were quite forgotten are recollected and spoken with perfect fluency. Many cases of this kind are on record. Dr. Rush, among many other similar instances, states, that the old Swedes of Philadelphia, when on their death-beds, would always pray in their native tongue, though they had not spoken it for fifty or sixty years, and had probably forgotten it before they were sick.*

In fatal cases, delirium usually passes into coma, but occasionally it disappears some hours or days before death, and leaves the patient in full possession of his faculties.

Delirium bears a close resemblance to certain forms of unsound mind, especially to that which goes by the name of incoherence. The distinction between the two is not always easily made, without some inquiry into the history of the case. Delirium is a symptom of some bodily disease, manifesting itself by well marked characters, while the various forms of unsound mind are rarely accompanied by such a degree of bodily disorder as would seriously affect the mind. There can be no difficulty then in distinguishing *febrile* delirium from that unsoundness of mind which is an original disorder, as the very aspect of the patient, the very first glance at the countenance, would at once reveal the real state of the case.

Legal Relations of Delirium.—Questions frequently arise in courts of law as to the validity of wills made by patients labouring under diseases attended with delirium. In such cases the law has regard more to the nature of the act, than to the proved existence of a lucid interval. "If the testamentary act be agreeable to instructions or declarations previously expressed, when unquestionably sound in mind; if it be consonant to the general tenor of his affections; if it be consistent and coherent, one part with another; and if it have been obtained by the exercise of no improper influence; it will be established, even though the medical evidence may throw strong doubts on the capacity of the testator. On the contrary, when these conditions are absent, or are replaced by others of an opposite description, it will as generally be annulled, however plain and positive may be the evidence in favour of the testator's capacity."† A less stringent proof of a lucid interval is required in these cases than in cases of insanity with lucid intervals, on the principle that "the *apparently* rational intervals of persons merely delirious," in contradistinction to the apparently lucid intervals of the insane, "are *really* such."‡ Civil acts, committed during an access of delirium, would be necessarily void, and criminal acts would entail no responsibility.

* On Diseases of the Mind, p. 282.

† Ray's Medical Jurisprudence of Insanity, p. 207.

‡ Sir John Nicholl's Judgment in Brogden *v.* Brown. 2. Addam's Reports, 441.

Delirium Tremens.—The delirium of drunkards is distinguished from febrile delirium on the one hand, and from mania on the other—from febrile delirium by the absence of fever, or at least of such a degree of febrile action as would account for the presence of delirium, and from mania, by the previous history, as well as by the peculiar symptoms accompanying the mental disorder. The tremor, from which this form of delirium is named, is rarely altogether absent, and where present is extremely characteristic. The patient is restless, anxious, sleepless, suspicious, timid, and cunning. He thinks that he is in a strange place, and under a controul from which he is constantly endeavouring to escape. He sees himself surrounded by hideous and loathsome objects,—toads, serpents, and scorpions,—and he hears strange sounds and threatening voices. His countenance is expressive of extreme anxiety, fear, and suspicion; he endeavours to escape from his imaginary tormentors, and if not properly watched is apt to commit suicide, or to destroy those who are about him, whom he mistakes for his enemies. The countenance, in the midst of all this excitement, is generally pale, except in those cases where the disease follows, as it sometimes does, a single debauch, instead of being the consequence, as it commonly is, of a short suspension of habits of intoxication.

The analogy which delirium tremens bears to dreaming has often been pointed out. In the milder forms of the affection, the patient goes about as usual, answers questions collectedly, and converses rationally; but when left to himself, he is as one in a walking dream, speaking of things calculated strongly to excite the feelings and passions with a manner perfectly free from excitement.* This form of delirium tremens differs from somnambulism, inasmuch as the latter is an actual dream, the former a dreamy state in one awake.

In cases of delirium tremens accompanied by strong excitement, there is sometimes the closest resemblance to moral insanity, the patient being impelled to acts of violence against himself and others by the most unfounded delusions.

Legal Relations of Delirium Tremens.—As delirium tremens is a form of temporary insanity produced by a peculiar exciting cause, its legal relations must be those of insanity, unless the nature of the exciting cause constitutes it an exception to the general rule. This it does not appear to do; for, though drunkenness has little effect on civil or criminal acts, delirium tremens is allowed to have the same effect as insanity itself. Thus, in the American cases of Alexander Drew and Theodore Wilson, tried for murder, an acquittal took place on the ground of insanity, and in that of John Birdsell, tried for the same crime, the punishment of death was, on the ground of insanity, commuted for that of imprisonment.†

* In the King's College Hospital Report for 1842, published in the Medical Gazette, March 10, 1843, a curious instance of this kind is related.

† See the cases at length in Ray's Medical Jurisprudence of Insanity, p. 292, and seq.

Drunkenness—It is unnecessary to describe the effects produced by intoxicating liquors. We are all familiar with drunkenness as it walks the streets—the boisterous mirth and noisy violence of its first stage, the beastly forgetfulness of its last. The hold which intemperance takes upon the mind, and the tyranny of the habit, once completely formed, is known in its full extent only by those who have had personal experience of it. An insatiable craving after ardent spirits also forms in some cases a marked feature of insanity, and in persons otherwise sane it has been often known to assume an intermittent character.

Legal Relations of Drunkenness.—Drunkenness alone is not sufficient to invalidate a deed or agreement, except when carried to such an excess as to deprive the party of all consciousness of what he is doing. The acts of the drunkard are also held to be valid, unless it can be shown that the drunkenness was procured by another with a view of obtaining some unfair advantage. The law, with regard to crimes committed under the influence of intoxicating liquors, is thus laid down by Coke upon Littleton :—"A drunkard, who is *voluntarius demon*, hath no privilege thereby; whatever ill or hurt he doeth, his drunkenness doth aggravate it." It is more correct to state that drunkenness has no legal effect whatever, on any offence to which it leads. It neither increases nor mitigates the penalties which attach to it.* This observation applies only to drunkenness in its usual acceptation, and not to delirium tremens.

3. OF THE SEVERAL FORMS OF UNSOUND MIND.

On referring to the table (p. 210), it will be seen that the several forms of unsound mind resolve themselves into three principal ones: Amentia, Dementia, and Mania.

AMENTIA.

Idiocy.—In this, as in other forms of unsound mind, the law has not been wanting in definitions. An idiot is defined as "of non-sane memory, à nativitate," as one "who from his nativity, by a perpetual infirmity, is non compos mentis," as "one that has no understanding from his nativity," or more loosely, and most incorrectly, thus: "He that shall be said to be a sot and idiot from his birth is such a person who cannot count or number twenty, and tell who was his father or mother, nor how old he is, so that it may appear that he hath no understanding of reason what shall be for his profit or what for his loss." Again, "if he be able to beget either son or daughter, he is no fool natural."† In the old writs the term is employed in a much more extended sense, for they constantly direct an inquiry "*num idiota a nativitate aut a quo tempore*," and one of them sanctions

* Ray, Medical Jurisprudence of Insanity, p. 292.
† Stock, op. cit. p. 4.

a still looser acceptation of the term, for it inquires whether the party be an idiot, and if so, whether from birth or from some other time, and if from some other time, from what time, and in what way, and from what cause, and whether he had lucid intervals. More recently, however, the meaning attached to the term by Lord Coke has been recognised by high legal authority, and may be fairly taken as the modern sense. There can be no objection on the part of the medical man to the use of the word idiot in the sense which the law attaches to it, provided it be understood that idiocy admits of degrees, and like other forms of unsound mind does not allow of strict definition.

The term *idiot* then, will be used in this work in the sense of one unsound from birth, the term *imbecility* being used to designate mental unsoundness, consisting also in defective development, but that defect originating after birth ; and, on that very account, being in most cases less complete.

Idiots are deformed in body as well as unsound in mind. Their heads are generally very small, but occasionally above the average size, depressed in the forehead, flattened at the sides, and grotesquely shaped ; the eyes are small and deeply set and often squint ; the mouth large and gaping, the lips thick, and the other features imperfect ; the complexion pale and unhealthy, the chest narrow and contracted, the limbs ill-formed, the gait awkward and unsteady. The senses are dull, or altogether wanting. Their sight is imperfect ; they are deaf or hard of hearing : dumb, and expressing their wants only by inarticulate sounds ; the senses of smell and taste being without power of discrimination, they have no choice of food. Sensation is not followed by perception ; their attention cannot be roused, and they are, therefore, incapable of instruction ; they show scarcely a trace of memory, judgment, or imagination, and have even less instinct than the brutes. Were it not for the constant care of parents or friends they must perish.

The following case will form a good illustration of complete idiocy : "In 1812 we had at the Salpêtrière, a female idiot who was found lying by the side of the body of her mother, who appeared to have been dead three days. This idiot, who was sent to the hospital by order of the police, was twenty-seven years of age, very thin, pale, rickety, blind, deaf, and dumb, and uttered from time to time a shrill, inarticulate, stifled cry. Her limbs were atrophied, and the legs were bent under the thighs, so that she could not walk. It was necessary to introduce liquid aliments into the mouth even down to the œsophagus ; she could neither masticate nor swallow. She was nourished with soup and wine, and died at the end of a few days."*

Some idiots display slight glimpses of intelligence. Their attention can be roused by strong impressions on the senses. They

* Esquirol des Maladies Mentales—de l'Idiotie, vol. ii. p. 96.

look at certain objects, go for their food and take it, recognise those who take care of them, indicate the objects of their desires by cries and gestures, manifest pleasure and pain, but are helpless, require to be dressed and undressed, put to bed, and placed where they are to remain. Others can move from place to place, go through a routine of movements, laugh mechanically, utter inarticulate sounds, as if for amusement, hum some simple airs, become attached to particular places and persons. They are, however, deficient in powers of thought and attention, and when left to themselves, are careless, slothful, filthy, lazy, and timid. At the period of puberty, they display the sexual passion by offensive gestures and habits, are subject to attacks of nymphomania or satyriasis, and to fits of violence; or they grow dejected, and sink under a gradual decay of health.*

There is a remarkable form of idiocy called Cretinism, endemic in the Vallais, among the Alps, and in some other mountainous countries. The victims of this singular affection are usually divided into three classes,—cretins, semi-cretins, and cretins of the third degree. The first of these classes, the cretins, answer in every point to the description of complete idiocy just given, with the addition of the peculiar deformity of the throat, to which they are subject. Life, with them, is altogether automatic; they are unable to speak, their senses are dull, if not altogether wanting, and nothing but the most urgent calls of nature rouses their attention. Their time is spent in basking in the sun, or sitting by the fire, without any trace of intelligence. The next class, or semi-cretins, show a higher degree of intelligence. They may be taught to read as parrots can, without understanding the meaning of what they read; they have no idea of numbers; they note what passes around them, and make use of language to express their wants. They remember common events, understand what is said to them, speak intelligibly on common subjects, and can be taught to repeat prayers, though without attaching any definite meaning to the words they use. The cretins of the third degree show glimpses of a higher nature, are capable of attaining a certain degree of proficiency in mechanical employments, in drawing, painting, mechanical contrivances, and music. Their knowledge, however, is merely the effect of imitation and habit. It is said that none of them can be taught arithmetic, and there is no doubt that it is a very rare acquirement. They are said to be acutely alive to their own interest, extremely litigious, unable to manage themselves or their affairs, but obstinate and unwilling to be advised.†

In the semi-cretins and cretins of the third degree, the mental deficiency is not always congenital, but supervenes in early childhood. If removed from the place of their birth and placed under judicious superintendance early in life, they are capable of considerable improve-

* See Pritchard on the "Different Forms of Insanity, in relation to Jurisprudence," pp. 208, 209.

† Abercrombie on the Intellectual Powers, p. 352.

ment, both of mind and body, and may be made useful members of society. Persons belonging to these two classes are not properly included under the head of idiots, but must be classed with imbeciles.

The Legal Relations of Idiocy, in the restricted sense here assigned to the term, are very obvious. The persons now described labour under complete civil disability, and are irresponsible.

Imbecility. This term is here used to designate unsoundness of mind occurring in early childhood, as contradistinguished from that which is congenital. This distinction, though not practically important, is useful, inasmuch as it is in accordance with the legal definition of idiocy already laid down; and it has the advantage of separating the idiot who has no use of speech, in consequence of his faculties at birth having been so defective as to prevent him from being taught even to this limited extent, from others who, having been endowed from birth with some degree of intellect, have evinced it by acquiring the use of speech. This distinction has the additional advantage of having been adopted by a distinguished writer on Mental Unsoundness, M. Georget, according to whom, the imbecile are persons who have some use, however limited, of speech, and who therewith display some indications of mind, of intellectual faculties, and of feelings or affections. Another advantage arising from the distinction here insisted on is, that it tends to simplify the subject of unsoundness from defective development of the faculties; for the idiot in this limited sense has obviously no capacity of action, no legal ability, and no responsibility for crime, so that it is with regard to the imbecile alone that medico-legal questions can arise.

Imbecility is defined by Dr. Ray as "an abnormal deficiency either in those faculties that acquaint us with the qualities and ordinary relations of things, or in those which furnish us with the moral motives that regulate our relations and conduct towards our fellow-men; and frequently attended with excessive activity of the animal propensities."* Imbeciles are capable of being educated, of forming and expressing a few simple ideas, of retaining to a certain extent that which they learn, of making some progress in reading, writing, arithmetic, music, and the mechanical arts, and even of attaining a certain degree of proficiency in some one branch of knowledge. But they cannot attain that degree of knowledge or practical skill which is common among people of their own rank and opportunities. Hence it happens that their education is neglected, and that they are employed in the coarsest and rudest labours. In moral and intellectual character they differ as widely as men of sound mind. Some are fickle and changeable, others persevering in the pursuit of some favourite object; while the attention of the one class cannot be arrested for a moment, that of the other can scarcely be diverted from the subject of their thoughts. Some engage in business, and can manage themselves and property,

* Ray's Treatise on the Medical Jurisprudence of Insanity.

though obliged to resort to others for advice and assistance; they can give rational answers to questions relating to their ordinary pursuits, but are incapable of argument or sustained conversation. They are thoughtless, improvident, timid, and wayward; incapable of strong attachment, and labour under a constant uneasiness and restlessness of disposition. Sometimes they are physically as well as intellectually and morally imperfect, with a tendency, though in a less degree, to the malformation and diseases of the idiot.

The following observations of Georget will serve to complete this description: "In hospitals for the insane there is always a certain number of imbeciles, who do the coarser work of the house, or serve as domestics and assistants to the regular officers. They become sufficiently intelligent at last to perform their duties well, to sweep the courts, carry burdens, move machines, execute simple commissions, know the use of money, and procure various enjoyments. But they have no idea, or a very imperfect one, of society, laws, morality, courts and trials; and though they may have the idea of property, they have no conception of the consequences of theft. They may have been taught to refrain from injuring others, but they are ignorant of what would be done to them if guilty of incendiarism or murder. Indeed, it is well known how common theft is among imbeciles and idiots, and for a very obvious reason. Some of them have no conception of property, nor of the distinction of *meum* and *tuum;* their conduct is actuated solely by the fear of punishment, when capable of experiencing this sentiment, and by their own desires. Others have some notions of property, but neither a sense of morality, nor a fear of punishment furnishes motives sufficiently powerful to prevent them from stealing. The sentiment of cunning, too, may be very much developed, while the other faculties are more or less deficient. Among the lower orders of society are many imbeciles a little more intelligent than these, and not considered as utterly devoid of understanding, who, nevertheless, have but vague and imperfect notions of social duties and of justice. They engage in occupations that require no great extent of intellect, and even in the simplest of the mechanic arts. If they do not pass among their acquaintances for imbeciles, they are at least regarded as singular beings, with feeble understandings, and are teased and tormented in innumerable ways. Many of them, for want of some powerfully restraining motive, indulge in drinking, and become lazy, drunken, and dissipated, and finally fall into the hands of justice in greater numbers than is generally suspected. They steal adroitly, and hence are considered as very intelligent; they recommence their offences the moment they are released from confinement, and thus are believed to be obstinately perverse; they are violent and passionate, and the slightest motive is sufficient to plunge them into deeds of incendiarism and murder. Those who have strong sexual propensities, soon become guilty of

outrages on female chastity."* The same author, elsewhere, observes, "these beings of limited capacity furnish to the courts of justice, to prisons and scaffolds, more subjects than it is generally supposed."

Such is a faithful description of imbecility, manifesting itself, as it usually does, jointly in the intellect, the feelings, and the propensities. But there is no doubt that imbecility is sometimes partial; that there is, in fact, an intellectual and a moral imbecility; —an inability to acquire and apply knowledge, occurring in persons who have a due sense of right, act with integrity, and perform every social duty, on the one hand; and, on the other hand, an unusual power of acquiring knowledge, with judgment, fancy, and refined taste, but combined with a feebleness of purpose, an inaptitude for business, a disregard of duty, a want of honesty, and oftentimes a strength of passion, which, were it not for the intellect they display, would class them at once with the imbecile. They are known in society as weak, soft, easy, good-natured, well-meaning, good sort of people, and if possessed of brilliant talents, as having every sense but common sense. They meet with much sympathy, and sometimes, perhaps, with more blame than they deserve. These are those who know not how to say *no* either to themselves or others; who are too easy to be just, too thoughtless to be honest. They have an instinctive horror of business, an aversion to their regular occupations, and a distaste for everything that wears the shape of a duty. If their profession is law they will give all their time to divinity, if divinity to physic. They are utterly ignorant of the value of money, and the last use they make of it is to pay their debts. Each man among them has his own favourite form of extravagance, and his own peculiar mode of ruining himself. One calls an architect to his assistance; another an upholsterer; a third collects useful things which he never uses, or displays a curious taste in worthless trifles. They are always forming acquaintances with unworthy persons, for rogues find it worth their while to know and to flatter them. With all their easiness of disposition they have much warmth of temper, and strength of passion, but this is known only to those from whom it ought to be concealed. They are bad husbands, children, and fathers, because in these relations of life they have duties to perform. Throughout life they are weak, wavering, fickle, and self-willed, as children; the source of constant anxiety and misery to their families, the prey of designing knaves, the expected inmates of gaols, workhouses, and lunatic asylums.

The persons subject to this form of moral imbecility remain at large, because the intellect being unaffected, they have no striking delusions, and no one could undertake to say that they have not the power, if they would exercise the will, to make themselves, at any moment, useful members of society. As weakness of intellect

* Discussion Médico-Légale sur la Folie, p. 140. Ray, p. 59.

is a necessary part of the legal notion of imbecility, the attempt to prove such persons imbecile in a court of law would necessarily fail. An absence of moral feeling and corresponding want of self-controul is the essence of their mental malady.

The imbecile are sometimes as much under the dominion of some childish fancy as the maniac is of his delusion. A commission of lunacy was lately granted in the case of William Obius Tillard, a gentleman aged 20, who was the slave of a childish fancy for windmills, with an aversion equally strong to watermills. Having been placed under controul in a place where there were no windmills, he cut the calves of a child's legs through to the bone, and stated that he should have taken away its life, in order that he might be tried for his act, and removed from a place where there were no windmills. He had always been violent when thwarted in his fancy, had threatened his keeper and members of his family, and had more than once made preparations for committing murder.

Legal Relations of Imbecility.— In respect to this form of mental unsoundness, two distinct orders of questions may arise—questions of competency, and questions of responsibility.

The competency of imbeciles to form contracts, and the validity of them when formed, has, in more than one instance, engaged the attention of our courts of law. Persons of weak mind have been brought by improper influence to ally themselves in marriage, and the validity of such marriages has been disputed.

The case of Portsmouth *v.* Portsmouth is an example of this kind. It was a suit of nullity of marriage on the ground of the mental unsoundness of the husband, the earl of Portsmouth. From the evidence of numerous witnesses it appeared, that he possessed a capacity and understanding fully equal to the ordinary transactions of life; that when at school he had a good memory, and became a respectable proficient in arithmetic and the languages; and that after coming of age, he settled accounts with his agents, attended public meetings and committees, prosecuted an offender, and was examined as a witness, and that his friends had failed in making him the object of a commission of lunacy. In regard to these circumstances, the court, Sir John Nicholl, observed in substance, that the capacity for instruction and improvement is possessed even by the brute creation, and therefore did not of itself disprove the fact of imbecility; that when he appeared as a witness in a court of justice, it was only a simple fact he had to state, requiring little, if anything, more than memory, and that his cross-examination could require nothing more than the recollection of facts, not any considerable exercise of the understanding and of the reasoning powers; that his behaviour in company, and his few observations on the state of the weather, horses and farming, were not incompatible with great imbecility of mind, because under the restraint produced by formal company, and by the sense of being observed, the more prominent features of imbecility would be shaded, and the indi-

vidual might pass as possessing a considerable degree of understanding. On the contrary, it was satisfactorily proved, that he had always been treated by his family as one of feeble capacity, and by a family arrangement, he was married, when thirty-two years of age, to a lady of forty-seven, evidently for the purpose of saving him from improper connections, and obtaining for him suitable care and protection. It appeared that his servants were his play-fellows, and that he played all sorts of tricks with them; that he was fond of driving a team, and that his wife so far indulged him as to have a team of horses kept for amusement, as a toy and a plaything, with which he carted dung, timber, and hay; that he had a propensity for bell-ringing, was fond of slaughtering cattle, and indulged in wanton cruelty towards man and beast, never expressing regret, but merely observing, "serves him right," on his own acts of cruelty. It also appeared that a medical man was taken into the family to assist in superintending the earl, and that he obtained complete ascendancy over him, the mention of his name being sufficient to intimidate him and exact his obedience. This gentleman at last thought it prudent to deliver up his charge to the earl's trustees in London, one of whom, within one week after, married him to his own daughter. This marriage was declared by the court null and void.*

From this case it appears that, in our courts of law, proof of imbecility is not drawn from a few isolated facts, but from an investigation of the whole life character and conduct of the party.

Medical men are often examined on commissions of lunacy, as to the competency of imbeciles to manage themselves and their affairs. In such a case as that just quoted, it would not be easy to establish the incompetency of the party, and it appears that, on a former occasion, the friends had failed in their attempt to take out a commission; but in many, perhaps in the majority, of instances, there is but little difficulty. Thus, the author was recently summoned as witness in a case of imbecility traced to the long continuance and repeated occurrence of epileptic fits. The patient did not know how many pence there were in sixpence or a shilling, or how many shillings in a sovereign; could not perform the most ordinary operation of arithmetic, was ignorant of the date, the month, and the year; did not know the name of the reigning monarch; could not recognise persons whom he had seen and conversed with only four days previously. His attention was aroused with the utmost difficulty, and could not be fixed to any one subject. His look was vacant, his dress peculiar, his gait awkward, his motions grotesque, his speech slow and hesitating. He used the same words and expressions again and again, repeated imperfectly the tasks and prayers of his childhood, and imitated the contortions of persons, like himself, subject to fits. Such a case could present no difficulty either to the medical witness or to the jury.

* 1. Haggard, 359, and Ray, p. 65. See also the case of Miss Bagster, Ray, p. 61.

In rare instances men have been pronounced incapable of managing their affairs, on the ground not so much of general weakness of intellect, as of a defective knowledge of numbers and of the value of money. Two such cases are related by Dr. Abercrombie, in one of which the most prominent character was a "total inability to perform the most simple process of arithmetic," and in the other "a total want of the power of tracing relations both as to time and numbers." In the face of evidence showing that they had made much progress in their education, both were pronounced incapable of managing their affairs.

The proof of imbecility, combined with undue influence, has, in numerous instances, been held to invalidate a will; but, in the absence of such influence, all that is required to establish the wills of people of weak understanding is, that they should have been capable of comprehending their nature and effect.*

Another question which may be raised respecting persons affected with imbecility is, as to their *responsibility* for crimes. This question, which is not of rare occurrence, may be illustrated by the following case: "On the 14th of May, 1843, a young man, John Barclay, was executed at Glasgow, for the murder of Samuel Neilson, for whom he had previously showed some affection. He took from him three one-pound notes and a watch, to obtain possession of which seems to have been the cause of the murder. So little sense had he of having done wrong, or of his own situation, that he hovered about almost without disguise, and, while going to spend part of the money with the first person he spoke to, he dropped first one and then another note at his feet, as a child would have done. When questioned, he could see no difference between killing a man and killing an ox, except that he "would never hear him fiddle again;" and so little did he know of the nature of the watch, that he regarded it as an animal, and when it stopped from not having been wound up, believed it had died of cold from the glass being broken. So obvious was Barclay's mental deficiency, that the court of justiciary, before whom he was brought, declined proceeding to his trial till it was decided by medical evidence that he was a fit subject for trial. In his parish, he was familiarly known as "daft John Barclay;" and the clergyman, who knew him well, "always regarded him as imbecile, and had never been able to give him any religious instruction, and did not consider him a responsible being." Notwithstanding the fact that Barclay's weakness of mind was recognised by all parties, from the judge downwards, and that the jury strongly recommended him to mercy on that account, he was condemned and executed."† In this well marked case of imbecility, "much stress was laid upon Barclay's *knowing* right from wrong, as affording indisputable proof of his being a moral agent." Ray very justly remarks "the reader is left to judge for himself, how extensive and accurate must have been the notions

* Shelford on Lunacy, 275.

† Ray, op. cit. p. 80.

on this point, of one who thought a watch was a living creature, and could see no difference between killing an ox, and killing a man." He might have added, to whom the clergyman of his parish "had never been able to give any religious instruction, and whom he did not consider a responsible being."

Several interesting cases of imbeciles, concerning whom the same question of responsibility was raised, are related and made the subject of judicious commentary, in Dr. Ray's work already quoted. The subject of criminal responsibility will be again referred to, when the several forms of unsound mind have been passed in review.

Having now described and illustrated, the forms of unsound mind, which are either congenital or occur during early childhood, and are characterised by defective development or diminished activity of the faculties, it now remains to examine the second subdivision, or that form of unsoundness which occurs subsequent to the development of the faculties.

DEMENTIA.

This form of unsoundness is to be carefully distinguished from the forms of *amentia* just described. In idiocy the deficiency is congenital; in imbecility it occurs in early life; in dementia, on the contrary, it supervenes slowly or suddenly in a mind already fully developed. In the former case the faculties are imperfect, in the latter enfeebled; the one class are as children who have never learned the duties of manhood, the other as men who have not the energy or power to perform them; the one have been furnished with no ideas to exercise the memory or reason, the other have not the power to recall or to use those which they have acquired. Dementia differs from mania, on the other hand, inasmuch as the phenomena of the one arise out of the exhaustion and torpor of the faculties, those of the other from their intense excitement. The one is helpless from want of power, the other embarrassed by the rapid succession of his thoughts and impulses. The want of power, however, is not the only character of dementia; for it is accompanied by positive derangement of the mind.

The characters of dementia differ with its cause and mode of commencement, and with the period of life at which it occurs. That form of it which arises from sudden mental shocks often presents a distinct and very peculiar feature.—The mind is, as it were, arrested and fixed for the remainder of life in sad abstraction on that one event. This form of dementia is well illustrated by the following cases:—

"In the asylum for the insane," (at Christiana) "I saw one curious case. The circumstances are these:—A fisherman was about to be married to a girl residing in one of the villages on the shore of the Christiania Fiord; and the day before that appointed for the wedding, he took his boat to go to his bride's house, to spend the night in feasting, as is the usual custom in Norway. She, accompanied by her parents, came to meet him; and while the two boats were return-

ing together, a sudden squall overset the boat which carried the bride, and she and her friends perished. But the circumstances are only remarkable, from the peculiar character they gave to the insanity of the fisherman. He sat from morning till night upon a small stool, which he fancied a boat, his arms and body constantly in the attitude of rowing; and if any one appeared at the door, he warned his visitor to beware how he approached, as the water was deep."*

In other instances, the effect of a sudden shock upon the mind is to occasion a state closely resembling imbecility. A case of this kind, unfortunately little creditable to the great man who bore a part in it, is related in a review of Sir John Malcolm's Life of Lord Clive.

Omichund had been employed by Lord Clive in important negotiations, under the promise of a reward of £300,000. When the time for fulfilling the promise had arrived, Omichund was suddenly informed that the written agreement which guaranteed the payment was null and void, and that he was to have nothing. "Omichund fell back insensible into the arms of his attendants. He revived, but his mind was irreparably ruined. From the moment of that sudden shock, the unhappy man sank gradually into idiocy (imbecility). He who had formerly been distinguished by the strength of his understanding, and the simplicity of his habits, now squandered the remains of his fortune in childish trinkets, and loved to exhibit himself dressed in rich garments, and hung with precious stones. In this abject state he languished a few months, and then died."†

The following case related in the London Medical Repository,‡ by the Reviewer of Beck's Medical Jurisprudence, illustrates the same effect produced by a strong impression acting upon the mind during a long space of time.

"The son of a respectable farmer had received the excellent and regular education which it is in the power of persons of limited means to bestow upon their children in Scotland, in order to qualify him for the medical profession; and he was actually pursuing his studies for that purpose, when he contracted, or persuaded himself he had contracted, a certain disorder, to which, among the moral inhabitants of the remoter districts, is attached every idea of shameful depravity. The sense of his situation seized with such force upon his (perhaps morbidly) sensitive mind, that the consequence, after twenty years' possession of a superior degree of intellect, and the acquisition of at least a competent share of knowledge, was the utter extinction of the rational being, and his degradation to a mere mass of animal substance —of which the only remaining evidences for many years have been the continuance of the functions indispensable for its existence, and of those which constitute him the most offensive of all nuisances in his hapless parents' house. The want of food stimulates him to utter

* A Personal Narrative of a Journey to Norway, &c. By Derwent Conway.
† Edinburgh Review, Jan. 1840.
‡ No. 7, vol. ii. New Series.

uncouth cries; but in the apparent scale of existence he has fallen below the meanest animal about his father's walls."

During the earthquake panic of last year, the author had an opportunity of observing a well-marked case of dementia in a lad of twelve years of age, brought on by the conversation of a knot of Irishmen in the dusk of the evening, concerning the expected visitation. The poor boy seemed deprived of all his faculties, was dull and listless, and answered every inquiry by a vacant smile. He occasionally had an access of terror and excitement, but soon relapsed into his state of stupor. Dementia also often follows upon severe attacks of fever, upon mania, melancholia, apoplexy, paralysis, or repeated attacks of epilepsy. In all these cases it may depend on a permanent disease of the brain.

Senile Dementia, or that which is incidental to persons in advanced age, is the most simple and well-marked form of that variety of dementia which arises from causes acting slowly and gradually; for dementia supervening upon mania has a mixed character, combining the delusions and the excitements of the one with the loss of vigour of the other. The first symptom of approaching senile dementia is loss of the memory of recent events, without any impairment of the reasoning faculties. There is dulness of perception and apprehension, and an inability to fix the attention, or to follow any train of thought. The things which were heard five minutes since, are forgotton, and the same question is repeated over and over again. Hence, the transaction of business, requiring sustained attention, becomes impossible. The power of attention, and the controul of the will over the thoughts becoming more and more enfeebled, the reasoning powers suffer; for scarcely are the premises laid down before they are forgotten, so that the act of comparison by which the conclusion is arrived at cannot be performed. Hence, after pursuing the same topic of conversation through part of a sentence, some accidental suggestion turns the ideas aside, and the expression becomes absurd or irrelevant. Many individuals in this stage of the disorder recognise their friends, but they seldom display signs of emotion on seeing them; and they can still employ themselves mechanically,—men in writing, and females in knitting and sewing. The next phase of the malady is one of complete incomprehension. Attention, memory, and reason, being entirely lost, the instincts alone remaining in vigour, and being supported by a fair share of bodily force and activity, display themselves in strange actions. Some jump or run to and fro, or walk round perpetually in a circle; others dance, and sing, and vociferate. Many talk incessantly in the most unmeaning jargon; others pass their time in muttering half sentences, or broken expressions, in which it is scarcely possible to discover any link or connexion, or if any association can be traced, it is of the most trivial kind, and depending on a word, or on some sensible object, which for a moment attracts a degree of attention. Many, on the other hand, sit in silence with a tranquil countenance, sometimes with a vacant

look or unmeaning stare, and scarcely pronounce a syllable for weeks, months, or even years. A few remain crouched in a particular posture, apparently uneasy and painful, but if placed in a different manner by those who have the care of them, they soon resume their habitual position. Many fatuous persons crowd round a stranger who happens to visit a lunatic asylum, having just enough intelligence to perceive something new; some have a propensity to adorn themselves in a strange manner; they take everything that happens to be in their way, and append it to their dress. In the last stage of all, even the animal instincts are lost; there is neither sensation, nor memory, nor thought, nor reason, but bare physical existence; with occasionally, at distant intervals, a short resuscitation of some of the powers of the mind. "Sometimes an individual may be seen standing erect and immoveable, with his head and neck bent almost at right angles with his trunk: his eyes fixed upon the ground, never appearing, by any movement or gesture, to be conscious of external impressions, or even of his own existence. Another sits on a rocking-chair, which she agitates to and fro, and throws her limbs into the most uncouth positions, at the same time chanting or yelling a dissonant song, only capable of expressing a total inanity of ideas and feelings. Many sit constantly still, with their chins resting upon their breasts, their eyes and mouths half open, unconscious of hunger or thirst, and almost destitute of the feelings which belong to mere physical life; they would never rise or lie down, were they not placed in bed. A great proportion of the patients who are reduced to this degree of fatuity, are found to have lost the use of their limbs, in a greater or less degree, by partial or general paralysis."*

It is scarcely necessary to add that in cases of dementia there may be every possible shade of mental affection between the excitement of mania, the partial glimmering of sense and reason, and the utter extinction of all the faculties of the mind, which constitutes complete and simple *dementia*. In the majority of cases, the loss of intellect will be gradual and progressive, and it may be our duty as medical men to examine it at any stage of its decline. The description here given may render this examination more easy.

Legal Relations of Dementia.—The questions most commonly raised respecting this form of unsoundness of mind relate to the validity of wills made or altered during that state. One case, that of Kindleside *v.* Harrison, will show the nature and difficulty of these questions.

"The points contested in this case were four codicils to the will of an old gentleman, on the ground, that, at the time of making them, he was incapable, by reason of mental decay, of understanding their nature and effect. It was testified by some of the servants of his brother, who lived at a little distance from him, and by those of the lady with

* Of the Different Forms of Insanity in Relation to Jurisprudence. By James Cowles Pritchard, M.D. pp. 228, 239.

whom he, the deceased, resided, that during the two or three years within which the codicils were made, he frequently did not know people with whom he had previously been well acquainted, without being told who they were; that he would go about the house and garden looking around, and appearing not to know what he was about. On one occasion he not only did not recognise a certain person, but could not be made to understand who he was; and it was testified by a very different kind of witness, that the deceased asked him how old was witness's father (though he had been dead sixteen years, and had been his partner in business), and soon after he inquired of the witness after his health, as if he were addressing another person. Several other similar lapses of memory, and various appearances of childishness in his conduct, were also revealed by the evidence, amply sufficient, no doubt, to induce superficial observers to believe that he was mentally incapacitated from disposing of property. It appeared, however that he was in the habit of giving in favour of his brother's butler, drafts accurately signed and filled up; that at Christmas-time, he gave the servants Christmas-boxes and the usual amount of money, and entered the sums in his account-book; that he received a farmer's bills for corn, and paid them with drafts on his banker, which he wrote himself, going through the whole business correctly; and that he docketed the bills and receipts on the back with the name of the person to whom paid, and the amount of the bills, making corresponding entries also in his private account-book; that he signed twenty drafts at least one morning for payment of his brother's debts, without instruction or assistance, subscribing his name as executor of his brother; that he would detect errors in the casting up of other people's accounts; that he discharged his physician's bills correctly; and in short, that he managed his affairs, and that prudently and correctly, to the last. It was also testified, that it was his practice to read aloud to the family the psalms and lessons of the day; that he was fond of a little fun, and played at whist remarkably well. That a person might have done all this, and yet been unsound in mind, is certainly not impossible; but it is far beyond the power of a mind so broken up by old age, and the invasion of disease, as to be incapable of altering testamentary dispositions already made. This consideration, and the fact that the circumstances of the case furnished abundant reasons for the alteration, induced the court to decide in favour of the capacity of the testator."*

MANIA.

THIS term includes all those forms of unsoundness of mind which are characterised by undue excitement of the faculties. It differs therefore in a marked manner from those already described; both

* Ray. Treatise on the Medical Jurisprudence of Insanity, p. 199. 2 Phillimore's Reports, 449.

in its legal relations, and in the tests by which its existence is ascertained. There is no legal term in common use which properly characterises this state; and one of its most important forms, moral insanity, is as yet unrecognised by the law. The only legal term employed in a sense analogous to that of mania is *lunacy*, which, as has been remarked, is objectionable from being founded on a variable feature of the disease.

Mania is divided in the table into three classes; General, Intellectual, and Moral; and each of these latter into two subdivisions—General and Partial.

General Mania.—There is a form of mania which affects both the intellect and the passions, and throws the whole mind into a state of mingled excitement and confusion. It is the counterpart of the incoherent stage of dementia, and the form which, in some cases, mania assumes from the very first. It is thus characterised by Pinel:—"Rapid succession or uninterrupted alternation of insulated ideas, and evanescent and unconnected emotions; continually repeated acts of extravagance; complete forgetfulness of every previous state; diminished sensibility to external impressions; abolition of the faculty of judgment; perpetual activity." There is another form of mania which is apt to be confounded with the foregoing variety, on the one hand, and with monomania on the other, but which, when carefully examined, will be found to be a general unsoundness, accompanied with undue excitement of the mind, the predominant feeling or passion merely taking the lead in the unsound, as it had previously done in the sound, mind. Both of these forms will be treated under the general term of Mania.

Mania, under whatever form it may appear, except when it is the immediate consequence of injuries, moral shocks, or acute disease, is generally preceded by a change in the natural condition of mind and body, designated as the period of *incubation*. The following, with slight alterations, is the account given by Georget of this state:—

Sometimes the cause acts strongly and rapidly; at other times, slowly and with less force. In the first case, madness breaks out at the end of some hours or days after a state of anxiety and uneasiness, with headache, sleeplessness, agitation or depression, and threatening of cerebral congestion; the patient begins to babble, cry, and sing, and becomes wild and agitated. He is then often taken for a person in a state of intoxication, and the mistake becomes apparent only after examining the previous circumstances and duration of the malady. In the other case, thought is affected gradually and often very slowly; the patient is generally conscious of some disorder in his intellectual faculties; he is beset by new and odd notions, and by unusual inclinations; he feels himself changing in his affections; but, at the same time, he preserves a consciousness of his condition, is vexed at it, and tries to conceal it; he continues his occupations as much as he can; and lastly, as many persons do in the first stage of intoxication, he makes every

effort to appear reasonable. Meantime his health continues to give way, and he either sleeps less or not at all; the appetite diminishes or disappears; sometimes digestion is difficult, and constipation supervenes; he grows thin, and the features alter. (In females the monthly discharge becomes irregular and scanty, and at last is altogether suspended.) At the same time there is observed something unusual, and even extraordinary, in the tastes of the patient, in his habits, his affections, his character, and aptitude for business; if he was gay and communicative, he becomes sad, morose, and averse to society; if he was orderly and economical, he becomes confused and prodigal; if he had long abstained from the pleasures of love, he becomes the victim of insatiable desires, and either seeks to associate with the other sex, or has recourse to disgraceful practices; if he was moderate in his political and religious opinions, he passes to an extreme exaggeration in both; if he was open and candid, he becomes suspicious and jealous; if a wife, she regards her husband and children with indifference; the merchant neglects his business; tears and laughter succeed each other without apparent motive; the exterior of candour and modesty gives place to an air of conceit and assurance, which, especially in women, astonishes us. But all these phenomena are less prominent than they may appear to be in this description; and unless the individual have been insane before, no one may suspect the nature of the ailment which torments him; all the questions put to him lead to no results, except that of fatiguing and giving him pain, for the ignorance that prevails relative to madness leads the friends to indulge in offensive insinuations, and to charge him with frivolous accusations, from not perceiving that he is under the influence of disease, and not of reason.

In some cases, the appetite is unaffected from the first; in others, it is impaired for a time, but speedily recovered, as well as the functions of digestion, nutrition, &c.; and it is in these circumstances that the conduct of the patient gives rise to a host of interpretations on the part of his relatives and the public.*

The duration of this period of *incubation* is often very considerable —as much as fifteen or twenty years. During this long period the patient is often misunderstood, and when he breaks out into furious mania, the attack is attributed to some slight contradiction or some cause equally inadequate to produce it.

Sooner or later this disorder of the cerebral functions becomes of a more obvious and positive character. The struggle between the convictions of reason, and the impulses of this new condition ceases; and the patient, instead of contending against the approaches of disease, or of concealing his thoughts, now believes in their reality, and openly and strenuously avows them, except when induced by powerful reasons to pursue a contrary course. The symptoms of physical derangement are also more striking and numerous. A febrile excitement pervades the system; the pulse is accelerated; the eyes have a wild

* Dictionaire de Médicine, art. Folie.

and glassy look; the sensations have become either more acute or more obtuse, and the patient complains of pain, sense of weight and giddiness in the head, and ringing in the ears. In this stage of mania, a singular insensibility to external impressions is often witnessed, so that intense cold, heat, hunger, and thirst, are borne to a wonderful degree not only without uneasiness, but even without consciousness of the fact, so that the patient abstains both from food and drink for long intervals of time. Hunger and thirst occasionally, however, exist to a great degree. He sleeps little, and his slumbers are disturbed by frightful dreams.* The muscular power is often inordinately developed, the waking moments being a scene of almost constant restlessness and agitation; while at others there is an equally unnatural sluggishness and indisposition to move about.

The state of the mind is so various at different times in the same patient, and varies so much in different patients, that no general description can possibly do this part of the subject justice. It is because general descriptions, mixing up all the faculties of the mind and all their delusions and perversions together, are wanting in accuracy, and on that account in usefulness, that the division in the table into *intellectual* and *moral* mania, and these again into general and partial, has been adopted.

Having now given a description of *mania* both in its stage of *incubation*, and in that of its complete *development*, from the work of a man in his sound senses, an esteemed authority on this subject, it may be useful to subjoin a case of mania sketched by the hand of a madman, a sketch which has all the appearance of being a faithful one, and likely to be in some respects more correct than any case drawn from observation can be.

This curious history forms the subject-matter of a work of nearly three hundred octavo pages,† and is evidently written by one who has passed from well-marked mania through several stages of improvement to a state of comparative sanity. The history opens with an account of one of the most severe family afflictions which it could fall to the lot of man to suffer. He represents himself as having been brought up religiously, and as having strong religious feelings, but joined with all the inconsistency which too often accompanies a religion of feeling. He joins the so-called evangelical party, becomes a zealous preacher, and mistakes his zeal for a certain sign of election. Believing himself secure in his election, and trusting to be kept from sin by the Holy Spirit, he became, as he tells us, lukewarm and inconsistent, and fell into sin. Still zealous and enthusiastic, though strangely inconsistent, in his religion, he next, during earnest prayer, sees visions, "pictures of what soon came to pass in reality, but with certain variations." We next find him

* Ray, op. cit. p. 101.

† A Narrative of the Treatment experienced by a Gentleman during a state of Mental Derangement; designed to explain the Causes and the Nature of Insanity, &c London, 1838.

among the Rowites, listening to the unknown tongues, and soon exercising the gift of tongues himself, singing unintelligible nonsense in beautiful tones which affected his mind greatly, or speaking under the supposed guidance of the Holy Spirit, which moved his arms and fingers, and guided him to distinct passages of the bible in regular connexion with his line of argument. Soon after this, he is put under the care of a physician, and after a longer interval is confined in an asylum. At first we find him doubting his delusions and doubting his physicians, and his delusion forbidding him to trust to human means, while his reason insists on their efficacy, he halves the difference by taking half the physic which has been ordered him. Then he hears voices addressing him, and, believing them to be the voices of spirits, he gives himself up to their guidance, however ridiculous the things they bid him do. Now they put him in one absurd posture, then in another, making him turn round like a top, desiring him to leap over stiles, to suffocate himself with his pillow, and to wrestle with his keepers —and always with the notion that by so doing, some great good is to be obtained—no less a good than his own salvation, and that of his fellow-creatures. The confusion into which he is thrown by the struggles between the absurd suggestions of his spirits, and the faint glimmerings of his own reason is dreadful, and he finishes one of them by inwardly cursing the *Holy Trinity*. All this time he seems to have doubted the reality of the voices and of the spirits, for he says, "I had a species of doubt, but no one who has not been deranged can understand how dreadfully true a lunatic's insane imaginations appear to him, how slight his sane doubts." As the confused workings of his mind are supposed to be the commands of spirits, so the sensations of his own body are falsely interpreted as parts of imaginary scenes, just as sensations occurring in sleep are known to be immediately worked up by the imagination into the texture of some improbable occurrence.* All the faculties of his mind seem to suffer. The senses deceive him ; he has false perceptions with regard to objects really existing, and sees hears and feels that which has no existence. His imagination, under the influence of his delusion, makes him the sport of a thousand fancies which sense and reason strive in vain to correct. If anything is difficult to explain, his delusion takes the office of interpreter ; if anything appears absurd in action, his delusion was the cause of it. He resists his keepers, because his spirits tell him that they wish it: he is taught that he can help a fellow-creature in distress by spinning round upon his heel ; he throws himself on the ground or over every stile he comes to, because to do such things in *decision* and *precision* is meritorious. The first truths which men in their senses believe, without being led to the belief by reason or sense, are by him disbelieved. He can be in many places at the same time, in Portugal and England, in Heaven and on Earth ; at one time, he is himself the hero of a story which he has long before heard told in a foreign country, and becomes the per-

See p. 214.

petrator of unheard-of enormities; at another, he is being crucified in different parts of the earth at the same instant. His keepers are one moment no less important personages than the maker of all things, or the saviour of mankind, at another he knows them for what they are, and complains of their cruelty towards him. His moral sense, too, is blunted, and all his natural affections perverted. His mother and family are the objects of his hatred and aversion, even at the time that he is giving proof of their affectionate care for him.

Such is a well-marked example of general mania, presenting a wild confusion of mind and feeling, with one of the higher sentiments to which education and habit had given power, taking the lead of all the rest, giving its own colouring to every thought, and its own direction to every action. It is in this mixed and confused form that mania often presents itself—the intellect and the moral feelings suffering together, and the entire mind being the seat of strange and inextricable confusion.

Intellectual Mania.—In some instances, mania seems to be almost entirely confined to the intellectual faculties, which are exercised with much excitement, the moral faculties being but little if at all affected. It is to this form of mania that the following description of Pinel applies: "The patient sometimes keeps his head elevated and his looks fixed on high; he speaks in a low voice, or utters cries and vociferations without apparent motive; he walks to and fro, and sometimes arrests his steps as if excited by the sentiment of admiration, or wrapped up in profound reverie."

It would probably be more correct to say that, in certain cases, some strong passion displays itself chiefly by its effect upon the intellect. Such a passion is pride or vanity; and it is with regard to such cases that it has been well observed, "none are so liable as the proud to this most humiliating of all afflictions." The following case is a good illustration of this form of mania:

A young medical student suddenly took it into his head, that he should realise a fortune by attaining academical honours. He accordingly entered himself at Cambridge, and so injured his health by fruitless application to study, as at length to fall into a state of decided derangement, of which vanity was the predominant and characteristic feature. This young man stated, that he was the Farnese Hercules; that it was he, in fact, that had written Dr. Clarke's Travels in Russia; that he had *done a job* also for Virgil, that is, had composed his Æneid; that one of the finest paintings of Raffaelle had been executed by him; that he knew everything.* The following characteristic letter furnishes a good illustration of this form of mania:—

Dec. 4th, 1832.

"To —— Esqre.

"I am Lord President of the Counsil, a most honourable situation, and the richest gift of the Crown, which brings me in 7000£ every

* Reid on Insanity, p. 51.

year. The Counsil consists of three Secretaries of State, of which I am one; and the Paymaster of the Forces. When the king William the Forth shall die, then shall be crowned King of England, and be crowned in Westminster Abbey, By the Lord Archbishop of Canterbury, I shall, on the occasion of my coronation, have placed in the different street of London one thousand pipes of wine for my people, and at night, in the Hyde Park a magnificent display of fireworks, and one hundred pieces of artillery shall fire three rounds for the amusement of my people and subjects. I have only now to give you a list of my titles and honors—King of England—First heir presumptive to the Crown—Major-general and Field Martiall—Duke of Leitzep—Prince of Denmark—Lord President of the Counsil—Knight Banneret—Lord Treasurer of the Exchequer—Lieutenant Colonel—Lord and Baronet—Aid de Camp to the King! Champion of England!—Dear ——, I wish to acquaint you that Windsor Castle belongs to me, that the Palace of Brighton belongs to me, also I purchased from the Duke of Wellington the splendid Park and Palace of Strathfieldsea, wherein there are very extensive forests of Oak and of Pine trees, together with a very magnificent sheet of water containing ells and salmon trout—Dear —— I have to beg that you give my love and duty to your wife, and give this letter to read I pray you, according to my disire and wish."*

Partial Intellectual Mania. This was formerly called melancholia, from the mistaken notion that such partial affections of the intellect are always of a gloomy character. Esquirol showed that this view of the case was incorrect; for, as he justly observes, the ideas of such persons are not always gloomy, but, on the contrary, oftentimes extremely gay and pleasant. This author substituted the term monomania, which is now generally received.

The most simple form of this disorder is that in which the patient has taken up some single notion opposed to common sense, and personal experience. Of this kind is a case mentioned by Sir George Mackenzie.† "I knew one," he says, "who seemed a discreet person, and could converse most pertinently in everything, till they spoke of the moon; but, upon hearing that named, fell instantly a staring, and into great extravagancies, believing himself to be secretary to the moon."

In many cases, this single delusive idea relates to, or is occasioned by, some bodily sensation or disease, which the monomaniac, like the dreamer, associates with imaginary accompaniments, and interprets by the aid of his delusion. Thus, Esquirol tells us of a woman who insisted that she was pregnant with the devil, and in her womb there was found after death a mass of hydatids; of another, in the Salpêtrière, who imagined that a regiment of soldiers lay concealed in

* On the Arrangement and Nomenclature of Mental Disorders. By Henr-Johnson, M. D. Edin The original spelling is retained.

† Reason, an Essay, 1790.

her belly, and that she could feel them struggling and fighting with each other; and of a third, who believed that the apostles and evangelists had taken up their abode in her bowels, and were occasionally visited by the pope and the patriarchs of the old Testament. In the last two cases the intestines were found agglutinated together in consequence of chronic peritonitis. But such hallucinations are not always dependent upon real sensations, as is proved by the cures which have been effected by a very laudable species of deception. Thus, a patient, after thinking himself cured of a serpent in his bowels by means of a pretended surgical operation, suddenly took up the idea, that the creature had left its ova behind, ready to be hatched into a brood of young ones, but was again restored by the dexterous reply of his physician, that the snake was a male.*

It must not be supposed that these cases of partial intellectual mania comprise all the cases designated by the term *monomania*. It is probable that there are very few cases of this extremely simple kind. In most instances the affection of the mind doubtless goes beyond a single insane idea, and influences more or less extensively the thoughts and the conduct, being marked by other intellectual and moral inconsistencies; and there is reason to believe, that many cases of so-called monomania are examples of general mania, characterised by the immoderate activity of some one faculty.

Moral Mania. It was Pinel who first directed the attention of the profession to moral insanity. Previous to his time, insanity was generally considered as either exclusively, or chiefly, a malady of the reasoning faculties. Participating in the prevalent belief of the sufficiency of a few faculties to explain all the phenomena of the sound and unsound mind, and doubtless influenced by the prevalent metaphysical doctrines of his time, he found, to his great surprise, that there were at the Bicêtre many maniacs "who betrayed no lesion whatever of the understanding, but were under the dominion of instinctive and abstract fury, as if the affective faculties alone had sustained injury." This form of mental disorder he designated as *manie sans délire*. The examples which he records are chiefly those of violent anger and fury, illustrating only one phase of the disorder. Since his time the reality and great importance of this distinction between intellectual and moral mania have been recognised by practical observers, amongst whom are to be found the well known names of Esquirol, Georget, Gall, Rush, Keil, Heinroth, Hoffbauer, Cox, Andrew Combe, Abercrombie, Conolly, Pritchard, and Ray. Pritchard has treated this subject with great ability, and has clearly made out, that moral generally precedes intellectual, insanity; that it is in fact the commencement of it. He defines moral mania as "consisting in a morbid perversion of the natural feelings, affections, inclinations, temper, habits, and moral dispositions, without any notable lesion

* Ray, op. cit. p. 110.

of the intellect, or knowing and reasoning faculties, and particularly without any maniacal hallucination."*

General Moral Mania. In describing this form of mental unsoundness, we shall follow closely the description of Dr. Pritchard :—

There are many individuals living at large in society, who are reputed persons of a singular, wayward, and eccentric character. An attentive observer will often recognise something remarkable in their manners and habits, which may lead him to entertain doubts as to their sanity; and on inquiry his suspicions are often strengthened by finding that an hereditary tendency to madness has existed in the family, that several of the relations have laboured under other diseases of the brain, or that the individual himself, in a former period of his life, has had a decided attack of madness. His temper and disposition are found to have undergone a change; to be not what they were previously to a certain time; he has become an altered man, and the difference has perhaps been noted from the period when he sustained some reverse of fortune, which deeply affected him, or the loss of some beloved relative, or some severe shock to his constitution,—some febrile or inflammatory disorder affecting the brain, a slight attack of paralysis, or a fit of epilepsy. In some cases, the alteration in temper and habits has been gradual and imperceptible, and seems to have consisted only in an exaltation or increase of peculiarities which were always more or less natural and habitual. Persons labouring under this disorder are capable of reasoning, or supporting an argument, upon any subject within their sphere of knowledge, and they often display great ingenuity in giving reasons for the eccentricities of their conduct, and in accounting for and justifying their existing state of moral feeling. In one sense, indeed, their intellectual faculties may be termed unsound; they think and act under the influence of strongly excited feelings, and persons accounted sane are under such circumstances proverbially liable to error both in judgment and conduct.†

Hoffbauer, who has written very ably on the subject of insanity, recognises this form of mental unsoundness.

" It is clear," he says, " that mania may exist uncomplicated with mental delusion; it is, in fact, only a kind of mental exaltation (*tollheit*), a state in which the reason has lost its empire over the passions and the actions by which they are manifested, to such a degree, that the individual can neither repress the former, nor abstain from the latter. It does not follow that he may not be in possession of his senses, and even of his usual intelligence, since, in order to resist the impulses of the passions, it is not sufficient that the reason should impart its counsels,—we must have the necessary power to obey them. The maniac may judge correctly of his actions without being in a

* Cyc. Prac. Med., *art.* Insanity.

† A Treatise on Insanity, &c. by James Cowles Pritchard, M.D., pp. 12 & 13.

condition to repress his passions, and to abstain from the acts of violence to which they impel him." He subsequently observes, that when mania proceeds from inordinate passions, " its more immediate cause lies in the physical temperament, or in certain moral affections which induce frequent occasions of anger. In every other respect, the maniac may be master of his propensities, and the actions to which they lead ; he may judge and act rationally. He is irrational only in his paroxysms of fury, and then his errors of judgment are rather the effect than the cause of his furious transports."*

This form of mental unsoundness is illustrated in the works of Pritchard and Ray, by a large number of cases, which may be consulted with advantage. One of the most remarkable of these is that of Frederick William of Prussia, father of Frederick the Great, who, in consequence of long indulgence in spirituous liquors, became hypochondriacal, and the strange, wayward, and cruel tyrant of his family and household. His religious austerities, his disgusting and brutal behaviour to his children, his unfounded hatred of his own son, and repeated attempts upon his life, his solitary attempt upon his own life, his course of steady and unswerving persecution of the innocent objects of his suspicion and dislike, without any delusion beyond that which might fairly be regarded as the offspring of his hate—present a striking picture of general moral mania.

Partial Moral Mania. This consists in an exorbitant activity of some one passion or propensity, and its predominance or complete mastery over every other. The faculty thus affected prompts the individual to action by a kind of irresistible instinct, while he either retains the most perfect consciousness of its impropriety, and horror at the enormity of the conduct to which it would impel him, and with difficulty restrains himself, or gives way, as if in desperation, to the impulse which urges him on.

There is not one of the stronger impulses of our nature that may not be thus urged into an activity which may place it beyond the restraint of reason and conscience.

The following are examples of some of the principal forms of partial moral mania.

Cleptomania, or *propensity to theft.*

" There are persons," says Dr. Rush, " who are moral to the highest degree as to certain duties, but who, nevertheless, live under the influence of some one vice. In one instance, a woman was exemplary in her obedience to every command of the moral law except one—she could not refrain from stealing. What made this vice more remarkable was, that she was in easy circumstances, and not addicted to extravagance in anything. Such was the propensity to this vice, that when she could lay her hands upon nothing more valuable, she would

* Hoffbauer, Die Psychologie in ihren hauptanwendungen auf die Rechtspflege, §§ 26—46, and Ray, p. 118.

often at the table of a friend fill her pockets secretly with bread. She both confessed and lamented her crime." Many such cases are on record. This propensity to theft is also a common feature of mania, and accompanies the paroxysms. Pritchard mentions the curious case of a lunatic who would never eat his food unless he had previously stolen it.

Lying is sometimes a form of partial moral mania.

Erotomania, or *amorous madness*. The following case, among many others, is quoted from Gall: "A man had lived many years in a happy and fruitful union, and had acquired by his industry a respectable fortune. After having retired from business, and led an idle life, his predominant propensity gradually obtained the mastery over him, and he yielded to his desires to such a degree that, though still in possession of his reason, he looked on every woman as a victim destined to gratify his sensual appetite. The moment he perceived a female from his window, he announced to his wife and daughters, with an air of the utmost delight, the bliss that awaited him. Finally, this partial mania degenerated into general mania, and shortly after he died in an insane hospital at Vienna." * Sometimes this propensity attacks virtuous females, who view their excited passions with horror and remorse.

Pyromania, or a morbid propensity to *incendiarism*. "A young girl of a quiet, inoffensive disposition, and whose character had been hitherto exemplary, made seven different attempts at incendiarism in a village near Cologne. When interrogated as to the motives which had prompted her to act so wickedly, she burst into tears, confessing that at certain periods she felt her reason forsake her, and that then she was irresistibly impelled to the commission of a deed which, when done, she bitterly repented. She was acquitted by a jury of all criminal intentions."†

Suicidal Monomania. Much difference of opinion has existed as to the real state of mind of self-murderers. The fact of suicide having been generally practised, and sanctioned by philosophers and lawgivers of past times, and of its still being in common use in a nation which has attained in many respects a high civilisation—the Chinese—has led some to the belief that it is not always the result of an insane impulse. The calm and deliberate manner in which the crime has been perpetrated, and the apparent soundness of the reasons alleged in its favour, have been somewhat strangely used as arguments against the opinion of those who attribute suicide in all cases to insanity. A better reason for believing it to be, occasionally at least, altogether independent of insanity is, that two persons have been known to combine for the purpose of self-destruction; such union of purpose being extremely rare in the case of the insane.

The argument drawn from national usage in ancient and modern

* Ray, p. 130, et seq. † Med. Chir. Rev., July, 1836, p. 216.

times cannot be allowed much weight, for who would hesitate to characterize an English widow who should burn herself on the death of her husband, as insane? and yet such self-sacrifice was until recently both a virtue and a custom in India. Some nations, again, have a custom of eating human flesh, but in a recent case of infanticide which occurred in France, the fact that the mother cooked a portion of her child, and eat of it, and then offered the dish to her husband, was justly regarded as a strong evidence of insanity.*

A careful consideration of recorded cases of suicide cannot but lead to the conclusion, that a considerable number, at least, are the result of insane impulse; and this conclusion is strengthened by the frequent attempts at self-destruction made by the acknowledgedly insane. The extraordinary modes of death selected might also be used as an additional argument in favour of insanity in certain cases.† It may be added, that some of our highest authorities, as Foderé and Esquirol, have strongly maintained the necessary dependence of suicide on insanity.

Homicidal Mania. The most distinguished authors, both at home and abroad, have recognised this form of mental unsoundness, as having an existence independent of delusion. The cases on record are so numerous, that the only difficulty is that of selection. The following is a remarkable one:—"William Brown was executed at Maidstone, in 1812, for strangling a child whom he accidentally met one morning while walking in the country. On the trial, he said he had never seen the child, had no malice against it, and could assign no motive for the dreadful act. He took up the body and laid it on some steps, and then went and told what he had done, requesting to be taken into custody. He bore an exemplary character, and had never been suspected of being insane."‡

Women seem to have been more frequently than men the victims of this propensity to destroy, and sometimes this excited feeling has led to the commission of infanticide.§ Females suffering from grief, or anxiety, from habitual discharges, at the menstrual period, at the change of life, and soon after delivery, are thrown into a peculiar nervous state, which is well characterised by the name of *mimosis inquieta.* This excited condition of the nervous system is sometimes accompanied by a strong impulse to crime, mixed with an overwhelming fear of giving way to the propensity. Cases of this kind frequently present themselves among the out-patients of the hospital.

Of Mania with Lucid intervals. Mania, in a considerable number of cases, assumes a recurrent or intermittent form, the patient in the interval being in his right mind. The proportion which such cases bear to those of complete recovery has been variously stated. Accord-

* Annales d'Hygiène, tom. viii. p. 397.

† As an example, see the curious frontispiece, and corresponding case a p. 331, of Mr. Forbes Winslow's Anatomy of Suicide.

‡ Ray. p. 137. § See p. 160.

‖ See the King's College Hospital Report for 1842, Medical Gazette.

ing to Pinel, one in six; according to Esquirol, one in ten were recurrent. M. Despartes states the number as one in six, or one in seven.* The interval is various. Esquirol has seen cases assume the quotidian, tertian, and quartan type; or the interval has been that of a month, or it has recurred with the same season of the year. More frequently the attacks occur at uncertain intervals, and are of uncertain duration. This recurrent mania, with intervals of complete sanity, must not be confounded with those periods of comparative tranquillity which, like lulls in a storm, occur in most cases of mania. With regard to such intervals of comparative repose, Haslam remarks that, "as a constant observer of this disease for more than twenty-five years, he cannot affirm that the lunatics, with whom he had daily intercourse, have manifested alternations of insanity and reason. They may at intervals become more tranquil, and less disposed to obtrude their distempered fancies into notice. For a time their minds may be less active, and the succession of their thoughts consequently more deliberate; they may endeavour to effect some desirable purpose, and artfully conceal their real opinions; but they have not abandoned nor renounced their distempered notions. It is as unnecessary to repeat, that a few coherent sentences do not constitute the sanity of the intellect, as that the sounding of one or two notes of a keyed instrument could not ascertain it to be in tune."

The legal relations of mania with lucid intervals are important. The law generally views civil acts done in lucid intervals as if they were performed by a person in a permanently sound state of mind; it admits the validity of wills made during such intervals, and has on more than one occasion admitted the reasonableness of the will as proof of a lucid interval.† With regard to criminal acts, it makes a reasonable distinction; for it justly regards the condition of unsoundness as one readily reproduced by provocation or excitement: accordingly no case has occurred in which a person has been convicted of crime committed during a lucid interval.‡ The legal relations of the other forms of mania will be considered in the following division.

4. OF SOME OF THE MORE IMPORTANT CHARACTERS OF THE UNSOUND MIND, AND OF THE LEGAL AND MEDICAL TESTS OF THAT UNSOUNDNESS.

A knowledge of the individual characters of mental unsoundness, is of the first importance both to the lawyer and to the physician. A general description of the several forms of unsound mind, without such a résumé of its characteristics, would present but an imperfect view of

* Pritchard on the various forms of Insanity, in relation to Jurisprudence, p. 184.

† Case of Cartwright *v.* Cartwright, Pritchard on the different forms of Insanity, p. 197.

‡ Ray, p. 246.

the subject, and leave in obscurity the great questions which arise out of it. It is proposed, therefore, in this place, to establish by appeal to facts, some of the more remarkable phenomena of mental unsoundness, as a preliminary to the discussion of the chief legal questions which arise out of that state, and to prescribe, for the guidance of the medical witness, such rules as these phenomena shall be found to suggest.

The objects, then, of the present inquiry are the suggestion of true tests, and the discrimination of real and feigned unsoundness.

The principal distinction already established between unsoundness from defective development, and unsoundness from excessive activity, will be found fully borne out by a consideration of the chief characters of the two forms, which will accordingly be discussed separately in this place.

Of the Characters of Unsoundness of Mind from Defective Development or Diminished Activity of the Faculties.

There is a simplicity about this part of the subject which does not belong to the other, and the principal characters are more easily deduced from the foregoing descriptions. The law, in reference to this form of unsoundness, moreover, is more simple and more in accordance with medical experience, and its decisions have been more uniform.

The appearance of the idiot or imbecile is in itself almost decisive, and scarcely requires confirmation from an actual inquiry into his mental condition. Difficulty of arousing and fixing the attention; slowness and weakness of comprehension; forgetfulness of recent occurrences; ignorance of social relations; unconsciousness of familiar things, even of such as immediately concern a man's self, as his age, the place in which he lives, and the mode in which he passes his time, the year, the month, and date of the month; ignorance of those public persons and events which are the most frequent topics of conversation, and most familiar to those who take an interest in the common affairs of life, as the name of the reigning monarch, of the prime minister, &c.; a scanty knowledge of arithmetic and of the value of money, an imperfect knowledge of right and wrong, and of the state of the law in regard to the most common and familiar crimes;— may be mentioned among the characters of the several forms of unsoundness from defective development.

In ordinary and extreme cases of imbecility there can be no difficulty in forming a decision as to the competency of the individual to take care of himself and his affairs, to form contracts, to devise property, &c.; but where the imbecility exists in a less degree, the question is by no means of this simple nature, and cases have occurred in which there has been room for much difference of opinion. In this class of cases it generally happens that the individual in question

has, for some part of his life, been at liberty, and entrusted with the management of his affairs. Hence an additional test is provided in a comparison of his existing with his former state of mind. It is strange that this simple and obvious test was overlooked by the medical witness, till it was distinctly and forcibly pointed out by the late Dr. Gooch in the course of some able strictures on the case of Mr. Edward Davies.*

As this case is one of considerable interest, (as the reviewer well observes "by far the most important lunatic case which has been tried in our time,") and as, moreover, it affords a striking illustration of the principle applicable to every form of mental unsoundness, viz., that the state of the mind, at the time it is a subject of inquiry, should be compared with its former condition, a short account of it is here subjoined.

Mr. Edward Davies was born of humble parents, and though at school very shy and reserved, had the character of being quick and intelligent. On leaving school, he commenced the business of a tea-dealer in London, and by great industry and careful management grew rapidly rich. His health was habitually delicate, he was a dyspeptic, and subject to strong nervous excitement. He was fond of reading medical books; and, like most persons who indulge in such a taste, was fanciful about his complaints, and subject to false alarms. He endeavoured to remedy the defects of his early education by reading what he conceived to be the best authors, and was often guilty of making a ridiculous display of his acquirements, by long quotations which he would spout with a theatrical air. He was of a remarkably timid and yielding disposition, so that, though twenty-seven years of age, and carrying on an extensive and lucrative business, he became completely subject to the authority of his mother. She would not allow him to carry any money in his pocket, or to spend the most trifling sum without her permission. He dared not quit the house for a few hours, or visit the play, without her leave. She was at great pains to prevent him meeting with young women whose personal qualifications seemed likely to engage him, lest he should marry, and she be displaced from the management of his house and the controul of his purse, for she took various opportunities of inducing him to give considerable sums of money to different branches of her family. "It appears, then, that this tea-dealer, in his natural or habitual state of mind, was easily agitated, anxious and fanciful about his complaints, vain of his self-taught literary acquirements, fond of spouting quotations with great emphasis and gesture, abjectly timid; yet with all these singularities and infirmities, an able and successful tradesman, and in all the affairs of life, thoroughly competent to take care of himself and his property." Mr. Davies having attained the age of twenty-seven, grew restive under his mother's restraint, and made

* Quarterly Review, 1830.

many attempts to emancipate himself, offering her most liberal and reasonable terms; but she was not to be got rid of at any price. This incessant state of contention acting on a feeble body, a sensitive mind, and not a very firm understanding, soon began to impair both his bodily health and his mental tranquillity. In this state he applied successively to Mr. Lawrence and Dr. Latham, and was seen by several persons, to whom he exhibited all his former peculiarities mingled with an incoherence and excitement which led them to consider him unsound in his mind, though Mr. Lawrence thought that his antipathy to his mother was "his chief delusion!" and Dr. Latham was not prepared to recommend "that he should be shut up as an acknowledged lunatic." It is remarkable that on the same days on which Mr. Lawrence, Dr. Latham, and others saw him in this highly excited state, his friends, who had known him long, passed hours with him; and though they found him ill and terrified, he appeared to them quite himself, and as equal as he had ever been to give directions about his affairs; indeed, the very persons who were trying to confine him as unfit to take care of his business, were themselves consulting him about the management of that business. Mr. Davies, shortly after this period, was removed to a private mad-house, where he remained till the end of December, when he was released by the verdict of a jury. Here his agitation subsided; his incoherence, as it had been called, diminished almost to nothing; and the only remaining grounds for believing him a lunatic, were his antipathy to his mother, and certain suspicions that were considered to be delusions. At this time he was what his oldest friends affirmed him to have been all his lifetime, and yet it was the opinion of the physicians sent to examine him, that he was mad and unfit to be released. On the strength of their evidence the Lord Chancellor granted a commission.

The medical evidence in this case is curious in many respects, but there is not space to display it at length. The following scarcely exaggerated summary of the reviewer will show upon what slight grounds many of the medical witnesses built their opinion of Mr. Davies's insanity, and of the necessity for his confinement. "In England people are shut up in mad-houses if they learn to box,—go to the gymnasium to fence,—employ the junior solicitor when they cannot get the senior,—are over vain of a smattering of literature,—spout poetry with a theatrical air,—are long-winded, prosy, and muddle-headed,—read medical books, and are fanciful about their complaints,—refuse, when they are twenty-seven years of age, and worth many thousands of pounds, to live with their mothers, because their mothers won't allow them pocket-money, or a wife, or liberty to go to the play without asking leave, (who consequently form a strong antipathy to such amiable parents,)—who having gained riches in early manhood, get uneasy of inhaling, summer and winter, the atmosphere of a city lane, and actually buy a villa near town for their occasional refreshment,—who will not confess that they have been mad simply because

they do not believe it,—if Englishmen be guilty of such horrors as these, they are pronounced insane,—they are shut up in mad-houses,—and the management of their business is taken out of their hands, although, notwithstanding all their singularities, they have conducted it, for a long term of years, with consummate skill and extraordinary success!"

The writer adds, "out of five cases of supposed lunacy, about which a medical friend of ours has been consulted by an eminent law officer, within the last two years, three of the individuals—more than half the number—had been confined, and would have continued to be confined, for the following reasons:—one, because his antipathy to his friends, who had shut him up, as he believed, unnecessarily, was disproportioned to the cause!—the second, because, in addition to a general singularity of appearance, and manners, and mode of expressing himself, he believed his wife's last child was not his own; this was set down as a delusion, though all the neighbourhood believed the same, and the history of his marriage, his decrepit appearance, the more youthful wife, and the vigorous lover, rendered it highly probable;—the third was Mr. Edward Davies."

The commission, after a careful consideration of the evidence in all its bearings, restored Mr. Edward Davies to liberty, and the management of his property. He made wise and advantageous arrangements, disposed of his business to his mother, and retired to indulge his innocent eccentricities on an estate in Wales. One more extract from the review of Dr. Gooch will point the moral of this tale.

"It is necessary to know how a man commonly acts under ordinary circumstances, in order to judge of his actions when placed under extraordinary ones. In examining the condition of a man's mind, for the purpose of determining whether it is sound or not, some standard of sanity must be taken to compare it with; but with what do physicians generally compare it? With the precise knowledge which they have of the workings of their own minds; with the more vague and general notions which they have of the minds of other sane persons; and with their experience of what they consider insane minds. These are the things they look to; but there is another standard with which they never think of comparing it, but with which it is more important to compare it than with all the others put together, and that is, the mind of the supposed lunatic himself, in its natural, habitual state,—that state in which the experience of many years proved him to have been capable of managing himself and his affairs."

The principal object of quoting this case so much at length, is to insist on the importance of the test which it suggests, viz., that of a comparison between the existing and former state of the mind. The medical witnesses are justly censured for having preferred other tests of doubtful value to this sure and certain one. This test also admits of useful application in cases of dementia.

The tests of capacity usually recommended in the case of imbeciles

are obviously insufficient to determine whether or not a man is capable of managing his own property. The arithmetical test, on which authors have laid so much stress, is merely a test of knowledge, not of power. A man may be the best accountant in the world, but he may labour under a moral imbecility, and have so mean a sense of right, so childish a fancy, and so weak a will, that from infancy to age he may yield to every impulse, and gratify every whim without once counting the cost. In a case that lately came under the author's notice, the individual owed pence as a child, and pounds as a boy, and added debt to debt with each year that passed over his head, till at length his madness showed itself chiefly by arrangements to spend a year's income in a week, and the unfounded expectation of an immense fortune on the morrow. He is now the inmate of an asylum, with delusions enough to furnish a dozen madmen. In this case, there was the cultivated and refined intellect of a man with more than the weakness of a child; but no test could have served to prove him incapable of managing himself and his affairs, save only the history of his life.

The criminal acts of persons of weak intellect are characterised by the absence of the motives which actuate sane men; the crimes which they commit are usually as strongly marked by folly as their daily words and actions. They have no other characters, and consequently we have no better test. In the case of imbeciles, as in that of maniacs, the law lays down the test of a knowledge of right and wrong. This is as insufficient a test in criminal, as the arithmetical test in civil cases. It is a test of knowledge, and not of power, and the knowledge of right, and the power to do it, are as distinct as science and art. An action presupposes knowledge, motive, and will. What if the motive be insane, and the will incapable of obeying any but the insane impulse? This subject will be presently examined more at length.

Of the Characters of Unsoundness of Mind from Excessive Activity of the Faculties.

In tracing some of the more prominent characters of mania, it is proposed to use the term in its most extended sense as applied to those cases (and they are the great majority) in which the intellect, the affections, and the passions, are jointly implicated, whether there be a single delusion or several delusions, or merely some one excited emotion or passion, the source of a thousand changing fancies. This inquiry will prepare the way for an examination of the plea of insanity in criminal cases—a subject of great interest and importance.

1. *The insane differ from the sane not in having lost any of their faculties, but in exercising them differently.*—In illustration of this statement the high authority of Lord Erskine may be quoted. On the trial of Hadfield for shooting at the king in Drury Lane Theatre,

in 1800, the attorney-general had told the jury, that to protect a person from criminal responsibility, there must be a total deprivation of memory and understanding. To this Lord Erskine replied, that if those expressions were meant to be taken in the literal sense of the words, "then no such madness ever existed in the world." He added "in all the cases which have filled Westminster Hall with the most complicated considerations, the lunatics and other insane persons who have been the subjects of them, have not only had memory *in my sense of the expression*,—they have not only had the most perfect knowledge and recollection of all the relations they stood in towards others, and of the acts and circumstances of their lives, but have, in general, been remarkable for subtlety and acuteness. Defects in their reasonings have seldom been traceable,—the disease consisting in the delusive sources of thought,—all their deductions, within the scope of their malady, being founded on the *immoveable* assumptions of matters as *realities*, either without any foundation whatever, or so distorted and disfigured by fancy, as to be nearly the same thing as their creation."

It is scarcely necessary to confirm the statement of so high an authority; but the following case from Muratori is a very good illustration of the sublety and acuteness which Lord Erskine mentions as one of the characters of insanity. A jesuit named Sgambari, believed himself a cardinal, and claimed to be addressed by the title of eminence. A friend was anxious to convince him of his error, and obtained a patient hearing to his remarks. When he had finished the madman replied, "Either you consider me insane or rational; on the latter supposition you do me injustice by your remonstrances; on the former, I hardly know which is most mad, I for believing myself a cardinal, or you for thinking to cure a madman by such reasonings."

The madman, then, reasons like other men, with this difference, that his delusions being stronger than the imaginations of a sane man, and his passions more violent, reason is more readily made the advocate of the one and the slave of the other. The same observations which apply to the reason apply to the other faculties of the mind. The senses are most apt to rebel; but even they are unsuccessful in their revolt. The delusion is too strong even for them.

2. *The Senses are deceived and confounded.* The author of the autobiography already quoted, says, "My senses were all mocked at and deceived. In reading, my eyes saw words on the paper which, when I looked again, were not. The forms of those around me, and their features, changed even as I looked on them." "I heard the voices of invisible agents, and notes so divine, so pure, so holy, that they alone, perhaps, might recompense me for many sufferings. My sense of feeling was not the same; my smell, my taste, gone or confounded." The conversion of familiar sounds, such as the lowing of cattle, the falling of water, the grating of a chain, the sound of foot-

steps, &c., into articulate speech, is not the least remarkable feature of this disorder of the mind. It is scarcely necessary to add, that illusions of sight and hearing are almost universal accompaniments of mania.

3. *The persons with whom the madman associates derive their characters from his delusion.* In the eye of the author of the autobiography the inmates of the asylum and his keepers were supernatural beings. There was a maniac there whom his spirits called the Lord Jehovah, supremely omnipotent, the trinity in unity; and one of the keepers was supposed by him to be the Saviour of mankind. At other times these same persons assumed other shapes, and according to the state of his mind, were either fiends or angels. His delusion could give to any object any shape it pleased.

4. *Real impressions on the organs of sense become, as in dreams, the materials of imaginary scenes.* This curious phenomenon has already been illustrated at p. 213.

5. *The strange antics of the madman are the effects of his delusion.* The following passages, quoted from the autobiography so often referred to, will fully establish this proposition: "When alone in the breakfast-room, I expected to be guided to prayer; but a spirit guided me, and placed me in a chair, in a constrained position, with my head turned to look at the clock, the hand of which I saw proceeding to the first quarter; I understood I was to leave the position when it came to the quarter," &c. p. 41. "Another delusion I laboured under was, that I should keep my head and heart together, and so serve the Lord, by throwing myself head over heels over every style or gate I came to; the condition here was, as before, on its being done in *precision and decision*," p. 125. On one occasion a keeper, in consequence of the resistance of one of the patients, throws him down and nearly strangles him. "When I saw his bloated and inflamed cheeks, and the eyes starting out of the sockets, I offered to do anything to rescue him. My spirits desired me to whirl myself round and round as fast as I could, which I did till I staggered against the wall, and nearly fell on the stone pavement," p. 252. This last quotation suggests a new corollary, viz. that

6. *The acts of the madman, the results of his delusion, are often such as no sane man would believe fitted to compass the object in view.*

7. *The violence of the madman is often the effect not of mere passion but of his delusion.* "I knew no malice," says the author of the autobiography, "no vice. I imagined that they (the keepers) loved me, and were all deeply interested in the salvation of my soul, and I imagined, too, that I loved them dearly. Yet I wrestled with the keepers, and offered to do so with others, and struck many hard blows; sometimes, as one informed me, making it difficult for three strong men to control me; yet whenever I did this, I was commanded, that they wished me to do so, to prove my faith and courage, but that they were commanded to prove both till they were satisfied of

my sincerity," p. 92. "It was always a great delight to me to get my hand at liberty, even for a moment, and the first use I usually made of it was to strike the keeper who untied me; directed by my spirits to do so, as the return he desired above all things else, because he knew I was proving my gratitude to the Lord Jehovah at the risk of being struck myself," p. 107. Doubtless the keepers regarded this as mere senseless and motiveless violence. Do we not equally misunderstand the criminal acts of the lunatic?

8. *The Maniac, if naturally of a reserved disposition, or when impelled by a strong motive, has the power to conceal his delusion.* The proof of this proposition may be found in every work on insanity. A remarkable illustration of this fact was given by Lord Erskine in his speech in defence of Hadfield. A person who had been confined in a lunatic asylum prosecuted his brother and the keeper of the asylum for imprisonment and false duress: Lord Erskine was counsel for the defence. He was informed in his brief that the man was undoubtedly insane; but he was not told of the particular form which the malady assumed. The prosecutor was himself a witness in support of the indictment; he was put into the witness-box and examined; and when Lord Erskine came to cross-examine him, he found his evidence clear, distinct, collected, and rational. He tried to discover some lurking alienation of mind; but during a cross-examination, conducted with all the skill and sagacity of which he was master, for nearly an hour, he was completely foiled: the answers were perfectly rational—there was not the slightest appearance of mental alienation. A gentleman, however, came into court who had been accidentally detained, and whispered in Lord Erskine's ear that the witness thought he was the Saviour of mankind. Lord Erskine, on receiving the hint, made a low bow to the witness, addressed him in terms of great reverence, respectfully begged to apologise for the unceremonious manner in which he had treated a person of his sacred character, and called him by the name of Christ. The man immediately said, "Thou hast spoken truly: I am the Christ!" Pinel relates a similar case. A commission was appointed to visit the prison of the Bicêtre for the purpose of liberating those persons who were unjustly confined there as being of unsound mind. They examined one particular patient repeatedly upon many successive days; but all their endeavours to prove the man insane failed. They accordingly ordered a certificate to be prepared for his liberation. It was necessary, before the man was released, that he should himself sign the certificate. It was placed before him, and he signed "Jesus Christ." In a case to which the author has already referred, more than one of the patient's delusions has never, as far as he can ascertain, been mentioned to any one but himself, and those who are most frequently in his company feel that he is insane, but cannot say why they deem him to be so.

9. *The acts of the Madman often evince the same forethought and preparation as those of the sane.*—This fact is well illustrated by the follow-

ing case: A patient who was confined in the Manchester Lunatic Asylum, had been cruelly treated, and in revenge killed the person who had charge of him. He related, with great calmness and self-possession, the particulars of the transaction to Dr. Haslam. He said, "The man whom I stabbed richly deserved it. He behaved to me with great violence and cruelty; he degraded my nature as a human being; he tied me down, hand-cuffed me, and confined my hands much higher than my head, with a leathern thong; he stretched me on the bed of torture; after some days he released me. I gave him warning; for I told his wife I would have justice of him. On her communicating this to him, he came to me in a furious passion, threw me down, dragged me through the court-yard, thumped me on my breast, and confined me in a dark and damp cell. Not liking this situation, I was induced to play the hypocrite. I pretended extreme sorrow for having threatened him, and, by an affectation of repentance, prevailed on him to release me. For several days I paid him great attention, and lent him every assistance. He seemed much pleased with the flattery, and became very friendly in his behaviour towards me. Going one day into the kitchen, where his wife was busied, I saw a knife; this was too great a temptation to be resisted: I concealed it about my person, and carried it with me. For some time afterwards, the same friendly intercourse was maintained between us; but, as he was one day unlocking his garden door, I seized the opportunity, and plunged the knife up to the hilt in his back."*

10. *The Madman, in spite of his proverbial cunning, is easily imposed upon.*—This forms the great safeguard of the sane in their dealings with maniacs. A good illustration of this point is contained in Lockhart's Life of Sir Walter Scott.† Henry Weber, Scott's protégé and amanuensis, had been reproved by him for indulging in habits of intoxication, which injured his health and interfered with his literary pursuits. On the evening after his return from Edinburgh, the author observed Weber's eye fixed upon him with an unusual solemnity of expression. On inquiring after his health, Weber rose and said, "Mr. Scott, you have long insulted me, and I can bear it no longer. I have brought a pair of pistols with me, and must insist on your taking one of them instantly;" and with that he produced the weapons, which had been deposited under his chair, and laid one of them on Scott's manuscript. "You are mistaken, I think," said Scott, "in your way of setting about this affair—but no matter. It can, however, be no part of your object to annoy Mrs. Scott and the children; therefore, if you please, we will put the pistols into the drawer till after dinner, and then arrange to go out together like gentlemen." Weber answered with equal coolness, "I believe that will be better," and laid the second pistol also on the table. Scott locked them both in his desk, and said, "I am glad you have felt the propriety of what

* Haslam on Madness. † Vol. iii. p. 110.

I suggested—let me only request further that nothing may occur while we are at dinner to give my wife any suspicion of what has been passing." Weber again assented, and Scott withdrew to his dressing-room, from which he immediately despatched a message to one of Weber's intimate companions. The maniac was secured and placed in confinement. This character of the insane is too familiarly known to require additional illustration.

11. *The Madman is often conscious of his state, and knows the legal relations in which it places him.*—"An intriguing, unruly, vicious madman was detected with a piece of iron, which he had contrived to shape like a dagger; into this iron he firmly fixed a handle. This weapon was taken away from him. He immediately became excessively abusive, and was placed under restraint. After this, he was more violent, and uttered the most revolting imprecations. In a fit of fury, he exclaimed to the keeper, "*I'll murder you yet: I am a madman, and they cannot hang me for it.*" "When Martin set fire to York Minster, a conversation took place among the inmates of a neighbouring madhouse, relating to the circumstance. The question discussed was, whether Martin would suffer the extreme penalty of the law for the crime. Various were the opinions expressed. In the midst of the conversation, one patient, apparently as mad as the rest, exclaimed, "He (Martin) will not be hanged—of course he will escape." "For what reason?" asked several voices. "They cannot hang him," replied the lunatic, "because he is mad,—*he is one of ourselves!*"* It must be remembered that this consciousness of their state occurs in the case of madmen surrounded by madmen; it is probably absent in those who are at large, so that they are not influenced, in the commission of crimes by that impunity which the law, under certain circumstances, attaches to the criminal acts of the insane.

The foregoing are some of the more prominent of those characters of mania which bear on the decision of medico-legal questions. They serve to throw light upon the phenomena of insanity, and to answer some of the arguments which are advanced by persons ignorant of the real nature of this strange condition of mind.† To those who are better informed they may be useful by setting forth more clearly than any general description can do, the contradictions of which the madman is the sport.

It is probably beyond the power of the sane mind to conceive the confusion which reigns in the mind of the madman. A series of delusions, the offspring of some one excited passion or emotion, or one single delusion, the work of fancy, the interpreter of every sensation, the source of every thought, the main-spring of every action; holding every faculty in stern subjection, making the senses its dupes, the reason its advocate, the fancy its sport, and the will its slave; now

* Winslow's Plea of Insanity in Criminal Cases, pp. 16, 17.

† For a very able exposition of some of the characters of mania see Abercrombie on the Intellectual Powers, 9th edition, pp. 315 and 326.

whispering in the ear things unspoken, now painting on the eye things unseen ; changing human beings at will into fiends or angels ; converting every sensation into a vision, every sound into articulate speech ; the unreal world within in constant conflict with the real world without ; understood of no one, yet believing himself to be comprehended by all ; punished for the very actions which he supposes his tyrants to have commanded, controlled in everything which he thinks it his duty to perform. There is no wish however presumptuous, no fancy however monstrous, no action however absurd, no crime however heinous, that his delusion cannot create, prompt, and justify. That a sane man might form a conception, however faint, of the distraction of such a state as this, it would be necessary to combine into one whole the strange confusion of a dream, and the sleeper's entire belief in its reality, the varying impressions and changing scenes of his waking hours, and the conduct, to him wholly unintelligible, of those about him.

The degree of confusion existing in the mind of the madman will of course vary with the nature and extent of his delusion. When several delusions spring from one excited emotion or passion, such as pride or vanity, the distraction may be expected to be greater than when one single delusion takes possession of the mind. But in this latter case, though the confusion will be less, and there may be many and long intervals of apparent sanity, the mind will be as abject a slave to the one delusion as to the many ; all his thoughts will be modified by it, and all his actions will be dictated by it. He will be a slave to one instead of to many tyrants, but still a slave.

A little consideration will convince us that, for legal purposes, it signifies little whether the mind is possessed by one delusion or by many, for the reasons which apply in the one case will hold good in the other. When any particular act of the insane is the subject of examination, the same remark will hold good ; for that one act, if the result of delusion at all, must, in the very nature of things, be dictated by one delusion—one of the many, or the only one.

In approaching the medico-legal questions relating to the form of mental unsoundness now under consideration (mental unsoundness with undue activity of the faculties), we encounter one of the strangest anomalies which the statute-book presents. In civil cases, if a man can be shown "to be *non compos mentis*, the law avoids his act, though it cannot be traced to, or connected with, the morbid imagination which constitutes his disease, and which may be extremely partial in its influence upon conduct."* This rule is very simple, and, if it err at all, it is on the side of safety. But in criminal cases, according to the highest and best legal authorities, it is not enough to prove a man *non compos ;* but it must be shown that at the time he committed the act he did not know right from wrong. This is the

* Lord Erskine in his defence of Hadfield.

received doctrine; but, as will be presently shown, the knowledge of right and wrong is not the only test which has been laid down. Now it is submitted that if the law in civil cases be right, the law in criminal cases must be wrong. If it be just to deprive a man of the management of his property on account of a delusion which has no immediate connexion with the affairs of business, ought not the same delusion which renders him incapable of civil acts, to render him also incapable of crimes? Does his delusion eclipse only half his mind? Has it not been abundantly shown that the madman's acts are as much the offspring of his delusion as his thoughts? Do not the same faculties concur in civil as in criminal acts? Is there not in both some wish or emotion or passion to originate the act, reason to plan it, and will to execute it? What ground is there for supposing that the hand which holds a pen is not moved by the same delusion with that which grasps a dagger? The civil acts of a madman are not void on account of the direct effect of his delusion upon them, but because there is no security that the influence of the delusion may not at any moment extend beyond its usual sphere of action. It is just so with his criminal acts. There can be no certainty that the delusion which ordinarily affects only the intellect, or shows itself in harmless peculiarities of conduct will not lead to acts of atrocious violence.

This distinction between civil and criminal cases has naturally arisen out of the high value which the law attaches to human life. It doubtless seems reasonable to accord to life a higher protection than to property, by applying to the criminal acts of the madman a more rigid test than to his civil acts. It is but natural that the law should have a misgiving as to the effect of allowing the proof of delusion to acquit a man of so heinous a crime as that of murder. The importance which this subject has recently assumed will justify a somewhat lengthened examination of it.

The plea of Insanity in criminal cases.—It has been just stated, that the received test of responsibility for criminal acts is the power of distinguishing, at the very time at which the act was done, right from wrong. Such is the received legal theory; but this theory has not always been carried out in our courts of law. Our earliest legal authorities evidently knew nothing of insanity beyond its violence, for we find them defining a madman as one who "does not understand what he is doing, and, wanting mind and reason, differs little from brutes."* The attorney-general, on the trial of Hadfield, evidently took this view of madness, when he laid down the law, "that to protect a man from criminal responsibility there must be a *total* deprivation of memory and understanding," and this Lord Erskine, in his defence, admits to be "the very expression used both by Lord Coke and by Lord Hale." This *total* insanity Lord Hale was the first to distinguish from *partial* insanity, and he first laid down the principle, that partial insanity is no excuse in the commission of any capital

* Bracton, lib. v.

offence. The same authority suggests as a measure of responsibility, "that such a person as, labouring under melancholy distempers, hath yet as great understanding as ordinarily a child of fourteen years hath, is such a person as can be guilty of treason and felony." The practice of our courts of law was for a long time in strict conformity with the principle thus laid down by Lord Hale. Thus, Mr. Justice Tracy, in the trial of Arnold in 1723, for shooting at Lord Onslow, observed, "it is not every kind of frantic humour, or something unaccountable in a man's actions, that points him out to be such a madman, as is exempted from punishment: it must be a man that is totally deprived of his understanding and memory, and doth not know what he is doing, no more than an infant, than a brute, or a wild beast, such a one is never the object of punishment."

The trial of Hadfield, in the year 1800, gave the death-blow to the doctrines of Lord Hale. On this memorable occasion Lord Erskine, in conducting the defence, brought his extraordinary talents to bear on the subject of insanity, and with a felicity of expression peculiarly his own, distinguished some of its more marked forms from each other, and established delusion as the true test of intellectual insanity. He showed that what the law had styled madness was idiocy—the idiocy *à nativitate vel dementia naturalis*, of Lord Hale himself—and that no such madness as that imagined by the older writers had "ever existed in the world." According to this great authority, "Delusion, when there is no frenzy or raving madness, is the true character of insanity," and, in order to render the madman irresponsible for crime, it must be shown, "that the act in question was the immediate unqualified offspring of the disease."

The doctrines of Lord Erskine, though always quoted with approbation were soon lost sight of, and in place of the test of delusion, sprang up that of "right and wrong." Thus, in the case of Bellingham tried at the Old Bailey for the murder of Mr. Perceval, May 15, 1812, Mansfield, C. J., is reported to have told the Jury, that they must be satisfied, in order to acquit, that the prisoner was incapable of judging between right and wrong, and that at the time of committing the atrocious act with which he stood charged, he did not consider that murder was a crime against the laws of *God and Nature*. In a case which occurred only two months later (that of Bowler for shooting Mr. Burrowes), Mr. Justice Le Blanc left it to the Jury to determine whether the prisoner, when he committed the offence, was incapable of distinguishing between right and wrong, or whether he was under any illusion in respect to the person he shot, which rendered his mind at the time insensible to the nature of the act he was about to commit; since in that case he would not be legally responsible for his conduct. In a still more recent case,* Lord Lyndhurst told the jury to acquit, if they were satisfied that the prisoner did not consider his act any

* Rex *v.* Offord, 5 C. and P. Reports, 168.

crime against the laws of *God and Nature.* A similar principle with slight and unimportant verbal variations was affirmed in the trial of Oxford for firing at the Queen, in the recent case of M'Naughton, in the able exposition of the law by the lord chancellor before the house of Lords, by the law lords who spoke on that occasion, and lastly, by all the judges to whom this grave question was referred. There can be no doubt, then, that the legal test at present received is the power of distinguishing right from wrong. This is the legal theory, but what is the legal practice? In the case of Hadfield, already referred to, Lord Kenyon, who with the rest of the judges of the queen's bench, presided, interrupted the defence, and said, "Mr. Attorney-General, can you call any witnesses to controvert these facts? With regard to the law, as it has been laid down, there can be no doubt whatever. If a man be in a deranged state of mind at the time of committing an act, he is not criminally answerable; the material part of the case is whether, at the very time, his mind was sane." And after other observations, his Lordship said, "His insanity must be made out to the satisfaction of a moral man meeting the case with fortitude of mind, and knowing the anxious duty he has to discharge; yet if the scales hang tremulously, throw in a certain proportion of mercy in favour of the prisoner."* In this case the distinction between right and wrong is altogether lost sight of, and in its place we have the more simple question of the insanity of the accused, in the sense which Lord Erskine had attached to that term, made the turning point of the verdict. As a general rule, however, the theory and the practice of the law have been consistent, that is to say, though the verdict has been couched in general terms, the question of right and wrong has been distinctly submitted to the jury. In the case of M'Naughton, for instance, the verdict was, "not guilty, on the ground of insanity," which verdict followed without hesitation the charge of Chief Justice Tindal, in which he had strongly and clearly laid down the distinction of right and wrong.†

* Speech of Lord Lyndhurst in the House of Lords.

† In this place it may be useful to subjoin the answers of the fifteen judges to the questions suggested by the trial of M'Naughton, submitted by them to the House of Lords, and read in the name of all the judges except one (Mr. Justice Maule) by Lord Chief Justice Tindal, on the 19th of June, 1843.

Question I. What is the law respecting alleged crimes committed by persons afflicted with insane delusion, in respect of one or more particular subjects or persons: as, for instance, when at the time of the commission of the alleged crime the accused knew he was acting contrary to law, but did the act complained of with the view, under the influence of some insane delusion, of redressing or avenging some supposed grievance or injury, or of producing some supposed public benefit?—Answer. *The opinion of the judges was, that, notwithstanding the party committed a wrong act, while labouring under the idea that he was redressing a supposed grievance or injury, or under the impression of obtaining some public or private benefit, he was liable to punishment.*

Question II. What are the proper questions to be submitted to the jury, when a person alleged to be affected with insane delusion, respecting one or

According to some high legal authorities the words *right* and *wrong* are synonymous with lawful and unlawful; and the fifteen judges seem to be of this opinion, for they say, "Every person was supposed to know what the law was, and *therefore* nothing could justify a wrong act except it was clearly proved that the party did not know right from wrong." As, however, the words *right* and *wrong* have frequently been used in a moral and religious sense, and the words just quoted are not sufficiently explicit as to their true meaning to place that meaning beyond the reach of doubt, it may be well to assume in the first place, that these words do mean something more than lawful and unlawful, and to inquire how far, when taken in a higher sense, the power of distinguishing between right and wrong can be used as a test of responsibility.

There is no doubt that this test has a show of reason, for the mind of the accused party must be either capable or incapable of distinguishing between right and wrong. But the real question is not whether

more particular subjects or persons, is charged with the commission of a crime, murder for example, and insanity is set up as a defence?—Answer. The jury ought in all cases to be told that every man should be considered of sane mind until the contrary were clearly proved in evidence. That before a plea of insanity should be allowed, undoubted evidence ought to be adduced, *that the accused was of diseased mind, and that at the time he committed the act he was not conscious of right and wrong.* This opinion related to every case in which a party was charged with an illegal act, and a plea of insanity was set up. *Every person was supposed to know what the law was, and therefore nothing could justify a wrong act except it was clearly proved that the party did not know right from wrong.* If that was not satisfactorily proved, the accused was liable to punishment; and it was the duty of the judge so to tell the jury when summing up the evidence, accompanied by those remarks and observations which the nature and peculiarities of each case might suggest and require.

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? No answer.

Question IV. If a person, under an insane delusion as to existing facts, commits an offence in consequence thereof, is he hereby excused?—Answer. *If the delusion were only partial, the party accused was equally liable with a person of sane mind. If the accused killed another in self-defence, he would be entitled to an acquittal, but if the crime were committed for any supposed injury, he would then be liable to the punishment awarded by the laws to his crime.*

Question V. Can a medical man, conversant with the disease of insanity, who never saw the prisoner previously to the trial, but who was present during the whole trial and the examination of all the witnesses, be asked his opinion as to the state of the prisoner's mind at the time of the commission of the alleged crime, or his opinion whether the prisoner was conscious, at the time of doing the act, that he was acting contrary to law? or whether he was labouring under any, and what delusion at the time?—Answer. The question could not be put in the precise form stated above, for by doing so it would be assumed that the facts had been proved. When the facts were proved and admitted, then the question as one of science would be generally put to a witness under the circumstances stated in the interrogatory.

Mr. Justice Maule dissented from this last question. In his opinion such questions might be at once put to medical men without reference to the facts proved; and he considered that this had been done, and the legality of the practice thereby confirmed on the trial of M'Naughton.

the test is reasonable in the abstract, but whether it is practical. There is one simple objection to it, and that is, that it never has been, never will be, and never can be, fairly applied. Medical witnesses may express, in general terms, their opinion that a man is irresponsible; judges, in their charges to the jury, may insist upon the distinction; and the jury may, without hesitation, return a verdict of guilty or of acquittal on the ground of insanity; but not one of them will dare to grapple with the naked question of right and wrong; not one of them will be really guilty of such presumption. The author will retract this strong opinion when he shall meet with an honest and reasonable man who will affirm that he is ready to solve this question. Till then, he will believe it to be possible with one Being alone.

If, on the other hand, the words right and wrong be taken to mean *lawful* and *unlawful*, the question is brought within very narrow limits; for the law assumes, that every member of society *knows* what the law is. Insanity, therefore, in order to make a man irresponsible, must, in some way or other, rob him of this knowledge. Now, it is clear that it does not always do this, for cases are on record in which madmen have committed murder that they might suffer the penalty of the law; and, as has been already stated, those who, from being placed under restraint, have grown conscious of their infirmity, know or believe that they are by that infirmity rendered irresponsible. On the other hand, it seems to the last degree improbable that madmen, who suffer from what is usually termed monomania, and whose intellects appear to be so little affected that they are allowed to mingle in society like other men, should be ignorant of a law with which from their earliest years they have been familiar, and of which we are all, unfortunately, too often reminded. The knowledge and consciousness of this law may be fairly expected to be the very last of which madness would deprive a man; and if a mere abstract *knowledge* of the law is all that is required to render a man responsible, then *most* madmen are responsible. But is this knowledge really all which requires to be taken into consideration? Is the case of the unhappy maniac under the accusation of crime to be the only one in which the law allows of no plea in mitigation? Is not delusion such a plea? Can any plea be stronger? It would be strange, indeed, if that which exercises so absolute a sway over every sense, and every faculty, which has the power at any moment to transport a man into an unreal world, to surround him with unreal things, and to perplex him with more than a dream's confusion, should not be allowed to have any effect upon his actions. It must have some effect. The law cannot be guilty of so great and glaring an inconsistency as to allow the proof of delusion, which is the proof of one form of madness, to vacate a man's civil acts, and yet to have no effect whatever upon his criminal acts; and yet of such an inconsistency it must be guilty, so long as the point upon which the whole question of responsibility turns, is the consciousness that the act is contrary to law.

There is one form of delusion which must form an exception to this simple rule, and that is, where a man kills another, imagining him to be a bird, a beast, or a fiend. There is also another obvious exception, and that is where a man's delusion is such as to produce an honest conviction in his mind of his being above the law ; as when he believes himself the Deity, or commissioned by him to fulfil some mission of wrath or extirpation. As a general rule, perhaps, it may be asserted that, when the delusion is of a religious character, we can never confidently affirm that the criminal act was not the natural consequence of a delusion, which placed the madman in his own sincere conviction beyond and above the operation of human laws. These, it may be said, are exceptional cases. Exactly so. They are used as exceptional cases ; but they invalidate your legal rule, and they are urged to show, that this apparently simple rule is, in some points at least, inapplicable ; and that the nature of a man's delusion must be taken into the account. There is another class of cases in which the law must extend its inquiries beyond the simple test of right and wrong, and that is, where the criminal act is the natural consequence of the delusion, as in the cases of Hadfield and M'Naughton.

This class of cases may serve to bring the question of the sufficiency of the legal test to an issue. To do this, the surest way is to take the strongest argument which can be advanced against the acquittal of the prisoner. That argument stands thus : A man believes himself to have been injured by another, and he takes away his life. Suppose the injury real instead of imaginary, would not the man be responsible for his act? Undoubtedly he would. This argument would be valid if all the concomitants in the two cases were the same ; but, in reality, they have nothing in common but the act itself. The imaginary offence has imaginary accompaniments, and every thought connected with it is one of confusion. To suppose that the mind which can imagine an impossible offence is as sound in all other respects as that of sane men, is contrary to the strong conviction of every author of experience who has written on the subject. They all with one consent repudiate the notion of a monomania consisting in a single delusion, which leaves the mind sound, and free to act as it will, beyond the sphere of its influence. The more closely the so-called monomaniac is observed, the more extensive is found to be the disorder of his mind. Those actions which are not directly prompted by his delusion are more strange, and his passions are more excitable than those of others. If his insane idea have its source in the imagination, how unlikely that this will be the only morbid display which his fancy makes! If it flow from passion, how improbable that the one passion by which it was suggested should be the only one disordered! The theory of a single insane idea springing up in the mind, unaccompanied by any other disordered action of the faculty from which it takes its rise, having no effect upon the remaining faculties, and showing itself simply by prompting an action, which, when once suggested, is carried

out with the complete consciousness of its real nature which exists in the mind of a sane man acting under the suggestion of a corresponding reality, is too absurd to be for one moment entertained. In this case then, as in those already supposed, it will be impossible to limit the inquiry to the assumed test ; the court must be led into a consideration of the general condition of the mind of the accused, must receive evidence concerning it from medical men, and must, whether it will or not, have the question decided upon different grounds from those which the law has laid down.

Nor will the fact that the murderer prepared and concealed a weapon, and watched his opportunity, be alleged by any reasonable man as a ground for inferring his sanity. Why the merest imbecile knows that a knife or a pistol is a common instrument of death ; weak as his mind may be, he conceals his weapon not because he is conscious of guilt, but because he knows that the action he contemplates would be prevented if it were openly displayed ; and, as has been shown, a maniac exhibits even more cunning than a man of sound mind, and the thing which he has conceived in madness, he executes by the same means and with the same precautions as the sane.

But there is another case which presents still greater difficulties. A man receives a real injury, and he avenges himself. It is alleged that he was not of sound mind when he committed the act, and that his act was the result of insanity, inasmuch as the injury was by his insane mind magnified to an undue importance, and then acted upon just as if it had been altogether imaginary. In this case will the law refuse all inquiry into the alleged condition of that man's mind? and, if not, what becomes of the simple test of right and wrong? Such cases as these are not of rare occurrence in lunatic asylums. Are their inmates punished as murderers? If not, how will it be possible to refuse all inquiry as to the state of mind of one, not actually under confinement, but still asserted to be as mad as if he were an inmate of an asylum? In these cases, too, an inquiry into the state of mind, extending much beyond the legal test, will be necessary, and cannot be refused ; and this very inquiry, once granted, must result in showing the insufficiency of the test. Even in those cases where the criminal act cannot be traced to any delusion of which it is the legitimate offspring, but it is simply alleged in defence, that the party is of unsound mind, will the jury, on the proof of such unsoundness, consent to treat the madman as if he were sane? Will the court refuse to regard this as a plea in mitigation?

It may be said, in answer to these arguments, that the court never has refused to entertain the general question of the mind's soundness or unsoundness, but that it institutes the inquiry for the express purpose of ascertaining whether the madman really knows that his act is forbidden by law, whether at the very time at which he did the act he was conscious that it was unlawful. If this be so, why does not the court direct the jury to state in so many words, that the accused,

at the time of committing the act, was in such a state of mind that he did not know it to be an unlawful one? The answer is obvious. The jury could not decide such a question: they could not apply such a test. The test is as unmanageable as the power of distinguishing right from wrong. We ourselves believe that, as a general rule, the madman knows the act he contemplates to be forbidden; but we should hesitate much and long before we consented to embody such an opinion in a verdict. The very horror felt at the atrocious act which has been committed, the very earnestness with which we invoke the punishment of murder on the murderer, makes the mind recoil from the thought of committing that worst of all murders—a judicial murder. It is possible that the madman might have acted under an ignorance of the law; it is certain that his motives are not in all respects such as actuate a man of sound mind; it is in the highest degree improbable that his mind, beyond the sphere of his delusion, thinks, feels, and acts, with the clearness, the force, and the freedom of the sane.

Another test has been recently proposed by an able writer in the British and Foreign Medical Review,* viz. "whether or not the individual had at the time *any power of controul over his actions.*" It is somewhat strange that such a test as this should have been proposed in the very paragraph in which all the legal tests are rejected on the ground "that they do not answer the purpose intended." It is strange that the writer should not have perceived that in shifting the test from the intellect to the will—from the knowledge of right to the power of acting aright—he was merely changing the difficulty. Is it more easy to ascertain a man's abstract knowledge of right and wrong, lawful and unlawful, than the exact amount of self-restraint which he possesses? A man must either know, or not know, that his action is right or lawful, and he must be able, or not able, to controul himself; but who will be bold enough to determine, in any particular case, which alternative is the true one? And what shall be his means of judging? Is his preparation for the act to prove his power of controlling himself in regard to the act itself? If a madman thinks another a fiend, or believes that the Deity has commissioned him to take away his life, will he not load a pistol, watch his opportunity, and act in many respects as a sane man would do? And, if prevented on one occasion, will he not wait for a more favourable one? The fact is, that in proposing this test, as in the general discussion of this question, two distinct things have been confounded,—the act itself, which is the result of the delusion, and the mode of accomplishing it. It is the delusion which distinguishes the madman from the sane, and not the mode in which the delusive impulse is carried into effect. This test, then, appears to be open to the same objections which lie against the legal tests: it seems reasonable, but it is not practical.

The entire argument, then, is an argumentum ad ignorantiam. It is because we know not what may be, that we do not pretend to say

* No. 31, p. 108.

what is; we have a horror of murder and the murderer; we should recoil, therefore, from the very thought of a judicial murder; we think that broad lines of distinction are to be preferred to subtile refinements; that it is better that punishment should be certain than severe; and we therefore conclude, that the law of France "Il n'y a ni crime ni délit lorsque le prévenu était en état de démence au temps de l'action" ought to be the law of England.

It may be objected that under such a law, even if the most rigid proof of insanity were required, many men would escape who ought to suffer the punishment of death: undoubtedly they would; but, on the other hand, none who did not deserve death would be executed; and it is a generally acknowledged principle, that it is better that many guilty persons should escape than that one innocent man should suffer. In this case, moreover, a verdict of acquittal, on the ground of insanity, brings with it, as a necessary consequence, confinement for life, which, were it inflicted as a punishment, would be second in severity only to death itself.

There are some who argue that to confine the insane for life is an injustice, inasmuch as the disease under which they labour may be completely cured. It is an injustice towards the individual, but the step is demanded by a regard to the public safety; and, when all the alternatives are weighed, it will be found to be the least injustice that the case allows of.

The practical question is this: What amount of injustice are we willing to inflict on the individual in order that society at large may be protected? If the public safety requires that the homicidal maniac should be put to death, let the principle be boldly proclaimed and acted on; but if, on the other hand, this seems too great a sacrifice, and too glaring an injustice, we must be content to confine him for life, to prevent the possibility of future mischief. This degree of injustice to the individual, a regard to the public safety will justify. Nor is there any good reason to fear that, by exempting the madman from the punishment of death, we shall weaken the hold which the law has on the man of sound mind; for, in order that he may escape death, he must successfully feign insanity—a task of no ordinary difficulty—and, if he succeed, a perpetual sacrifice of liberty awaits him. It is not likely, therefore, that society will suffer any injury from the adoption of the course here advocated; and we may perhaps find that it gains something by openly attributing to disease some of the most revolting crimes which degrade and debase our common nature.

In respect to the responsibility of madmen, then, the law seems to be in this dilemma:—it must either insist upon a test which it is impossible to apply, or it must uniformly refuse or admit the plea of insanity. If it hold to a test, its decisions will want that uniformity which ought to belong to them, and their soundness will be constantly liable to be called in question; if it reject the plea of insanity, it ought forthwith to do away with all other pleas in mitigation.

This question has already been discussed at great length, but the author cannot quit it without adding a few words as to the important object of prevention. There are doubtless many persons living at large in society, or under the insufficient control of parents or relations, and known to harbour delusions naturally tending to acts of violence; and there are others whose delusions tend less directly to criminal acts, but who are subject to sudden and dangerous bursts of passion disproportioned to their cause. Might not the natural guardians of such persons, or those who have assumed the control over them, be required to submit their cases to a competent tribunal, which should decide on the necessity and extent of restraint? And further, in case of an injury being committed by such persons, might not the sufferer or those legally dependent upon him for their support, be allowed to recover damages in an action at law against their natural guardians, on proof that they were fully cognizant of the state of the accused, and had neglected to resort to this tribunal, or had not obeyed its orders? Such an enactment might, it is conceived, be even extended to the overseers and guardians of the poor: but very many cases, among all classes of society, must still remain beyond the reach of any precautionary measure. If such a tribunal were established, its investigations should be conducted at the public expense, or at the least possible cost to the parties resorting to it; its proceedings should be unfettered by technicalities, and it should be presided over by men practically conversant with the insane, who might discharge the additional duty of ascertaining the state of mind of those accused of crime — a duty for which a common jury is totally unfit.

The removal of the insane as much as possible from the eye of the curious, and the avoidance of all unnecessary notoriety, are public duties so obvious that they need not be insisted on in this place.

The foregoing observations apply to those cases only in which distinct proof has been obtained of unsoundness of mind, existing previously, as well as at the very time of the criminal act, and not to that instinctive madness which is altogether independent of the intellect, and consists merely in uncontrollable impulse. This form of madness is now generally recognized by medical men, and has on more than one occasion led to the acquittal of an accused party. The criminal acts committed under its influence have most or all of the following characters:—

They are without discoverable motive, or in opposition to all known motives. A man kills his wife to whom he is tenderly attached, a brother his sister, a mother her infant; or the victim is one whom the madman never saw before in the course of his life, and against whom it is impossible that he can bear any malice. After the commission of the act, he does not seek to escape; he often publishes what he has done; does not conceal the body from view, but openly exposes it; delivers himself up to justice; describes the state of mind which led to the act, and either remains stupid and indifferent, or is overwhelmed

by remorse. He has no accomplices ; in most instances he has made no preparations, and he takes nothing from his victim. Sometimes he has previously spoken of his strong temptation, and begged to be prevented from doing mischief. These homicidal acts are generally preceded by a striking change of conduct and character, and, on inquiry, the unhappy maniac is often found to have an hereditary tendency to insanity, to have attempted suicide, to have expressed a wish for death, or to be executed as a criminal.

As a knowledge of the existence of such cases as these, and of the irresponsibility which would probably attach to them, might act as an encouragement to real criminals, it is most important that all the circumstances of the case should be duly weighed, and that careful search should be made after those motives which most frequently actuate the criminal. It is in such difficult cases, too, that a caution is especially necessary against basing a decision upon one or two alleged characteristics. All the circumstances of the act ought to be duly weighed, in the spirit of the words of Lord Hale: "lest, on the one side, there be a kind of inhumanity towards the defects of human nature, or, on the other side, too great an indulgence given to great crimes."

It will be seen that this class of cases stands quite apart from those in which we can obtain evidence of insanity previous to the homicidal act, and altogether independent of it. Indeed, it admits of doubt whether the mere act itself ought to be admitted in a court of law as evidence of insanity; but the circumstances of the case might justify the court in recommending the prisoner to mercy.

There is no room for prevention in these cases, except it consist in rendering the idea of violent death as little familiar as possible, and in discouraging to the utmost those revolting details which fill the columns of our papers, and often prove suggestive of crime. This precaution must be left to public opinion, which will grow stronger and stronger as the dangers and inconveniences of indiscriminate publicity shall make themselves felt, and the truth become more securely established, that what we wish men not to do we should not talk about.

This instinctive madness is no doubt sometimes associated with delusion, the criminal act itself being the result of the strong excitement of the passions, while the delusion suggests the motive. To this class probably belong those cases of wholesale murder in which the father of a family destroys his wife and children, to prevent them from falling victims to starvation, and then puts an end to his own life: the idea that such an evil threatens them being insane, no less than the impulse which prompts such a mode of escape.*

* In all discussions concerning the criminal responsibility of persons of unsound mind, it is necessary carefully to distinguish the several conditions of mind from each other. An imbecile has a confused and imperfect notion of crimes, laws, and punishments; and his acts are as foolish as his thoughts. The cases of John Barclay (p. 228) and William Tillard (p. 226) are instances of

Men feign insanity from the same motives which lead to the simulation of other diseases. The same observation, too, applies to this class of feigned diseases as to those already noticed at greater length, that it is only by actual experience of the real disease that the counterfeit can be detected. Indeed, this remark is generally acknowledged to be peculiarly applicable to feigned insanity, as no distinction which the medical man is called upon to make demands so great a share of experience. Zacchias tells us, that there is no disease more easily feigned or more difficult of detection; it may be added, that there is no point in which writers of fiction have more generally failed than in their descriptions of insanity; and it is this general ignorance of its phenomena which leads to such marked failures in assuming it.

Idiocy.—This form of mental unsoundness is rarely assumed, and, when feigned, is easy of detection. The idiot has aways a peculiar form of head, accompanied in most instances by other deformities. It must always be practicable to learn so much of a man's history as, that he was not always in the condition which he has assumed.

Imbecility.—In this case, too, the history, where it can be obtained, will serve to unmask the imposition. In the few cases in which his previous history is unknown, the patient's account of himself may assist us in detecting the imposition, for he may assign his unsoundness to some inadequate cause. The peculiar cast of countenance of the imbecile is extremely difficult to imitate. The dull, stupid, vacant, and wandering look, so characteristic of this state; the strange want of connexion in the ideas, the submissive and pusillanimous behaviour, with sudden and transient gusts of passion, are very difficult to assume. In the less strongly marked forms of imbecility, shrewdness and stupidity are displayed as it were indifferently on all points; but in an assumed case the impostor is shrewd on all points involving his interest or the success of his scheme, and displays his stupidity only in matters of indifference. All his conversation tends to exculpate himself; that of the real imbecile, on the contrary, tends to criminate himself. Ray lays much stress on this means of discrimination.*

crimes committed by this class. A monomaniac fancies himself an object of persecution, and he murders one of his imaginary tormentors. His act is as mad as his thought. He destroys one of his supposed enemies, and hopes thereby to rid himself of all. Such was M'Naughton. Another man having betrayed decided symptoms of madness, receives a real injury, and murders the person who has injured him. Such was Lord Ferrers. A third, oppressed with melancholy fears, kills those to whom he is most attached, to save them from some imaginary fate. Such was the female already referred to, who, under the fear of starvation arising out of temporary difficulties, murdered her child, cooked it, eat of it, and offered the dish to her husband. Lastly, we have the so-called instinctive madness, of which a good example is given at page 244 in the case of William Brown. Much of the difference of opinion which has been displayed in the recent discussions has doubtless arisen from not sufficiently distinguishing these several forms of unsoundness. * Op. cit. p. 240.

Dementia.—This form of unsoundness, like the two former, is neither frequently nor easily assumed. In attempting an imitation, the impostor generally indulges in hallucinations and gives evidence of mental excitement, in place of that torpor of all the faculties which belongs to the true disease.

Mania.—It is more easy to assume the violence of mania than the more subdued characters of the foregoing forms of unsoundness; hence it is more frequently assumed. The distinction of the feigned from the true disease, though occasionally requiring time and continued observation, is not difficult; but in this, as in other feigned diseases, the impostor often obstinately resists the efforts of the medical man to obtain a confession of his fraud.

The description of mania already given will assist us in our diagnosis. The peculiar expression of the countenance, the marked alteration of the features, and the wildness of the eye, which belong to real mania, can scarcely be successfully assumed. The violent excitement, accompanied by peculiar convulsive movements, also scarcely admits of imitation, and cannot be supported for any length of time. The real maniac will continue without sleep for days, and even weeks, or, if he sleep at all, his rest will be disturbed and agitated; but the impostor can scarcely keep himself awake beyond one or two days, and, in spite of himself, sound sleep will come upon him. A dose of opium, too, which would produce no effect whatever upon the madman, would infallibly send the impostor to sleep. The same remark applies to all other remedies, the real maniac being remarkably insensible to their action, so that a gentle emetic or purgative may be successfully used as a test. Another character of true mania is insensibility to external impressions. The madman will bear the most intense cold, and gaze without being dazzled on the strong light of the sun. There is, at the same time, a corresponding insensibility to internal impressions, as hunger and thirst, and the madman will go without food for days together with impunity. The bowels are also unusually inactive. Other symptoms of less importance have been much insisted on. The temperature of the skin, with the exception of that of the head, is usually lower than natural; the patient gives out a peculiar odour,* and the pulse is stated to be more frequent.†

* This odour, by some authors, has been considered as evidence of existing mania. It is doubtless a symptom of some importance, but I have myself observed it in a most marked degree in one who had been some time convalescent from an acute attack of the disease. It is best perceived in the patient's bedroom of a morning, and is so marked as to be observed even by servants. It closely resembles the smell of a corpse.

† More stress has been laid upon this symptom than it deserves; and Dr. Rush, chiefly on the strength of an increased frequency of pulse, is asserted to have decided on the insanity of a criminal supposed to be feigning madness. As it is important to guard against errors in diagnosis, it will be useful to contrast the observations made by Leuret and Mitivié at La Salpêtrière on the pulses of insane females with those of the author on the pulses of healthy persons of

Such are the chief physical symptoms of mania, which may assist us in distinguishing the true from the feigned disorder. Those which belong more especially to the mind and its manifestations are the following: The impostor is apt to overact his part during such times as he is watched; instead of becoming more quiet and reserved on the approach of the physician, his violence increases; he assumes a total annihilation of reason instead of that perversion of it which is so characteristic of the real affection; he obtrudes instead of concealing his thoughts; pretends a defect of memory which does not belong to real insanity; he has not the method of true madness, nor does he recur constantly to the leading idea; he betrays some hesitation in the midst of his assumed violence; he has not the steady gaze of the madman, and cannot resist the inquiring glance of the physician; his fits occur suddenly and at irregular and convenient intervals, instead of having the periodicity of intermittent attacks of mania. The first attack of his disorder is sudden, instead of having the long period of incubation so general in true mania. The perversion of the moral feelings which causes the madman to dislike every person to whom he was previously attached, being a symptom little known to the vulgar, is not assumed by the impostor.

the same sex. As it is probable that these observations on the insane were made in the erect posture, the frequency of the pulses of healthy females in that as well as in the sitting posture is given in the subjoined table. The results of both series of observations are expressed in percentage proportions of the whole number of observations. Those of Leuret and Mitivié amount to 89, those of the author to 50.

	Leuret and Mitivié.	Author's Observations.	
		Standing.	Sitting.
Above 100	8 per cent.	30 per cent.	12 per cent.
90 to 99	11 ,,	12 ,,	18 ,,
80 to 89	43 ,,	24 ,,	20 ,,
70 to 79	33 ,,	22 ,,	32 ,,
60 to 69	4 ,,	12 ,,	14 ,,
Under 60	1 ,,	0 ,,	4 ,,

From this table it results, that in healthy females there are 42 cases per cent. in the erect and 30 per cent. in the sitting posture in which the pulse exceeds 90, whilst in insane females the number above 90 does not exceed 19 per cent. It is only between 80 and 90 that there is any great excess on the side of the insane. This increased frequency of pulse has, therefore, been unjustly considered as diagnostic of mania. There can be no doubt that during the paroxysms the violent exertion of the muscles must tend to raise the pulse considerably above the healthy standard; but the same effect would follow the same amount of exertion in the sane. Some recent observations by Dr. Sutherland, in his Clinical Lectures on Insanity, give a higher frequency than the observations of Leuret and Mitivié. The subject still requires investigation.

Besides the diagnostic marks to be gleaned from the foregoing description, and the precautions already mentioned under the head of feigned diseases, some special tests have been recommended ; such as repeating to the suspected person a series of ideas recently uttered, when the real maniac will introduce new ideas, the impostor, on the contrary, will deem it expedient to repeat the same words. The use of the whirling chair is also recommended as a means of diagnosis. The giddiness and nausea produced by it totally incapacitate the impostor from continuing his fraud.

Few impostors are sufficiently acquainted with the true characters of mania to be able to bear the test of a careful cross-examination. The answers given by Jean Pierre, a pretended maniac, brought before the court of assizes of Paris, February 21, 1824, accused of forgery, swindling, and incendiarism, were such as at once to unmask the imposition.

Q. How old are you ? *A.* Twenty-six years (he was forty-three). *Q.* Have you ever had any business with Messrs. Pellène and Desgranges (two of his dupes) ? *A.* I don't know them. *Q.* Do you acknowledge the pretended notorial deed which you gave this witness? *A.* I do not understand you. *Q.* You have acknowledged this deed before the commissary of police ? *A.* Possibly. *Q.* Why, the day of your arrest, did you tear up the bill for three thousand eight hundred francs ? *A.* I don't recollect. *Q.* You stated in your previous examinations, that it was because the bill had been paid. *A.* Possibly. *Q.* Do you know this witness (the portress of the house he lived in) ? *A.* I don't know that woman ? *Q.* Can you point out any person who was confined in La Force with you, and who can give any account of your then state of mind ? *A.* I don't understand you. *Q.* You made your escape from the Bicêtre ? *A.* Were you there ? *Q.* At what hour did you escape ? *A.* At midnight — one o'clock — three o'clock. *Q.* What road did you take ? *A.* That of Meaux en Brie. (He took that of Normandy.) *Q.* Can you tell us who set the Bicêtre on fire ? *A.* I don't know what you mean. *Q.* You wrote a letter to Captain Freyoff the day after your escape from the Bicêtre? *A.* I did not write that letter. (It was his own hand-writing.)

Dr. Ray justly observes, that there is perhaps not one of these answers that would have been given by a madman.*

Partial Intellectual Mania. — Monomania. — Melancholia. — These partial forms of insanity are less frequently feigned than general mania. Impostors "are deficient in the presiding principle, the ruling delusion, the unfounded aversions, and causeless attachments, which characterize insanity; they are unable to mimic the solemn dignity of characteristic madness, nor to recur to those associations which mark this disorder ; and they will want the peculiarity of look which so strongly impresses an experienced observer."† The pretended monomaniac openly ob-

* See the case quoted at length from Georget's work by Ray, p. 233.

† Haslam, Med. Jur. of Insanity, p. 323.

trudes his assumed delusion, and strives to make it square with other notions with which it has more or less relation ; the real monomaniac, on the other hand, does not solicit attention, and takes no pains to reconcile his many contradictions. The open display and searching after effect of the one, contrasts strongly with the reserve, the taciturnity, and the indifference of the other. The ungovernable fury which opposition and argument excite in most monomaniacs is also a very striking character of the real affection.

A poor woman, who came under the author's notice, becoming, without cause, jealous of her husband, believed that he was constantly whispering in her ear. When asked whether he was always present when she heard his voice, she would burst into a violent fit of crying, and immediately repeat her former story, to be again interrupted in the same way when placed in the same dilemma. In this case, as often happens in women, tears took the place of anger.

Many of the characters of mania already described are common features of monomania, such as the irritability of temper, the violent prejudices, the sleeplessness, the insensibility to impressions, and to the operation of medicines.

Moral Insanity.—As the character of the act or acts committed is the chief ground for believing in the existence of moral insanity, so there is no means of distinguishing the real from the feigned disease, provided the feigned disease manifest itself by strictly analogous actions. In the case of homicidal insanity, it is so unlikely that a man would commit a murder, for which no motive could be discovered, with the certainty of being hanged if found guilty, and imprisoned for life if acquitted, that we may fairly assume a homicide accompanied by all or many of the characters already pointed out to have been the result of real moral insanity. In general moral insanity it is of great importance to attend to the previous history of the case.

Concealed Insanity. This has already been sufficiently examined among the general characteristics of insanity. A careful and repeated interrogating of the patient, long-continued observation, and the evidence of those who have known him in past times, may be necessary to detect the lurking disorder.

RULES FOR THE EXAMINATION OF PERSONS SUPPOSED TO BE OF UNSOUND MIND.

Under this head it is proposed to give a few simple directions as to the chief points to be attended to in the several examinations which the medical man may be required to institute.

1. Examine the general appearance of the individual, the shape of the head, the conformation of the body, the expression of the countenance, the temperament, the gait and movements, the speech, &c.

2. Ascertain the state of the general health, especially of the functions of the organs of digestion, the appetite, the bowels, &c. Does

the person sleep well ; or is he disturbed by dreams, or unusually restless ? Is he susceptible of heat and cold, or the reverse ?

3. Inquire into the history of the person's family. Has he any hereditary predisposition to insanity ? Have any members of his family been subject to fits, or have they betrayed any marked eccentricity of behaviour ?

4. If the mind appear unsound, how long has it been so ?—from birth or from infancy ? If the unsoundness has supervened later in life, did it follow any mental shock, or long-continued anxiety of mind, any severe bodily illness, or repeated epileptic fits ? Have the habits of life been regular or the reverse ? Has he indulged in the use of intoxicating liquors, or exposed himself habitually to causes of excitement ?

5. Does the present state of mind differ materially from that which existed when the party was reputed of sound mind ? Have his feelings, affections, and domestic habits, undergone any marked change ?

6. When the inquiry is directed to ascertain the capacity of the mind, inquire as to the person's knowledge of his family, and of the relation in which they stand to him ; as to his memory of persons recently seen, and of events which have recently transpired. Does he know his own age ? Is he conscious of the lapse of time, and can he name the day of the week, the month, the year, &c. ? Does he know the name of the reigning monarch, and of those persons who are most frequently subjects of conversation ? Ascertain his knowledge of the simple operations of arithmetic, and of the value of money. Can he repeat those simple forms of words which are in general use, as the Lord's Prayer, &c. ? Note his power of attention, and distinguish carefully between mere negative or affirmative answers to leading questions, and such as indicate judgment and reflection. If the inquiry relate not to the capacity of the mind, but to its soundness in other respects, endeavour to discover the existence of delusion by conversation directed to those topics which are most likely to interest and excite the mind. If the unsoundness affects the moral feelings rather than the intellect, make the relations and friends of the individual the subject of conversation. In cases of supposed moral insanity, inquire into the motives which may have led to the commission of the act of which the party is accused.

7. When undergoing examination in a court of law, the medical witness should carefully avoid all definitions of insanity, on the plea that mental, like bodily diseases, do not admit of definition, but are subjects for description ; and that diagnosis in most cases must depend upon a comparison of several combined symptoms. The medical man should also insist on having sufficient opportunity of forming his opinion. He should rarely content himself with a single visit, and in cases of difficulty should require the party to be placed for some time under his inspection.

In other respects the same observations apply to the examination of persons supposed to be of unsound mind as to other investigations which the medical man may be required to make.

CHAPTER VII.

PERSONS FOUND DEAD.—REAL AND APPARENT DEATH.—SUDDEN DEATH.—SURVIVORSHIP.

The contents of this chapter are more closely allied than those of most of the preceding chapters. Under the title of *Persons found Dead* it is proposed to consider those general precautions which the medical man should observe in conducting inquiries concerning persons whose mode of death is altogether unknown, and to lay down some general rules relating to such cases. It will be seen, therefore, that this title is here used in a much more restricted sense than that which is often attached to it. As the first question which would naturally be raised is as to the reality of death, the subject of real and apparent death occupies the next place. This is followed by the title sudden death, in which some of the more common modes of dissolution are briefly considered ; and this, in turn, by the subject of survivorship, which is naturally and closely connected with it.

PERSONS FOUND DEAD.

Relation of the Body to surrounding Objects.—The place in which the Body is found.—Position of the Body.—Examination of the Spot on which the Body is found—of the Soil or Surface on which it lies.—Position of surrounding Objects.—The Clothes.—Examination of the Body.—Post-mortem Inspection.

In the chapter on Medical Evidence instructions were given as to the best mode of stating facts and opinions in a court of law, so as to give them their full force, and to render them admissible as evidence. It is proposed, in this place, to give some brief directions for observing and collecting a very important class of these facts, namely, those which refer to persons found dead. It may be useful to recur to the distinction already made (p. 6) between a common and a skilled witness. In almost all medico-legal cases, but especially in those referring to persons found dead, these two functions are combined. The medical man is cognizant of two orders of facts,—those which require no interpretation from him, and those from which he is expected to draw his own inferences. Let us suppose that he is sent for to a dying man, or to one already dead, and that he is subsequently required by the coroner to make an examination of the body; he must of necessity observe many things connected with the body itself—the position in which it is placed, and the objects by which it is surrounded—which might just as well be observed and stated in evidence by any other person ; but the post-mortem inspection can be made by himself alone. Hence the present inquiry branches off into two divisions. 1. The relation of the body to surrounding ob-

jects. 2. Directions for the performance of post-mortem inspections for legal purposes: in other words, directions as to the best mode of performing the duties of a *common* witness and of a *skilled* witness respectively.

1. RELATION OF THE BODY TO SURROUNDING OBJECTS.

The professional duties which the medical man has to perform give him many opportunities of furthering the ends of justice. He is summoned to all cases of severe illness or sudden death, and is therefore one of the first persons to become cognizant of those simple facts which in every criminal trial have so important a bearing on the decision of the case, and which constitute the presumptive or circumstantial evidence. But the medical man is not only one of the first witnesses of these facts; he is also in most cases by far the best educated and most intelligent witness. Whenever, then, he is called to visit the dying or the dead, under circumstances of suspicion, he should be alive to all that is passing around him, that no object, however trifling, which may possibly throw light on the cause of death, may be overlooked. The following are some of the principal points to which his attention should be directed :—

The place in which the body is found.—This is the first thing which will attract attention; and the first caution with regard to it is, not to conclude too hastily, that the spot in which a body is discovered is that in which death actually took place. A case enforcing this caution, and strongly reminding us of the story of the Hunchback in the Arabian Nights, occurred about forty years since at Liverpool. A body was found in an upright position, supported by railings which fenced a shipwright's yard. On examination, it was proved that the deceased had been killed by a fracture of the skull inflicted by some blunt instrument. A reward was offered, every effort was made to discover the murderer, and several parties were taken up on suspicion, but acquitted from want of evidence. Forty years afterwards, an old woman on her death-bed made the following confession : She was standing at the door of her house, and the deceased, passing by in a state of intoxication, caught hold of her. She ran into the front parlour, and he with her ; she called out, and her husband, who was a pilot, happening to come in at the moment, took up the poker and killed the deceased at one blow. He and his wife, terrified at what had happened, began to think how the body should be disposed of, when the wife hit upon the plan of taking the body out, between 12 and 1 at night, being very dark, and rearing it against the railings where it was found by the watchman. The corpse was carried by her husband a distance of 200 or 300 yards from his house.*

The position of the body.—We must endeavour to ascertain whether this position corresponds with the supposed or ascertained cause of

* Times newspaper, Nov. 31, 1838.

death. In the case just quoted, the mere fact of a man killed by a blow on the head being found in an upright position, would have led to the inference, that the body had been placed in that position after death. It is not uncommon for a murderer, after having despatched his victim, to dispose of the body in such a way as to make it appear that the deceased died by his own hand. Thus persons who have been poisoned have afterwards been suspended by the neck, or thrown into the water. Sir Edmundbury Godfrey was found lying in a ditch with a distinct mark round his neck, which was dislocated, and with his own sword passed through his body; and there is little reason to doubt that he was first strangled, that the wound was inflicted after his death, and that the body was so disposed of as to lead to the belief that he had committed suicide.* It may happen, in cases of this kind, that something has been omitted by the criminal in the arrangement of the body itself or of the surrounding objects, which may enable an intelligent witness to detect the fraud that has been committed. In cases of death by hanging, considerable importance may attach to the posture of the body.

Examination of the spot on which the body is found.—It is often highly important to examine carefully the spot on which a body lies. A wound or bruise has been inflicted, and there is reason to regard the injury as the cause of death. The question naturally arises: Might not the wound or bruise have been caused by a fall on some body projecting from the spot on which the body was found? Thus, in the case of a man who was found lying in a field with a severe bruise on the head, the question was put—Might not the deceased have fallen on a stone, or on a fragment of wood? The answer was easy: the field had been carefully searched, and no such object could be found near the spot on which the body lay. In another extremely interesting case, an intelligent medical witness found a small wound in the head, which had passed through the integuments and bones to the brain, and he stated that it must have been caused either by a fall on a sharp object, such as a nail fixed in the floor, or by some pointed weapon. The floor was examined, but no such object was to be found. It followed, therefore, that the wound had been inflicted by some small pointed instrument. The murderer confessed that he had struck his victim with the point of a pair of snuffers. There are many occasions on which this close correspondence of wounds or bruises found on a dead body with the objects immediately surrounding it forms a most important item in the evidence by which the cause of death is determined. Thus, in the case of the Prince de Condé, who was found suspended by the neck in his bed-room, certain abrasions found on the legs and one of the shoulders corresponded closely with the position of surrounding objects; those on the legs with a heavy chair placed close to the body, and that on the shoulder with a projecting part of the win-

* See the case at greater length in Beck's Med. Jur. p. 644.

dow to which he was suspended. This case created a great deal of discussion, and many persons were of opinion that the prince had been murdered and afterwards suspended. The correspondence of the bruises with the position of the chair and window harmonized much better with the struggles of a man suspended during life than with any other cause to which they could be attributed, and gave strong confirmation to the opinion of those who attributed the death to suicide.

The soil or surface on which the body lies may furnish important indications. It rarely happens that a struggle takes place without leaving on the spot itself some traces which may be compared with the clothes of the suspected murderer or of his victim. Stains of blood upon the clothes, for instance, or impressions of the foot on the soil, have led to detection. An interesting example of this latter kind is given by Sir Walter Scott. The murderer was discovered by the print of his foot which he left on the clay floor of the cottage in the death struggle. The measure of the foot, the tread, and the mode in which the sole of one of the shoes had been patched, corresponded most closely with the foot-mark; and this was the first link in the chain of evidence which led to the conviction of the murderer.*

Position of surrounding objects.—Having examined the spot on which the body lies, attention should next be directed to the position of the objects that surround it. Oftentimes the instrument of death is found lying near the body, and as, in certain cases, its relation to the corpse may furnish important evidence, it should always be carefully noted. In cases of suspected poisoning, every vessel in which food has recently been prepared and administered should be carefully examined, and its contents reserved for analysis. The same observation applies to suspicious liquids or powders which may be found in the apartment.

The bearing and conduct of the parties in attendance should not be overlooked. Crime is rarely self-possessed, and, when most on his guard, the culprit is apt to betray himself by an excess of caution. The medical man, therefore, should be alive to all that is taking place around him.

The Clothes.—Having noted the position of the body, the spot on which it lies, the objects by which it is surrounded, and the persons who are in attendance, the medical man now proceeds to a more close inspection of the body itself. He examines the clothes; they may be covered with mud, or corroded by an acid, or stained by blood, or by some animal secretion; or they may be torn as if during a struggle, or cut by a sharp instrument. The position of the stain and the direction of the rents or cuts must be carefully noted. The indications to be derived from an observation of these things must vary with each case; but it is easy to understand how they may prove important.

* Lockhart's Life of Sir Walter Scott, vol. iii. p. 39.

If the clothes have been cut, we must examine them to see whether the size, shape, and direction of the cuts coincide in the several garments, and whether they correspond with any wounds that may be found on the body itself; for it sometimes happens that a murderer tries to conceal his crime, by cutting the clothes after he has wounded the body, and the wounds and incisions do not coincide.

Crimes have often been discovered in consequence of the close correspondence of things found in the possession of the accused, with things used in the perpetration of the crimes themselves. As the discovery of such means of identifying a criminal falls more frequently to the lot of the police-officer than to that of the medical man, the subject is merely mentioned in this place.

These are some of the points to be attended to; but neither examples nor rules can do more than suggest the sort of inquiries which we should be prepared to make; each man's own judgment and foresight must prompt the particular points to be observed in individual instances. One general rule, indeed, may be laid down. The medical man should never content himself with the mere passive exercise of his senses or judgment. It is not enough to see the objects which actually present themselves to the eye; he must look for such as are not obvious at the first glance. To the correctness of a good observer he must add the intelligence and invention of an experimenter. He must beware of a hasty decision, and remember that the apparent cause of death is not always the real one. A man may die a natural death, in a situation or under circumstances which may cause suspicion to fall upon the innocent; the murderer may place his victim in a situation which may attach guilt to an innocent party, or lead to the belief that the deceased died by his own hand. To guard against all such sources of error, the medical man must arm himself with caution and even with scepticism; without the first of these, at least, he may both endanger his own reputation and the lives of his fellow-creatures. The service which an intelligent medical witness may have it in his power to render to the cause of justice cannot be better illustrated than by the following case, for which the author is indebted to his friend Dr. James Reid. It is given as nearly as possible in his own words:—

"I was sent for one day to a man and his wife, whom I found lying in the same room with their throats cut. The woman lay on the floor with her right arm extended under the bed, and a razor close to her right hand. Her throat was deeply cut from ear to ear, and she lay in a complete pool of blood. The husband, who was in bed, had received a wound in the throat, which had merely divided the trachea without wounding any important blood-vessel, and without causing any great loss of blood. When questioned, he gave the following account:—In the middle of the night he was roused from sleep by receiving a wound in the throat from the hand of his wife. The shock, the wound, and the loss of blood together, had prevented him

from making any resistance or giving any alarm. My suspicions were roused, partly by the man's manner, and partly by observing the water in a basin standing in the room slightly tinged with blood. In endeavouring to find some confirmation of my suspicions, a thought struck me. *I turned up the bed-clothes, and found the sole of the foot covered with dried blood.* I stated this fact to the jury at the coroner's inquest: a verdict of guilty was immediately returned, but the man died almost at the moment that the sentence was passed."

A more instructive case than this could scarcely have been selected.

2. EXAMINATION OF THE BODY.—POST-MORTEM INSPECTION.

The medical man having discharged the duty of a common witness by noting all those points which may throw light on the mode and cause of death, proceeds to the examination of the body itself. Should the body be that of some person unknown, we must note all those circumstances which may lead to its identification—the sex and probable age, the stature, the degree of corpulence, the colour of the hair and eyes, and any peculiar marks which may exist on the surface of the body. Those appearances which serve to denote how long the party has been dead, viz. the presence or absence of animal heat, of cadaveric rigidity, and of putrefaction, and the extent to which the latter change has gone, must then be observed. These will be the subject of the next chapter.

The condition of the several parts of the body must now be noted, and any wounds, contusions, or excoriations which may exist, must be described, and in this description we must not content ourselves with general phrases, if any certain measure can be applied. We must then examine the neck, back, and limbs, to ascertain whether any dislocation or fracture exists, and we must not hastily assume that the bones are not displaced or injured because the external parts of the body bear no traces of contusion or laceration. We should compress the chest to ascertain whether blood or any fluid mixed with air or gas escapes from the mouth or nostrils. The cavity of the mouth should be inspected; for suffocation has been produced by foreign bodies introduced into it. The anus should be examined, for poisons have been introduced into the body by that opening. In new-born children the orbits, fontanelles and nuchæ should be inspected in search of minute wounds inflicted by pointed instruments. In women the breasts should be examined, especially beneath the deep fold which they form with the skin of the chest, for there is a case on record in which a woman, found suspended by the neck, was at first thought to have died of strangulation, but on closer inspection a minute wound inflicted by a pointed instrument, and extending to the heart, was found concealed by the left breast. The female organs of generation should also be examined, for there are cases on record in which arsenic has been introduced, or strong acids injected into these parts, some-

times with a view of destroying the female herself, in other cases to procure abortion. There is also one horrible case on record, in which a woman was murdered by deep incisions made on the internal surface of the labia pudendi.

Post-mortem Inspection.—There is one great rule to be observed in conducting post-mortem inspections for medico-legal purposes, and that is, to examine every cavity of the body. Even when the cause of death is quite obvious, it is well to observe this caution ; for if any part of the body have been left unexamined, the objection may be made that the cause of death might have been found there, or, at any rate, that some disease may have been present which would have given a mortal character to an injury not otherwise fatal.

Chaussier has given very minute directions for performing post-mortem examinations for legal purposes ; but such detail is quite unnecessary. No one who is aware of the important object of the inspection will be likely to perform it in a hasty or slovenly manner ; and provided it be done with care, the precise order or mode in which the several cavities are opened is of little importance. All traces of injury, whether external or internal, must of course be very minutely and carefully examined and described.

Specific directions for post-mortem examinations in cases of rape, delivery, poisoning, infanticide, &c., are given under those heads.

REAL AND APPARENT DEATH.

Questions as to the Reality of Death of rare occurrence in this Country.—What Condition of the System has been most frequently mistaken for Real Death.— Syncope.— Voluntary Syncope.— Case of Colonel Townshend.—Asphyxia.—Signs of Death.—Cessation of the Respiration.—Of the Circulation.—Facies Hippocratica.—State of the Eye.—Of the Skin.—Insensibility, Immobility, and loss of the Intellectual Faculties.—Loss of Muscular Irritability.—Extinction of Animal Heat, Cadaveric Rigidity, and Putrefaction, considered not only as Signs of Death, but as means of determining how long Life has been extinct.—Phenomena of Putrefaction in Air and Water.

When a medical man is sent for on a sudden to a person who has fallen into a state of insensibility, and finds him lying motionless, the first question which would arise in his mind is, whether the person is really dead ; and although the question seems very easy of solution, it is not altogether so simple as not to deserve a little attention.

It is true that it has very rarely happened in this country that persons have been treated as if they were dead when they were really alive, although one or two authors who have taken great pains to collect examples of so melancholy a mistake have not found their search altogether fruitless.

In consequence of the supposed or actual infrequency of such events in England, no medical author of reputation has written at any length

on this subject; the only work devoted expressly to it in our own language being from the pen of a clergyman, the Rev. Mr. Whiter, whom Dr. Gordon Smith accuses of "having laboured under one mistake from the title-page to the concluding paragraph."

The little attention which has been given to this subject in England is attributable to the popular usages in respect of interment—the body being never committed to the grave until putrefaction has taken place.

As this usage with regard to interments prevents all risk of persons being buried before life is actually extinct, this subject of real and apparent death might be summarily dismissed, but that there are other reasons which justify its introduction in a work on Forensic Medicine.

In the first place, it has been suggested that in times of pestilence a regard to public safety would require the bodies of the dead to be interred before the infallible sign of putrefaction had made its appearance; and we might be obliged to trust to other indications of a less satisfactory nature. In the second place, it must be borne in mind that the question of real or apparent death may be one of practical importance long before the usual period of interment arrives, and when the decision of the question must determine the adoption or neglect of the measures usually resorted to with a view of restoring animation. If the medical man decides hastily, and without due examination, that death has really taken place, he may omit, or prematurely desist from, the employment of those means by the persevering use of which life might have been restored.

To these reasons for allowing this subject a place in the present treatise may be added the example of most authors on Forensic Medicine, and the fact that, on the Continent, and especially in France, it has employed the pens of some of the most distinguished medico-legal writers. Bruhier, for instance, has contrived to bring together no less than 180 cases, in 52 of which persons were buried alive, 4 were opened before death, 53 revived after being placed in their coffins, and 72 were pronounced dead when they were really living.*

Bruhier was preceded by Winslow, who is said to have been led to devote especial attention to this subject from having been twice pronounced dead himself. The writings of Winslow and Bruhier excited much attention in France, and influenced the minds of the best authors on Forensic Medicine in that country in favour of their views; Mahon, Foderé, and Orfila having shown some disposition to give credence to the strange and improbable stories of those authors. The importance attached to the subject in France led Professor Louis to devote much attention to it, and to write a book, of which the title "Sur la *Certitude* des Signes de la Mort" expressed his dissent from the doctrines of Bruhier.

There is no other subject connected with Forensic Medicine which can boast so large a collection of strange and improbable fictions; but

* Sur l'Incertitude des Signes de la Mort.

mixed with them there are doubtless some well-authenticated cases. One of these is given on the authority of Professor Louis.

A stout young country girl having been brought to bed at the Hôtel Dieu, walked to the hospital Salpêtrière on the second day, to avoid a malady that had proved fatal to several patients in the former hospital. She was so much exhausted by the exertion, that she fainted on her arrival; and though she recovered in the first instance, she was reputed dead upon a recurrence of the fit. The attendant sent notice to Louis that there was a subject for him; and his pupils, without examining, carried her off to the anatomical theatre. Next morning, the professor was informed that moans and the like noises had been heard in the theatre. On repairing thither, the subject (really dead now) gave evidence of having in vain struggled to disentangle herself from the winding-sheet. One leg was thrust from the bier, and an arm rested on the bar of an adjoining table.

It is unnecessary to multiply instances of such melancholy mistakes. It is not to be wondered at that the vulgar should mistake the repose and apparent lifelessness of a fainting fit for the sleep of death, or that even the medical man, if he will not take the pains to make a careful examination, should fall into a similar error. It is possible that one or other of the cases mentioned in most works on Forensic Medicine, of persons being roused from apparent death by the touch of the anatomist's scalpel, may have really occurred.*

That some of the many recorded instances of apparent mistaken for real death, and consequent premature interment, have really occurred, scarcely admits of doubt, and they are rendered the more probable by a class of cases which seems to point clearly enough to the exact condition of the living body that has been thus confounded with actual death. These are cases in which persons have been roused from what seemed the sleep of death by the accidental employment of the very means that are found most efficacious in restoring those who have fainted,—a strong reason for believing that, in the majority of instances at least, the apparent death, about which so much has been said and written, is nothing more nor less than a state of syncope.

Thus, many cases are recorded in which persons taken for dead have been restored to life by sprinkling them with cold water. Hippocrates mentions the case of a woman, who being in appearance dead from fever, was restored by throwing 30 amphoræ of cold water over the body. The philanthropic Howard, in his work on Prisons, says, "I have known instances, where persons supposed to be dead of the gaol fever, and brought out for burial, on being washed with cold water have shown signs of life, and soon afterwards recovered."

The inference drawn from the success of so simple a means as the

* Case of Prévot d'Exiles; another on the authority of Philippe Peu, a celebrated French accoucheur; a third quoted by Bruhier on the authority of the Abbé Ménon; and that of the Spanish gentleman dissected by Vesalius, in whom the heart was found beating.

sprinkling with cold water, that apparent death is nothing but *syncope*, is strengthened by the efficacy of pure and cold air in producing the same result.

Diemerbröck mentions the case of a rustic, who having appeared to die of the plague, discovered after three days no signs of respiration, but, on being carried to the grave, recovered and lived many years afterwards; and Paul Zacchias relates an analogous case which occurred at the hospital of Santo Spirito at Rome.

One of the best authenticated instances of this kind is that of the daughter of Henry Laurens, the first President of the American Congress. When an infant she had the small-pox, and was laid out as dead; upon which the window of the apartment, that had been carefully closed during the progress of the disease, was thrown open to ventilate the chamber, when the fresh air revived the supposed corpse, and restored her to her family. This circumstance occasioned in the father so powerful a dread of being buried alive, that he directed by will that his body should be burnt, and enjoined on his children the performance of this wish as a sacred duty. If the story told by Pliny of a certain Avicola, whose body was brought out and placed on the funeral pile, the flames of which resuscitated the unhappy victim, but too late to allow him to be rescued, be true, this caution might not have availed him.

Such cases as these are very likely to have been of frequent occurrence before the time of Sydenham, who abolished the stifling system of treating eruptive diseases, especially small-pox. It is not to be wondered at that persons shut up in close apartments during a long and debilitating disease should fall into a state of long-continued syncope; or that, by inattentive observers, this state should be mistaken for death. In such cases, all that would be required in order to resuscitate the supposed corpse would be a draught of fresh air or a sprinkling of cold water. The efficacy of cold air and cold water, therefore, in restoring those who have been supposed dead, gives us the best reason for believing that, in most cases, the state confounded with actual death was nothing more than *syncope;* and this state of the body bears so close a resemblance to real death, that even the medical man may be justified in trusting more to the effect of the means of resuscitation than to any positive signs of death.

There is no doubt that some individuals have possessed the power of fainting at will, for such cases are reported by more than one author. A minutely-described and well-authenticated instance of this kind, that of the Honourable Colonel Townshend, is related by Cheyne.* The following is an account of this singular case in the words of Dr. Cheyne:—

"He told us, he had sent for us to give him some account of an *odd sensation* he had for some time observed and felt in himself; which

* English Malady, p. 307.

was, that composing himself, he could *die* or *expire* when he pleased, and yet, by an *effort*, or somehow, he could come to life again: which, it seems, he had sometimes tried before he had sent for us. We all three felt his pulse first: it was distinct, though small and thready, and his heart had its usual beating. He composed himself on his back, and lay in a still posture some time; while I held his right hand, Dr. Baynard laid his hand on his heart, and Mr. Skrine held a clean looking-glass to his mouth. I found his pulse sink gradually, till at last I could not feel any by the most exact and nice touch. Dr. Baynard could not feel the least motion in his heart, nor Mr. Skrine discern the least soil of breath on the bright mirror he held to his mouth. Then each of us by turns examined his arm, heart, and breath, but could not by the nicest scrutiny discover the least symptom of life in him. This continued about half an hour. As we were going away (thinking him dead) we observed some motion about the body, and upon examination found his pulse and the motion of his heart gradually returning; he began to breathe gently, and speak softly." This experiment was made in the morning, and he died in the evening. On opening the body nothing was discovered but disease of the kidney, for which he had long been under medical treatment, all the other viscera being perfectly sound.

This case of *voluntary syncope* is not only curious but instructive, as it renders it in the highest degree probable, that there may be states of system so nearly resembling death as even to deceive medical men, and distinguishable from real death only by the continuance of animal heat and the absence of rigidity.

Asphyxia is another condition of system which may be mistaken for real death, and which can be distinguished from it only by the result of the means employed for the recovery of the patient. As Dr. Gordon Smith has well observed, "Between the state of asphyxia, or animation merely suspended, and that of absolute death, the only satisfactory means of discrimination is the result of the proper application of the approved means of recovery."

There are also states of system, vulgarly known by the name of *trance*, occurring mostly in hysterical women, and resembling death in the motionless and insensible state of the frame. The case of Colonel Townshend renders it probable that in some of these instances there may have been that absence of the functions of respiration and circulation which might deceive even medical men. At any rate, we are not justified either in treating such cases as fabulous, or in asserting that the semblance of death may not be such as to require the use of some test more sure than those resorted to in that curious case.

The most important application of the fact, that there are certain states of the living system which may closely simulate death, is that we should not too soon give over our attempts to resuscitate those who have appeared to die by some means applied to them when in a state of health, or by some disease which is not of a necessarily fatal

character, such as hæmorrhage. On this subject Dr. Gordon Smith makes some very sensible observations. After quoting Bruhier's commentary on Winslow's Thesis on the uncertainty of the signs of death, in which Bruhier complains that many lives have been lost, that might otherwise have been saved, by the Roman Catholic rite of extreme unction, which being administered to persons in the last extremity, allows of no subsequent interference with the dying person, he says, "I have myself been debarred from the exercise of my professional duty, by means of this very act, where had the religious profession of the patient been different, there would have been no reason to suppose that the continued administration of remedies was either improper or utterly hopeless. How often have we seen in that exhaustion which accompanies many diseases, every superficial indication of death dissipated by sedulous care and judicious applications, and recovery to health and vigour take place! And in certain times of public sickness, during the confusion of a battle, or under a dread of speedy putrefaction, possibly we might encounter practical illustrations of that apprehension which in ordinary circumstances must be considered chimerical." "Asphyxia, or suspended animation, too, is often undistinguishable from recent death; and from ignorance of the real history of the case, it may be feared that the means of resuscitation are sometimes withheld, or but indolently employed, where judicious practice and adequate perseverance might be crowned with success."

Where the circumstances of the case, then, are such as to afford the slightest hope of recovery, the medical man should persevere in the use of means, and not allow himself to be discouraged by want of immediate success. It is in these cases that the effect of the means employed forms the true test of the reality of death.

SIGNS OF DEATH.

The principal signs of death insisted upon by authors are, *a.* Cessation of the Circulation; *b.* Cessation of the Respiration; *c.* The Facies Hippocratica; *d.* The State of the Eye; *e.* The State of the Skin; *f.* Insensibility and Immobility; *g.* The Extinction of Muscular Irritability; *h.* The Extinction of Animal Heat; *i.* Cadaveric Rigidity; *k.* Putrefaction.

a. Cessation of the Circulation.—The usual mode of determining whether or not the heart still continues to beat is the application of the finger to the wrist, and the hand or ear to the heart. It is obvious that these means may be insufficient, for though the stronger contractions of the heart may be perceived in these several ways, there is reason to believe that the weaker ones would altogether escape detection. It will not be possible, therefore, by any or all of these tests, to assure ourselves that the heart has really ceased to beat, and the blood to circulate. Even assuming that these means would enable us

to detect the weakest contractions of the heart, there is reason to believe that life may be restored even after the entire cessation of the heart's action. Whether the heart cease to beat altogether, or contract so feebly as not to make itself perceptible to the hand or ear, is of little consequence, as the fact of its contractions being apparently suspended for a time is enough to deprive the test of all practical value.

In the remarkable case of Colonel Townshend, the contractions of the heart appeared to have entirely ceased, and that for a long interval, and yet life was not extinct. The same thing occurs, though for a shorter time, in all cases of syncope and asphyxia, whether they prove fatal or not. The cessation of the circulation, therefore, is not a sure sign of death.

b. Cessation of the Respiration.—If the possibility of the heart's action being suspended for a time be conceded, there is no difficulty in supposing the suspension of the respiration for an equal space. The tests of respiration—the looking-glass, the feather, the cup of water placed on the chest or abdomen—are more certain in their nature than those by which we seek to determine the continuance of the heart's action. It is scarcely possible that respiration should take place in any degree, and yet escape detection by such means. Now, in the case of Colonel Townshend, the looking-glass remained for a long period unsoiled, and no trace of respiration could be detected. For practical purposes, therefore, it may be fairly assumed, that respiration, like the circulation, may be suspended for a time, and that such suspension is not a sure sign of death.

The same remarks apply to the joint cessation of the functions of respiration and circulation as to the cessation of either separately.

c. The Facies Hippocratica.—This peculiar appearance of countenance is thus described by Foderé :—" A wrinkled and dry brow ; hollow eyes ; pointed nose, bordered with a black discolouration ; a depressed, hollow, and wrinkled state of the temples ; elevation of the ears ; the lips relaxed and pendant ; the cheek bones sunk ; the chin wrinkled and pointed ; the skin dry and livid, or lead-coloured ; a dull white powder on the hair of the nostrils and eye-brows ;"—in fact, such an entire alteration of the physiognomy as to render the individual almost irrecognizable. There are several objections to this sign.

1. It is not universally met with, being sometimes present in those who are worn out by lingering suffering, but nearly always absent in cases of sudden death, and in the victims of acute disease.

2. Wherever it has been present in the dead, it must have existed in the dying. Hence it is a sign that a man is dying, full as much as that he is dead.

3. It has been observed where recovery has taken place.

4. It is often present in living persons ; and, according to Foderé, a strong impression of danger, the apprehension of a dreadful punishment, or the anticipation of certain death, may bring about a state of countenance similar to that described.

5. Where it exists, it does not long survive the extinction of life.

This sign, therefore, cannot be relied on; its absence does not prove that a man is not dead, nor does its presence afford sufficient evidence that life is extinct.

d. State of the Eye.—The formation of a tenacious glairy mucus, almost of the consistence of membrane, covering the conjunctiva, and with difficulty removed from it; a loss of transparency in the cornea, and especially a collapsed and wrinkled state of that membrane—have been mentioned among the signs of death. These signs, too, are not worthy of implicit confidence; for the conjunctiva may be invested by a mucous film in the living, and the cornea may lose its usual brilliancy. The collapsed and softened state of the eye, generally attributed to the absorption of the aqueous humour, is an appearance to which Professor Louis attached much importance; and there is no doubt that, in most cases, it makes its appearance very early. But it must be recollected, that it does not exist in all forms of death. In death from *apoplexy*, and from the *inhalation of carbonic acid*, the eyes preserve their brilliancy and prominence for a long time. The same is said to be the case in death from *prussic acid*. Where, too, the eyes are dull and collapsed after death, the commencement of the putrefactive process sends blood towards the head, and makes the eyes brilliant and prominent. Nysten produced this state of the eyes at will, by introducing substances in a state of fermentation into the stomach after death.

e. State of the Skin.—*Pallor* of the skin, owing to the absence of circulation; *livid discolourations*, the result of the irregular subsidence of the blood, and *loss of elasticity*, so that if the skin be pressed, it does not resume its original form,—have been mentioned among the signs of death. The first two may exist during life, and the first is not always present after death; but loss of elasticity is a sign of considerable value.

f. Insensibility and Immobility.—As both of these may exist during life as well as after death, it is absurd to name these among the signs of death. They are of course present in all cases of apparent death in which life may be restored by proper appliances. The combined loss of voluntary motion and sensibility is not of rare occurrence in hysteric females, and it is present in the mesmeric slumber, so that the strong stimulants which have been recommended as tests of the reality of death produce no effect. In these cases, however, the functions of circulation and respiration go on uninterruptedly, and a careful observer will detect a vibrating movement of the eyelid, which forms an exception to the general rule of immobility. This peculiar vibration of the eyelids is probably present in all cases of so-called trance.

Extinction of Muscular Irritability.—When muscular irritability is altogether extinct, life may be assumed to be extinct also. Nysten has recommended this as a certain criterion of death. He tells us to lay a muscle bare, and test it by pricking it or by applying the galva-

nic or electric fluid. If it do not contract, death has certainly taken place ; if it do contract, the person is either alive or recently dead.* The left ventricle of the heart is the first part of the frame in which irritability is extinct, the right auricle the last. The muscles of the trunk and extremities retain their irritability longer than the involuntary muscles, with the one exception of the right auricle. Among the voluntary muscles, those of the upper extremity are the last to lose their irritability, and the muscles of the trunk the first. These results, obtained by Nysten from an examination of seven decapitated criminals, would probably apply to death from natural causes, but the period of extinction would of course vary.

Among the more trivial signs of death, the flexure of the thumb across the palm of the hand may be mentioned. The thumb assumes this position in most cases, if not in all, and even before cadaveric rigidity comes on. It is similarly contracted in spasmodic affections of the muscles of the hand.

The foregoing signs are merely signs of death, and not means of determining how long life has been extinct. Those which remain to be discussed, viz. the extinction of animal heat, rigidity, and putrefaction, at the same time that they are, with the exception of the extinction of muscular irritability, the only certain signs of death, are also means of determining, with more or less precision and certainty, the period at which death took place. These signs must therefore be examined a little more closely.

SIGNS OF DEATH WHICH ARE ALSO MEANS OF DETERMINING HOW LONG LIFE HAS BEEN EXTINCT.

h. Extinction of Animal Heat.— One of the chief peculiarities of living beings is, that they retain a temperature independent of the media in which they are placed. This temperature is closely dependent on the circulation of the blood ; so that when this ceases, in a part of the body or in the entire frame, that part, or the whole body, soon becomes cold. Thus, the extremities generally become cold before death ; and as the circulation becomes more and more languid, even the internal parts of the body grow cold, and the breath as it issues from the lungs themselves is felt to have a low temperature. But it is only when life is extinct, that all the parts of the body become cold. The entire extinction of animal heat may therefore be justly regarded as a sign of death. But the persistence of it must not be considered as a proof that life still continues ; for, according to Foderé and Mahon, the bodies of individuals apparently dead, and who have not been restored to life, have retained their heat for more than four days. If these cases are authentic, it is probable that some remnant of the vital principle still lingered in the bodies, though life could not be restored ; for if they were in every respect

* Récherches de Physiologie et de Chimie Pathologique.

reduced to the condition of dead matter, they must long before that period have fallen to the temperature of surrounding objects.

The same explanation may perhaps be given of some curious exceptions to the general rule observed in cholera morbus. An extreme coldness of the surface is among the most marked symptoms of that disease; but in certain fatal cases, after death had apparently taken place, the temperature of the abdomen, and sometimes of the whole body, was observed to rise suddenly, so as, on one occasion, to reach 86° or 87° of Fahrenheit.*

It must be borne in mind, on the other hand, that a great degree of coldness of surface exists during life in all cases in which the circulation is very languid, or the powers of the nervous system greatly depressed. Thus, there is great coldness of surface in syncope, asphyxia, and trance, and in paralytic affections. A great diminution of animal heat, taken by itself, therefore, is not a certain sign of death, as the continuance of animal heat is not a proof of life. This sign must be taken in connexion with others, and in no case admits of application until life has already been some time extinct.

The extinction of animal heat is not a very sure means of determining the period at which death took place, for the body cools with very different degrees of rapidity in different modes of death, the period varying from two or three hours to fifteen or twenty, and, if we may trust to the authority of Foderé and Mahon, to upwards of four days.

The following are some of the chief causes which influence the cooling of the body:—

1. The temperature and moisture of the surrounding air; the stillness or motion of the atmosphere; the covered or naked state of the body itself; and, in fact, all the causes which affect the cooling of dead matter. It takes place more speedily in water than in air.

2. The condition of the body itself. It takes place more slowly in the corpulent than in the emaciated.

3. The age. The bodies of the aged cool more rapidly than those of younger persons.

4. The mode of death. The body parts with its heat more rapidly after death from chronic diseases, or from hæmorrhage; more slowly after all forms of sudden death; after apoplexy, the various forms of asphyxia, coup de soleil, &c. In persons falling victims to the same disease, the extinction of animal heat is, *cæteris paribus*, as the rapidity with which they prove fatal. In chronic diseases, the body parts with much of its heat during life.

i. Rigidity.—For some time after life is, to all appearance, extinct, the muscles continue to contract on the application of stimuli. This irritability, as has been stated, is of short duration, even in the muscles of voluntary motion, probably not continuing, in extreme cases, longer than two hours. When this muscular irritability ceases, cadaveric rigidity sets in.

* Medical Gazette, 1832-3.

This rigidity takes place in all classes of animals alike, and is the first certain evidence of death. It is confined to the muscular system; for so long as the muscles remain entire, the limbs continue inflexible, unless great force be used; but when they are cut or torn, the rigidity ceases. In some cases, the contraction of the muscles is so strong that the body may be lifted by the head and feet, like a plank of wood. It takes place also in all positions of the body, and whether the limbs be flexed or extended. Hence, it does not change the positions which the several parts of the body had at the time of death. It is entirely independent of the nervous system, for it makes its appearance after the nerves have ceased to be excited by the galvanic fluid. A division of the nerves, or even the removal of the entire brain, does not prevent its occurrence; and in death from apoplexy or hemiplegia, the paralyzed limb is affected in the same way, and to the same extent, as the sound one. This curious phenomenon is regarded by John Hunter as the last act of the vital principle, and by Nysten as a concentration of the remaining vital powers in the muscles, preparatory to the total disappearance of the vital principle.

It was originally supposed to commence only with the complete extinction of the animal heat; but it is now known to make its appearance long before the body has cooled, and to commence in those parts which lose their heat the latest. The following is the order of its appearance:—The muscles of the trunk and neck, those of the upper extremity, those of the lower. It disappears nearly in the same order; the muscles of the lower extremity often remaining rigid when those of the trunk and upper extremity have resumed their state of relaxation.

The degree and duration of the rigidity are, *cæteris paribus*, directly as the muscular development. The period, too, at which it takes place has an important influence upon its amount and duration; the later it occurs, the longer it lasts, and *vice versâ*. The malady of which a patient dies has also a marked effect. When death is occasioned by diseases accompanied by great debility, such as low fever, consumption, scurvy, &c., and the diseases of old age, the rigidity takes place very speedily, and disappears again in the course of one or two hours. When, on the contrary, death is caused by acute inflammation of the stomach or viscera, by irritant poisons, whether mineral, vegetable, or aerial (provided they exert no specific influence on the contractile powers of the muscles), the rigidity is for the most part strongly developed, and lasts for a considerable time. In cases of death from spasmodic cholera it is said that rigidity has commenced soon after death, and has not ceased till after the lapse of four or five days. It is slow in showing itself in death from apoplexy, hæmorrhage, wounds of the heart, decapitation, injury of the spinal marrow, and asphyxia, especially that produced by carbonic acid. The duration of the rigidity in poisoning with this agent is very considerable, and in one case Nysten found that it continued seven days. Sulphu-

retted hydrogen gas, on the other hand, has the effect of preventing the occurrence of rigidity.

Though rigidity may make its appearance long before the animal heat has disappeared, it may be retarded by the application of warmth, or accelerated by exposure to cold. In those cases, too, in which the animal heat lasts for an unusually long period, as in the several forms of asphyxia, especially in that caused by the inhalation of carbonic acid gas, rigidity does not develop itself so soon as after other more common forms of death. A knowledge of this fact may prove serviceable in determining the probable period at which death took place; and it has, on more than one occasion, been practically applied.

It is scarcely possible to confound cadaveric rigidity with any state of the living body. It has been asserted, that the stiffness arising from exposure to intense cold may simulate it. If such a stiffness were to occur in one apparently dead, it could only arise from the congelation of the fluids of the limb; in that case there would be no difficulty in moving the limb, and the crackling of the small particles of ice would furnish an easy criterion.

Syncope, asphyxia, apoplexy, catalepsy, and tetanus, are enumerated as diseases in which a rigidity of the muscular system may be met with similar to cadaveric rigidity. Of course the only cases in which any difficulty can arise are those in which respiration, circulation, and all the other vital actions, have been for a time suspended. It is said that the existence of animal heat, and the prevalence of the contraction through the whole body, will distinguish the rigidity present in those cases from that of death; but we have seen that the dead body may be rigid in all its parts even whilst the animal heat still remains. This criterion, therefore, will not serve us in all cases. If any distinction were necessary, it could be drawn from the effect of bending the extremity forcibly; when, if the rigidity was due to a vital contraction, the limb would be restored to its original position, which would not happen in the rigidity of death. Rigidity, then, is a certain sign of death, and a state not easily confounded with any existing in the living body, or in the several forms of apparent death. Supervening, too, as it does, after the extinction of muscular irritability, it is the first indication of the hopelessness of our attempts at resuscitation.

k. Putrefaction.—This, too, is an infallible sign of death; one about which it is almost impossible to make any mistake; a condition easily distinguished from all states of the living body. It is characterised by the peculiar odour which it occasions, and by the softening, and bluish greenish or brownish discolouration of the structures.

The only appearance of the living body with which it could by any possibility be confounded is gangrene, for this too softens the tissues which it attacks, and is accompanied by a peculiar odour. The distinction between the two conditions is obvious. The odour of gangrenous parts is different from that of putrefaction: gangrene is

limited, putrefaction has no precise limits: putrefaction begins for the most part in the trunk, neck, or head, gangrene generally attacks the extremities: in putrefaction there is neither tension nor redness of the parts implicated, and the cuticle is not separated from the cutis by fluid; in gangrene, on the other hand, the dead parts are separated from the living by swelling and inflammatory redness, by a distinct red line, and by a circular vesicle containing effused serum. These observations apply to moist gangrene, in contradistinction to dry gangrene, which cannot possibly be confounded with the effects of putrefaction. An eschar cannot be produced by any but a living action.

This state, then, like the foregoing, does not admit of being confounded with any appearance existing in the living or dead body, but is a certain sign of death.

In examining the process of putrefaction, it will be necessary to describe the changes which take place in the body from the period of the cessation of cadaveric rigidity to that of its complete decay. In the period which elapses between the extinction of life and the commencement of the putrefactive process, the body is falling more and more under the influence of physical laws. The skin loses its elasticity, the flesh its firmness, and the blood, which was equally distributed through the body by the action of the heart and the elasticity of the arteries, now obeys the laws of gravity, and falls to the most depending parts of the body. Hence results the paleness of some parts of the corpse and the deep violet tint of others, the discolourations of the back, the engorgement of the depending parts of the intestines, of the posterior part of the lungs, and of the vessels at the back part of the head.

As the body is usually placed on the back, these cadaveric lividities, as they are called, are found on the posterior parts of the body and of its several organs; but if the body be placed on the face, they will occupy the anterior part of the body and its viscera. If again, after these discolourations have formed on the back, the body be turned while still warm and before the blood has coagulated, they will disappear. These discolourations often extend uniformly over a considerable extent of the skin, but this depends entirely on the surface on which the body lies. If the surface is rough, its projections will compress the parts with which they come in contact, and force out the blood. Hence such discolourations are almost always irregular, in the form of patches, or lines, or ramifications. The pressure of the clothes is alone sufficient to produce these variations in colour; so that a careless observer might mistake the marks of clothes fastened round the neck for the effect of strangulation, or isolated patches for severe bruises.

Cadaveric lividity may be distinguished from the effect of injuries inflicted during life by the seat of the discolouration. On cutting into the skin, the epidermis is found colourless, the rete mucosum and vas-

cular membrane which lie exterior to the true skin are filled with dark blood, so that the cut surface presents a black line from which the blood may be expelled by pressure: the several layers of the dermis or true skin are white. Thus the seat of the discolouration is the membrane which lies between the epidermis and dermis. But in the discolourations of the skin which are produced by the afflux of blood *during life* the tissue of the true skin is injected with blood, and exhibits when divided a number of bloody points. This, then, is the distinction between the discolourations of the skin produced during life and after death.

The amount of discolouration is proportioned to the quantity of the blood which the body contains; the general prevalence, therefore, of cadaveric lividity through the whole body will indicate the general fulness of the vascular system. On the other hand, the absence of this cadaveric lividity will indicate that a small quantity of blood exists in the body. Thus in cases of sudden death, unaccompanied by hæmorrhage or effusion of blood, there will be extensive lividity; while in death preceded or caused by hæmorrhage, the skin will be remarkably pale, and present but faint traces of such discolouration.

This tendency of the blood to gravitate explains its absence from the vessels of parts which have betrayed evident symptoms of inflammation during life—a fact which has long been attended to by the morbid anatomist, and must not be overlooked by the medical jurist.

In addition to these discolourations produced by the blood which follows the course of the vessels, there are others due to a different cause, the transudation of the fluids. Thus the parts in immediate contact with the gall-bladder are deeply tinged with bile, which has exuded through the coats of that viscus. The aqueous parts of the humours of the eye are among the first to transude, and hence arises the dull and collapsed appearance of the cornea.

The subsidence of the blood and the transudation of the fluids precede the decomposition of the body, and explain, in part at least, that relaxed and softened state of the tissues which is the first of the series of changes usually attributed to putrefaction. These fluids now undergo changes in colour, and tinge the several textures with red, brown, blue, or green discolourations, according to the degree of decomposition which they have undergone.

The exudation of fluids is followed by the development of gases in the several cavities of the body, especially in the abdomen. This gives buoyancy to the bodies of the drowned, and when the formation of gas is very rapid, sometimes gives motion to the limbs and changes the position of the body. The diaphragm is thrust upwards, the blood contained in the larger vessels is forced towards the head and neck, the face swells, the eyes become prominent, and a mucous or bloody fluid flows from the mouth and nostrils. In rare instances the contents of the viscera are forced out, and wounds which had ceased to

flow during life again pour out blood. Of old, much importance was attached to this bleeding of wounds, and questions of supposed murder were decided by the touch of the accused. If the bleeding of the wound happened to coincide with the touch of the supposed criminal, he was summarily convicted of the murder.

As putrefaction advances, the cuticle becomes detached, the muscles grow viscid and pulpy, acquiring a dark greenish colour, and exhaling a highly offensive odour. Lastly, the whole texture of the body becomes changed into a soft semi-fluid mass, that gradually loses its moisture, dries up, and forms a fibrous fatty residue, which is slowly lost in the soil.

The rapidity with which these several changes take place depends greatly upon the circumstances in which the body is placed. Sometimes the processes of putrefaction and decay go on very rapidly, and are soon completed ; at other times they are extended over many years. When the process of putrefaction is once established under favourable circumstances it goes on rapidly, the parts already decomposed acting as a sort of leaven to those which still remain entire.

There are a great number of conditions which materially affect the progress of putrefaction, and which ought to be known that we may form a probable guess as to the time at which death took place. These will be examined seriatim. The most important of them are the following : *a*. Temperature. *b*. Moisture. *c*. Access of air. *d*. Age and sex. *e*. Condition of the body, and cause of death. *f*. Period of interment. *g*. Place and mode of interment.

a. Temperature.—Putrefaction is arrested by a temperature of 212° and of 32° ; in the former case the body is reduced to dryness by the evaporation of the fluids; in the latter the fluids are congealed. The most favourable temperature is one ranging from 70° to 100°. Putrefaction, therefore, takes place more rapidly in summer than in winter, and, other things being equal, varies with the temperature.

b. Moisture.—This is an essential condition, and without it putrefaction cannot begin, or, having begun, cannot continue. The body naturally contains, in all its parts, moisture enough to insure its decomposition ; but those parts which contain the largest quantity of fluid are most prone to putrefaction, *e.g.* the *brain* and *eye*. Dropsical subjects, again, putrefy more speedily than those which are free from accumulations of fluid.

Putrefaction commences promptly in bruises and at the edges of wounds, because these injuries are accompanied by effusion of blood and other fluids. In the case of wounds, the free exposure of the injured surfaces to the air is an additional cause of rapid change.

Bodies which have remained for some time in the water, and are then exposed to the air, putrefy very rapidly; much more so than those which have remained in constant contact with the air.

There is one apparent exception to the rule that moisture encourages putrefaction ; it is, that this process takes place more slowly in water

than in the air. The reason of this is obvious. The contact of air, another condition highly favourable to putrefaction, is prevented.

On the other hand, when the air is very dry, putrefaction takes place slowly, or is entirely arrested. Hence it happens that the bodies of travellers which have lain exposed in the deserts of Arabia have been discovered perfectly preserved some years after their disappearance. Gay Lussac preserved meat, during many months, without undergoing any change, by suspending it in a bell-glass, and absorbing the moisture by means of chloride of calcium. A rapid current of air will have the same effect as dry air. It suspends putrefaction by causing rapid evaporation. On the other hand, a moist and stagnant atmosphere encourages it, by preventing evaporation no less than by supplying the moisture which is so directly favourable to that change.

c. Access of Air.—Gay Lussac thought the presence of air essential to putrefaction. Later authorities adopt a different opinion. One of these, Guntz of Leipzig, supports his own view by a decisive experiment. Having introduced his little finger into a vessel full of mercury, he pricked it, when a small drop of blood rose to the upper part of the vessel. He then exposed the apparatus to a temperature of 65°, which he gradually raised to 100°. At first, the blood coagulated; then, at the end of five days, it became liquid, of a dirty colour, almost homogeneous, and at length bubbles of gas rose to the surface. Fragments of meat, freed as much as possible from air, being plunged under mercury, underwent the same change in vacuo.

These experiments, though they prove that the presence of air is not essential to putrefaction, do not settle the question of the influence which it exerts when present. That the atmospheric air exercises a positive influence in accelerating putrefaction, may be inferred from the fact, that if its place be supplied by other gases, that process is materially retarded. Thus, hydrogen, carbonic acid, and nitrous acid, have been proved, by experiment, to retard putrefaction. According to Hildebrand, a portion of muscle kept in carbonic acid remained free from odour during fifty-one days. The same observation applies to nitrogen gas, which separately retards putrefaction; hence the antiseptic quality of the contents of common sewers; but when mixed with oxygen, in the proportion existing in the atmosphere, it facilitates that process. Oxygen, again, when taken separately, promotes putrefaction more than any other gas whatever; but when combined with nitrogen, as in atmospheric air, its activity is greatly increased.

It appears then, that heat, moisture, and the free access of air, are the conditions most favourable to putrefaction. The two former combined are sufficient to develop it; but the free access of air is necessary to its rapid progress. In judging, therefore, of the period at which death took place, we should consider well what amount of influence each of these agents has brought to bear on the result.

d. Age and Sex.—Cæteris paribus, the bodies of children putrefy

more speedily than those of adults and aged persons, and the bodies of old persons undergo this change more rapidly than those of the adult.

Sex.—According to Orfila, putrefaction takes place more rapidly in females than in males. He attributes this to the greater quantity of adipose matter with which their cellular membrane is loaded. This explanation, though not quite satisfactory, agrees with the fact, that the bodies of fat persons undergo this change more readily than those of the lean and emaciated.

e. Condition of the Body and Cause of Death.—On this subject no very accurate observations have been made. It appears, however, that putrefaction takes place more or less speedily in proportion as the body is more or less filled with fluid. Thus, it is *more* rapid in those who have died of *acute* than in those who have died of *chronic* diseases. *Cæteris paribus*, those who have died from asphyxia putrefy more speedily than those who die from hæmorrhage. Putrefaction, as has been already stated, takes place more rapidly in anasarcous and dropsical persons than in others. But we must except those who die from inhaling carbonic acid ; for, from three cases mentioned by Devergie in the 17th vol. of the Annales d'Hygiène, there can be little doubt that putrefaction is greatly retarded in this form of death. The same observation applies to the parts of the body as to the entire frame ; for those parts which are filled with fluids at the time of death (for instance, inflamed, congested, bruised, or wounded parts) putrefy more rapidly than healthy and entire structures.

The fact, that those parts of the body which have sustained mechanical injury are the first to go into the putrefactive process, ought to be borne in mind ; for it is in parts thus injured that the process first commences, and it is in such parts that it advances the most rapidly. If called on, therefore, to examine a body some time after death, we should take care not to exaggerate the importance of any injuries which it may have sustained.

It is said that the bodies of persons destroyed by poison, especially by certain animal and vegetable poisons, putrefy very rapidly. Some years since, indeed, the rapid occurrence of putrefaction was looked upon as a strong evidence of poisoning. Thus, in the trial of Angus for the murder of Miss Burns, the absence of putrefaction was looked upon as a strong presumption against the administration of poison. Whatever may be the case with regard to animal and vegetable poisons, there is now sufficient evidence that mineral poisons (at least the most important of them, arsenic) have no effect in promoting putrefaction, but, on the contrary, that they act as powerful antiseptics. Some striking instances of arsenic detected in the body many years after death, in consequence of the preservative influence of this poison on the parts with which it was in immediate contact, will be mentioned under the head of poisoning by arsenic.

f. Period of Interment.—A body putrefies much more speedily in air than in the ground. Hence the longer the period which elapses

before interment, the greater the changes produced in it by the putrefactive process. Thus, Orfila observes, that if, during the summer, a body be kept exposed for five or six days, and then interred, it may be found at the end of a month, to have undergone as much change as it would have done at the end of seven months, if it had been interred at once.

g. Place and Mode of Interment.—In dry elevated situations, putrefaction goes on slowly; in low swampy grounds, rapidly. A dry absorbent soil retards, a moist one accelerates, putrefaction. The nature of the soil exercises an important influence. In sand or gravel the change goes on slowly, and adipocere is rarely met with. In marl or clay, and in loose mould, especially that which is impregnated with animal or vegetable matter, more quickly (except peat, which clearly retards putrefaction). The deeper the grave, *cæteris paribus*, the slower the putrefaction. The more completely the body is defended from the air by clothes or coffin, the more slowly does putrefaction go on. It is *rapid* where the body is exposed to the soil, but very slow where it is buried in a coffin hermetically sealed.

It would occupy too much space were we to enter into more minute details on this subject of putrefaction. For further particulars the reader is referred to Orfila's admirable work entitled, "Traité des Exhumations Juridiques," where this subject is treated at great length, or to Devergie's "Médicine Légale," which contains the marrow of Orfila's observations, with his own account of the changes produced by putrefaction in the water. From the extensive opportunities which an official situation at the Morgue afforded him, Devergie has been enabled to treat this part of the subject of putrefaction with the same success with which Orfila has handled that of putrefaction in the air and in the earth.

It may be well to premise, that the several media retard putrefaction in the following order:—

1. Water of common sewers and cesspools. 2. Common water. 3. The earth (in different degrees according to the character of the soil). 4. The air (in different degrees according to its temperature, moisture, &c.).

Putrefaction in Water.—More dependence is to be placed on the criteria laid down for determining the period of death in those whose bodies have remained in the water, than in those who have been exposed to the air or interred. The reason of this is obvious. The temperature of the water is more uniform, and its close contact with every part of the body excludes the most sensible of the influences which are brought to bear on bodies exposed to the air or buried in the soil. As Devergie places much reliance on the signs by which the period of death is determined in the drowned, it may be well to subjoin his description of the successive changes which occur.

Three to Four Days.—Cadaverous rigidity, loss of animal heat, extinction of muscular irritability, epidermis of the hand beginning to bleach.

Four to Eight Days.—All parts of the body supple, extinction of muscular irritability, colour of the skin natural, skin of the palms of the hands very white.

Eight to Twelve Days.—All the parts of the body flaccid, epidermis of the back of the hand beginning to bleach, the face softened and beginning to exhibit a pale appearance different from the skin of the rest of the body.

About Fifteen Days.—Face slightly swollen, here and there red; greenish tint of the middle portion of the sternum; epidermis of the hands and feet uniformly white, and beginning to wrinkle.

About One Month.—Face brownish red, eyelids and lips green; a reddish-brown spot, surrounded by a greenish tint at the anterior part of the chest; epidermis of the hands and feet white, and wrinkled as if by the application of a poultice.

About Two Months.—Face generally brownish and swollen; the hairs but slightly adherent; a great part of the epidermis of the hands and feet detached; nails still attached to the skin.

Two Months and a Half.—Epidermis and nails of the hands detached; epidermis of the feet detached, but the nails still adherent. In the female, reddish discolouration of the sub-cutaneous cellular tissue of the neck, of that which surrounds the trachea, and of the organs contained in the cavity of the chest; partial saponification of the cheeks and chin; superficial saponification of the mammæ, the axillæ, and the anterior part of the thighs.

Three Months and a Half.—Destruction of a part of the hairy scalp, of the eyelids, and of the nose; partial saponification of the face, of the upper part of the neck and axillæ; corrosions and destruction of the skin in various parts of the body; epidermis and nails of the hands and feet completely removed.

Four Months and a Half.—Nearly total saponification of the fat of the face, of the neck, of the axillæ, and of the anterior part of the thighs; commencing earthy incrustation of the thighs; incipient saponification of the anterior part of the brain; opaline state of the greater part of the skin; almost entire separation and destruction of the hairy scalp; calvarium denuded and beginning to be very friable.

As to the more remote periods no accurate approximations can be given.

To this detailed account Devergie adds, that the signs here laid down have been repeatedly applied with complete success to bodies which have remained in the water during periods unknown at the time of their examination.

It is necessary to bear in mind that these observations of Devergie are made on bodies immersed during winter and spring, and that bodies immersed in summer undergo the same changes much more rapidly. Thus, 5 to 8 hours of immersion in summer correspond to 3 to 5 days in winter; 24 hours to 4 to 8 days; 48 hours to 8 to 12 days; 4 days to 15 days. Thus on the average the same changes in

summer take place from three to five or six times as rapidly as in winter, or even more promptly than that. The changes in spring are intermediate between those of winter and summer.

To this account of the changes which take place in those who have remained long in the water, must be added that development of gas which plays so important a part in giving buoyancy to the body, and thus raising it to the surface. This takes place slowly in winter, and the body rarely rises to the surface in less than six weeks to two months. The same change takes place in summer from the 14th to the 16th day, or even earlier.*

Frequent mention has been made of *adipocere*. This curious substance was first examined and well described by Fourcroy, on the occasion of the exhumations practised at Paris during the years 1785, 1786, and 1787, and subsequently analyzed by M. Chevreul. It is of a yellowish white colour, and has the physical characters of a compound of wax and fat, from which circumstance it has acquired the name of adipocere. It is formed in the following way:—The fat of the body becomes slowly converted into the margaric and oleic acids, which uniting with the ammonia generated during decomposition, form a sort of animal soap. Adipocere is formed in bodies which remain for a long time in water, also in bodies buried in moist soils, and especially where a large number of bodies have been interred in one common grave. A body must remain about three years in the ground in order that it may be completely transformed, but the change takes place much more rapidly in water.

There is still another point requiring attention before concluding the subject of putrefaction. Under the head of Infanticide (p. 134), an instance is given of incipient putrefaction with a large development of gas on the surface of the lungs, where the peculiar odour of putrefaction, softening of the tissues, and change of colour, were altogether wanting. This appearance is comparatively rare, and not having been recognized as incipient putrefaction, gave rise to the curious theory of emphysema occurring in lungs which had never received air, and added an unfounded objection to the hydrostatic test. This early formation of gas (probably carbonic acid) takes place occasionally beneath the membranes of the brain, and possibly in other situations. It is a fact of some importance.

* Devergie, Médicine Légale, vol. i. p. 95.

SUDDEN DEATH.

Proximate Causes of Sudden Death. — *Death commencing in the* HEART. — *Syncope.* — *In the* HEAD. — *Asthenia.* — *In the* LUNGS. — *Apnœa* (*Asphyxia*). — *Causes of.* — *Symptoms.* — *Post-Mortem Appearances.* — *Theory of.* — *Post-Mortem Appearances in the Three Modes of Death contrasted.* — *Frequency of Cases of Sudden Death.* — *Number of Cases due to each Cause.*

A temporary suspension of the heart's action constitutes the chief sign and the essence of apparent death; a total arrest of its contractions is real death. Some of the vital endowments of the blood and muscles survive this cessation of the heart's action; and the lingering irritability of the heart itself, and especially of the right auricle, forms our ground of hope in the use of means of resuscitation. This suspension or total arrest of the heart's action, or, in other words, apparent or real death, may be brought about in two different ways.

1. The heart itself may be paralysed, in consequence of a violent shock sustained by the nervous system, as in death by lightning, by heavy blows on the head, and by strong and sudden emotions, as of fear and joy.

2. The heart may cease to act in consequence of one or both of its cavities receiving a quantity of blood too small to excite them to contraction: this happens in death by hæmorrhage, and in the several forms of death by asphyxia. Again, the blood may be mixed with some foreign substance, or so altered in quality as to be unfit to excite the heart to contraction: thus the introduction of air into the veins will cause a sudden arrest of the heart's action, and the same result follows some of the more active poisons, when introduced directly into the circulation.

In the first of these modes of death, the immediate cause of death has no antecedent, but the shock to the nervous system is directly followed by paralysis of the heart. The same remark applies to the second division of the second class of causes, viz. blood changed in quality; for the introduction of a certain quantity of air into one of the large veins near the heart, or the admixture with the blood of a small quantity of an active poison, such as the upas antiar, will put an immediate stop to the heart's action. In the cases of paralysis of the heart produced by severe shocks to the nervous system, every part of the organ is probably paralysed at the same time, but the action of air or poison may be supposed to be confined to the right side.

In paralysis of the heart, also, from a deficient supply of its natural stimulus, the effect is either immediate and upon all its cavities alike, as in hæmorrhage; or the effect is only upon the left side of the heart, as in the form of death improperly termed asphyxia. Now this latter state is brought about by two distinct causes, impediments to the res-

piration, existing in the air passages and lungs themselves, or acting mechanically on the parietes of the chest, and injuries to the base of the brain or upper part of the spinal cord. The ultimate effect in both cases is the same, but the process is less circuitous in the one case than in the other.

The following scheme will exhibit at a glance these several modes of death. To render it complete it is merely necessary to add to the causes of death, wounds and ruptures of the heart itself.

- SUDDEN DEATH.
  - 1. THROUGH THE NERVOUS SYSTEM.
    - By lightning.
    - By severe blows on the head.
    - By severe constitutional shocks.
    - By strong mental emotion.
  - 2. THROUGH THE BLOOD.
    - Deficient supply of blood . . .
      - To both sides of the heart . . . . — Death by Hæmorrhage.
      - To the left side of the heart . . . — Death by Asphyxia, or Apnœa . . — From injury to the Medulla oblongata. / From impeded Respiration.
    - Altered quality of blood . . . . — Air introduced into the veins. / Poisons introduced into the blood.

This scheme presents the immediate or proximate causes of death, and the more simple and obvious of the remote causes, and is more correct than the classification of Bichat,—viz. death beginning at the *head*, death beginning at the *heart*, and death beginning at the *lungs*,—for it will be seen that death beginning at the head may affect the heart and destroy life in two distinct ways, directly through the nervous system, and more remotely through the lungs, and that there is no essential difference between the one and the other.

For practical purposes, however, the classification of Bichat may be usefully adopted, and the several forms of sudden death may be examined in turn, as commencing at the heart, at the head, and at the lungs.

Sudden Death commencing at the Heart.—Syncope.—The most common forms of death belonging to this class are, rupture of the heart itself, and hæmorrhage, and these modes of death are characterised by the term *syncope*.

The phænomena which attend this form of death are familiar to all observers—pallor of the face and lips, cold sweats, dizziness, dimness of vision, dilated pupils, gasping and sighing respiration, a slow, weak, and irregular pulse ; to which are sometimes added nausea and vomiting, restlessness and tossing of the limbs, transient delirium and convulsions. On inspecting the body, the vessels generally will be found to contain but little blood, and the *heart to be nearly or quite empty, and contracted*. This empty state of all the cavities of the heart contrasts strongly with their distended state in the rare cases of death originating in the brain, and acting directly upon the heart ; and not less strongly with the distended condition of the right side of the heart, and empty state of the left, which occurs in death from asphyxia.

Sudden Death commencing at the Head.—On referring to the table, it will be seen that there are two ways in which injuries to the nervous centres may affect the heart, and put a stop to its contractions: the one acts directly upon the heart, the other first affects the function of respiration by paralyzing the respiratory muscles. When the heart is directly affected, the circulation is, as it were, arrested and fixed in what may be termed its normal state, each side of the heart containing its due proportion of blood, and all the cavities being distended from the sudden loss of power in the heart to propel its contents. This mode of death has been designated *asthenia*. When, on the contrary, the muscles of respiration are paralysed, the post-mortem appearances will be those presently to be described under the head of asphyxia.

Sudden Death commencing at the Lungs: Apnœa (Asphyxia). As this form of death is one which will have to be frequently considered in the next chapter, it demands a somewhat lengthened description. The sense affixed to the term asphyxia departs strangely from the original derivation of the word, which means, pulselessness. This is not its present signification, for if it were, it would be synonymous with syncope. It is now understood to mean real or apparent death primarily produced by a suspension of the function of respiration,—a mode of death much more aptly designated by the term *apnœa*, which term will accordingly be preferred in these pages. Apnœa may be produced by a great variety of causes, which it may be well to specify in this place. They are as follows :—

1. Cessation of the action of the muscles of Respiration. 2. Cessation of the action of the Lungs themselves. 3. Exclusion of the atmospheric air from the Lungs.

1. *Cessation of the Action of the Muscles of Respiration* may be due to *inertia* of the muscles themselves, in consequence of cold or debility; to *a loss of nervous influence supplied to the muscles*, as from division of the upper portion of the spinal marrow, or of the pneumogastric and phrenic nerves, or from the lightning stroke; to *mechanical restraint*, as by pressure on the chest or abdomen; or to *tonic spasm*, as in death from Tetanus or Hydrophobia.

2. *Cessation of the Action of the Lungs.* This may be due to a division of the eighth pair of nerves; or to a mechanical obstacle, as by the admission of air into the pleura, or the entrance of the viscera of the abdomen through a wound in the diaphragm.

3. *The partial or complete Exclusion of Atmospheric Air from the Lungs* may be brought about by the entire absence of air, as in a vacuum; or by its extreme rarefaction, as on the top of very lofty mountains. The air, again, may be mechanically excluded, as by a foreign body introduced into the larynx, by submersion, by suffocation, by strangulation, by suspension; or lastly, the place of the atmospheric air may be taken by a gas, which acts merely by excluding it. These gases are, nitrogen, protoxide of nitrogen, and hydrogen. The remainder of the gases seem to exercise a deleterious influence on the œconomy, independent of the mere exclusion of the air. Some of these are intensely irritating, as the sulphurous acid gas, chlorine, and ammonia; others, though less irritating, are not less fatal in their effects, such as the carbonic acid, carbonic oxide, carburetted hydrogen, nitrous acid, hydrosulphuric acid, hydrosulphate of ammonia, the arseniuretted hydrogen, and the vapour of hydrocyanic acid. There is reason to believe that some of these, as well as the more simply irritant gases, act mechanically by producing a spasm of the glottis, and closing it against the admission of air.

To this list of the causes of apnœa may be added certain diseases of the lungs, as hepatization, œdema, &c., which prove fatal by filling the air-cells, and preventing the process of respiration from being duly performed. These causes possess no interest or importance for the medical jurist.

The *symptoms* of apnœa will be more or less strongly marked according as the asphyxiating cause acts suddenly or slowly. If the atmospheric air is suddenly excluded from the lungs, as by mechanical compression of the trachea, or the inhalation of a gas which is so irritating as to cause spasmodic contraction of the glottis, the symptoms are strongly marked, and run a rapid course.

The sufferer struggles violently for breath, and uses strong efforts to remove the obstruction. The face at first flushes, and soon grows turgid and livid; the veins of the head and neck swell; and the eyeballs start from their sockets. This extreme distress is soon followed by sensations of an agreeable kind, by giddiness, with visions of brilliant circles of colours before the eyes. To this succeed loss of consciousness, convulsive movements of the limbs, and relaxation of the

sphincters. These symptoms occupy but two or three minutes, and if relief be not afforded, life is soon extinct beyond recovery.

When the asphyxiating cause acts more slowly, the symptoms are somewhat modified, and succeed each other at longer intervals.

There is a greater or less impediment to the respiration, and a feeling of constriction in the chest, from which the sufferer strives to free himself by strong voluntary efforts to inspire air, or by involuntary efforts, such as yawning or sighing. These efforts to respire are followed by a sense of heaviness and dull pain in the head, especially over the forehead. The want of air is now more strongly felt, and the patient is in a state of extreme anguish. Then follow in succession dimness of sight, torpor of the intellectual faculties, and of all the sensations, vertigo, and loss of voluntary motion. Still, the functions of respiration and circulation continue; but the former consists merely in almost imperceptible movements of the parietes of the chest, and the latter of pulsations of the heart, which are scarcely sensible to the hand. The arterial pulse, if it can be felt, is extremely feeble. This imperfect state of respiration and circulation is followed by the entire cessation of those functions, and by complete loss of motion, voluntary and involuntary. It is at this point of time that the fulness of the capillary system begins to show itself, by the injected state of the face, and by a deep violet discolouration of that part, which also extends to the hands and feet. Some portions of the trunk and extremities exhibit spots, more or less extensive, of the same colour. At length, the capillary circulation ceases, and the state of asphyxia is complete, distinguished only from the state of death by the presence of animal heat, and the absence of rigidity.

Such are the usual symptoms of apnœa; but there are some cases in which the asphyxiating cause, acting more slowly still, seems to induce a sleep which terminates, without suffering, in death ; in other instances, the sufferer is suddenly roused from a state of torpor to a vivid and painful perception of his state : he makes a violent effort to escape from the death which threatens him, attempts to leave the spot, but finds his muscular strength unequal to the accomplishment of his purpose, and falls to the ground.

With regard to the duration of apnœa, this will of course depend on the intensity of the asphyxiating cause, and the degree in which it prevents or impedes respiration. As a general rule, we may state, that the more slowly and gradually it takes place, the longer does the chance of recovery last, and vice versâ. We may perhaps safely conclude that when the respiration is entirely prevented, death will take place within three or four minutes of the application of the asphyxiating cause.

The appearances which the body presents after death from apnœa are the following: There is a rosy, bright red, or violet discolouration, either on the face or on other parts of the body. This discolouration is distinguished from cadaverous lividity by being situated as much on

the least as on the most depending parts of the body, and by the fact, that the situation of the discoloured spots cannot be explained by the position in which the body may happen to have been placed after death. The seat of the discolouration is the mucous tissue of the skin, but it sometimes extends to the dermis, so that when we make an incision into it, blood issues from the vessels, and gives the membrane a dotted appearance. The *eyes* are usually prominent, firm, and brilliant. The mouth is sometimes expressive of calmness, at others of suffering. Cadaveric rigidity is very marked, and continues for a long time. The venous system of the brain is commonly full of blood, but its substance presents, when divided, but few bloody points. Sometimes the ventricles of the brain contain serum ; sometimes blood is effused at the base or in the substance of the organ. The base of the tongue is almost always injected, and its papillæ are here strongly developed. The mucous membrane which covers the larynx and epiglottis is of a red colour, and this colour is confined to the mucous membrane, as is the case on the skin. The lining membrane of the trachea is of a deep red, and the colour increases in intensity as we approach the last ramifications of the air-tubes. On the surface of the membrane we often encounter a frothy sanguinolent fluid analogous to that expectorated in hæmoptysis. The discolouration of the mucous membrane of the trachea extends to the fibrous tissue which unites the cartilaginous rings, so as to form a striking contrast with the whiteness of the rings themselves. The *lungs* are very voluminous, projecting over and concealing the pericardium, and sometimes, on the division of the mediastinum, folding over each other. Their colour is a blackish brown, and their parenchyma red. When they are compressed, large drops of black, thick, liquid blood exude. The liver, the spleen, and the kidneys, are also gorged with blood, which, as in the lungs, exudes on pressure. The veins of the heart are distinctly traced upon its surface, its right cavities are distended, gorged with black blood, thick, but liquid, or rarely coagulated. The venæ cavæ and their principal branches are also gorged with blood ; but the left cavities of the heart are found empty, or containing but a small quantity of blood. Such are the appearances present in death by asphyxia, when carried to an *extreme degree*, and they are those observed in the bodies of persons who have perished by inhaling carbonic acid. But it must not be supposed that all these appearances are present in every case, or, if present, that they are equally marked in all. The description is a general one, and like all such descriptions must be applied with some reserve.

It is usual, in works on Forensic Medicine, to enter into a minute inquiry concerning the proximate cause of death from apnœa — to discuss the *theory* of apnœa ; and, as in the table already given such a theory is assumed, a few observations on this subject may not be misplaced.

Theory of Apnœa (*Asphyxia*).—It is admitted on all hands, that when

the air is prevented from gaining access to the lungs, the blood does not undergo its usual change from venous to arterial, and it is equally admitted that venous blood does not minister to the support of the vital functions of the several organs so completely as the arterial blood does. Some, indeed, suppose that venous blood is a positive poison; and that it is much worse for an organ to be supplied exclusively with venous blood than to receive no blood at all. Assuming that venous blood *is* positively noxious to the several textures of the body—that it prevents the continuance of their several functions,—how shall we explain that cessation of the heart's action which constitutes the direct cause, the immediate forerunner, of death? By what means is the heart paralysed?

The heart is a muscle, and venous blood circulating through the substance of a muscle is assumed to destroy its functions. Now, venous blood circulates through the coronary arteries in place of arterial blood. Hence the heart may be directly paralysed.

Another theory is, that the venous blood is unfitted to excite the left cavities of the heart to contraction, and that its motions are therefore suspended. This theory of Goodwyn has been disproved by Bichat.

Again, the heart is excited to contraction by nervous influence, and, according to the assumption already mentioned, nervous influence is suspended when venous blood circulates through the nerves in place of arterial. Hence Bichat explains the paralysis of the heart by the circulation of black blood through the brain.

Now, either of these theories (that which attributes the paralysis of the heart directly to the circulation of black blood through its muscular structure, or that which attributes it to the more remote influence of the nerves) goes on the assumption, that venous blood is directly poisonous, and worse than no blood at all. This assumption has been disproved, as far as it can be, by experiment. Kay has shown that the venous blood exercises no deleterious influence on the muscles, by comparing the contractility of a limb from which the supply of arterial blood has been cut off with that of a limb supplied exclusively with venous blood.* What is proved to be true of a limb seems to hold good of the whole body; for the same author has shown that it is as bad for a rabbit to have its *windpipe tied* as to have its *aorta secured* close to the heart; and Edwards has gone still further in his experiments on the cold-blooded animals, for he has found that such an animal placed in an asphyxiating medium lives longer than one whose heart and bulb of the aorta have been excised.†

Venous blood, therefore, is not positively, or to a great degree, injurious; its circulation is merely a negative injury, and destructive of life by occupying the place of arterial blood and cutting off the

* Kay on Asphyxia, p. 151.

† De l'Influence des Agens Physiques sur la Vie, par W. F. Edwards, M. D.

supply of that fluid to the economy. As the absence of all circulation through the vessels of the heart, or through those of the brain, or through the nerves supplying the heart with vital stimulus, would certainly and speedily prove fatal to life, so would the mechanical exclusion of arterial blood from the vessels of these parts, whether by warm water or by venous blood. This theory of exclusion, then, will answer as well at least as the one just alluded to. It has been shown, however, by Dr. Kay, that neither of these theories is the true one, but that the essential character of this form of death consists in the accumulation of blood in the lungs, and a constantly diminished supply of that fluid to the left cavities of the heart; so that the quantity of blood sent out for the supply of the system constantly diminishes, till at length the circulation is altogether arrested, Hence in death by asphyxia the left ventricle is found contracted, and nearly or altogether empty. It is of little consequence to inquire into the proximate cause of this arrest of the circulation through the lungs ; the fact is all with which, as medical jurists, we have to do.

On contrasting the post-mortem appearances proper to the three modes of death, syncope, asthenia, and apnœa (asphyxia), it will be seen, that in the first, all the cavities of the heart are empty or contain little blood ; in the second, all the cavities are full of blood ; and in the third, the right side is gorged with blood, while the left ventricle contains little or none.

It is most important, however, that the medical jurist should bear in mind that the characteristic appearances of sudden death, due primarily to the heart, the lungs, or the brain, are not always equally marked; that they may be combined with each other in different proportions ; and that a cause usually productive of the one may, in certain circumstances, give rise to the other. Thus, a person may be threatened with suffocation (one of the causes of asphyxia), and apprehension may give rise to sudden *syncope;* or a violent attempt to escape the threatened injury may burst a blood-vessel in the brain, and cause *apoplexy*. We must, therefore, bear in mind the possibility of such combinations as these, in order that we may be prepared to understand the different appearances presented by those who perish from a common cause, and to act with becoming caution when we have to discharge the duties of the medical jurist.

It may be useful to subjoin the following facts connected with sudden death.

From the Registrar-General's Report of Births, Deaths, and Marriages for 1839, it appears that of 331,007 deaths from all causes, occurring in the year, 3012 were cases of sudden death, being 1 in 109 deaths. Of these 1840 were males and 1172 females, being in the proportion of about 18 to 12, or 3 to 2. The relative frequency of the several forms of sudden death appears, from a work of Ferrario and Sormoni on sudden deaths occurring in Milan, to be as follows:—

Head (including apoplexy, cerebral concussion, vertigo, and coma), 879
Heart (including diseases of the heart, angina pectoris, aneurism, and hæmorrhage), ... 150
Lungs (including asphyxia, suffocative catarrh, and pulmonary apoplexy), ... 14
Difficult labours, 5, making in all 1048 cases.

SURVIVORSHIP.

Probabilities afforded by Age and Sex irrespective of the Mode of Death.—Mother and Child.—Probabilities established by the Mode of Death.—Apnœa.—Drowning.—Suffocation.—Cold.—Heat.—Hunger and Thirst.—Other Modes of Death.

When two or more persons die by the same accident, a question sometimes arises as to which died first. In certain cases the succession to property would be secured on proof of survivorship even for an instant of time. Hence the importance of the question.

Questions of survivorship are by no means of rare occurrence, and the more voluminous works on Forensic Medicine, in all languages, abound with examples. As our law lays down no positive rules for the decision of this class of cases, more than usual importance attaches to medical evidence. Hitherto little has been done towards establishing broad general principles applicable to this class of inquiries: indeed the materials for the establishment of such principles are wanting. It is proposed, therefore, to state as briefly as possible some of the more accurate results which have been attained.

The subject is best examined under the following heads:—1. Of the probabilities afforded by age and sex, irrespective of the mode of death. 2. Of the degree in which such probability is affected by the peculiar mode of death.

1. *Of the Probabilities afforded by Age and Sex.*

Age.—As the body is at its maximum of strength and vigour at about 27 years of age, or from 25 to 30*, and continues in possession of its strength up to about 50 years, there will be no sufficient ground for inferring survivorship in the case of adults of the same sex, whose age ranges between these extreme points, and where the form of death is one in which mere strength of frame and power of endurance is concerned. Before and after the ages specified, the strength and power of endurance will be less, but still within the limits of puberty and old age (say 15 and 60 years) the difference will be too slight to justify any general rule. The probability of survivorship, in the case of a middle-aged adult perishing with one under puberty or above 60, will be in

* Quetelet's observations show, that the body does not generally attain its full stature till 27 years.

favour of the adult. In the case of one under 15 and one above 60 perishing together, the French law assumes that the former survived; when both are under 15, that the elder outlived the younger. According to the civil law of England, if parent and child perish by a common death, the child shall be presumed to have survived if above puberty, and to have died first if under puberty.

In the case of mother and child both dying in childbed, the presumption is, that the mother survived, for there is a *primâ facie* probability of still birth, and a still stronger probability that a woman perishing in child-bed will be unable to render to her child the assistance necessary for its preservation. It is probable, therefore, that the death of the child would precede that of the mother. A large child would be still more likely to perish first, for it has been elsewhere stated that still-born children greatly exceed in size and weight those born alive. If there is an opportunity of examining the body, the presumption may be still further strengthened by the external marks of a difficult labour, or the absence of the signs of respiration. Legal decisions have not been always in conformity with the principle here laid down.

Sex.—If one of either sex perish by a common accident, it may be inferred that the male, being the stronger, is the survivor; but this rule applies only to modes of death in which strength and courage give the best chance of safety. On the other hand, females being subject to prolonged faintings in consequence of fright, may be, by that very circumstance, incapacitated from those struggles which in so many forms of death may be presumed to increase danger. When, then, there is safety in exertion, the probability of survivorship will be with the male; where passive endurance or insensibility would tend to lessen the danger, with the female.

The subject of *temperament* is too indefinite to admit of any general rules being laid down with regard to it. It is necessary, however, to understand that mere muscular strength and power of endurance are two very distinct things, and do not often meet in the same person. Muscular strength is often greatest in the so-called lymphatic temperament; power of endurance in the bilious.

2. *Of the Degree in which the foregoing Probabilities are affected by the Mode of Death.*

Under this head it is proposed to specify some of the more common modes of death, and to endeavour to establish some general principles with respect to them, assuming, as before, that the parties about whom the question is raised are placed, as nearly as may be, in the same circumstances.

Apnœa (*Asphyxia*).—Females consume less oxygen than men; the same quantity of air, therefore, will last them for a longer time. Hence, of adult males and females perishing together of apnœa, the females may be presumed to have survived. In poisoning by carbonic acid gas, which is nearly allied to death by apnœa, the chances of survivorship

are with the female. This statement rests on the authority of a large number of facts. In 19 out of 360 cases of asphyxia by carbonic acid, which took place in Paris during 1834 and 1835, a man and woman were asphyxiated together ; of these three only were saved, and these three were females. In solitary cases of the same form of death the result is also favourable to the female ; for 18 out of 73 females were restored, and only 19 out of 83 males, so that the chances for the female and male respectively are nearly as 15 and 14 (instead of 5 and 4 as Devergie represents it).* Single cases are in strict conformity with this result. Thus, in a case quoted by Beck from the Transylvania Journal, a man and his wife were exposed in a small room to the gas from live coals. The man was found dead, rigid, and contracted, but the woman was still breathing and recovered. Again, in a case reported by M. Sardaillon, a man, his wife, and their child aged seven years were asphyxiated in a porter's lodge. The child died, the father was very ill and with difficulty restored to life, while the wife was well enough to call for help and to assist both husband and child. In these cases it would be necessary to take into account the position which the parties occupied in the room, whether on the bed or on the floor, near or remote from an open window, &c.

Drowning.—There are many complicated considerations connected with this mode of death. In shipwrecks men are more likely to be in a favourable situation for saving themselves, as they are more on deck than women ; they also in many instances are able to swim, or to save themselves by clinging to portions of the wreck, and they are less encumbered by clothing. When the comparison is between men similarly exposed and capable of the same exertion, it may be necessary to inquire whether one was more exposed to cold by having the body half immersed, whilst the other was more under water. Search should also be made for severe injuries which may have prevented the swimmer from using his strength, or may have otherwise proved fatal. Death from apoplexy is stated by Devergie to be sooner fatal than by apnœa, while in death by syncope there is the best chance of recovery.

Suffocation.—In all cases of suffocation depending upon an insufficient quantity of air, or upon air rendered partially unfit for respiration, it may be presumed that those who require least air live the longest—women longer than men, children than adults. In suffocation from the falling of houses or earth, or by mechanical means in general, the stronger may be presumed to survive the weaker—men, women ; adults, children and old persons.

Cold.—The experiments of Edwards show that young children bear cold worse than adults ; hence the probability of survivorship in exposure to the same degree of cold is in favour of the latter. Men bear cold better than women, adults better than the aged. Here it is necessary to take into account the clothing of the persons exposed, and

* Devergie, Médicine Légale, Art. Survie.

their state of health. Spirituous liquors in excess increase the effect of cold; in moderation they give increased tolerance of it.

Heat.—The young and old, as they suffer more from cold, so do they bear heat better. The relative tolerance of heat of the two sexes is not well ascertained. Foderé relates the case of an Englishman and his daughter aged seven years, who, in the year 1814, crossed the desert of Syria to the Persian Gulf. Both rode on camels, and were placed in precisely similar circumstances, but the father died, while the child arrived in safety at its journey's end.

Hunger and Thirst.—Those who have not reached their full growth require more nourishment than adults, and adults than aged persons. The aged, then, may be presumed to survive both, and the adult to live longer than the child. Corpulent persons are thought to bear hunger better than the emaciated. In death from starvation, those who have the freest access to water may be presumed to live the longest. Those who use the greatest exertions will suffer earliest in this as in the foregoing modes of death. Those who possess most passive endurance may be expected to live the longest.

Such are some of the principal forms of death, in which the circumstances of the several victims are likely to be so similar as to admit of the application of general rules. In other modes of death, and in these under certain circumstances, there may be no points admitting of strict comparison, and many things which may exercise a marked influence on the result will have to be taken into the account. The reader will find several such cases quoted by Beck,* but as they throw little light upon the general question, and establish no fixed principles, it would be useless to quote them in this place.

It has been suggested by more than one writer, that a distinct enactment would be preferable to the present custom of deciding each case on its own merits. Such an enactment, extending to that large class of cases in which the circumstances of the death are but imperfectly known, and those in which it is in the very nature of things impossible to come to a correct decision, is certainly much to be desired. On many points, as it has been seen, the opinions of medical men can throw much light, and their researches lead to general principles admitting of tolerably safe application.

* Med. Jur. p. 387.

CHAPTER VIII.

DEATH BY DROWNING.—HANGING.—STRANGULATION.—SUFFOCATION.

THESE modes of death are thrown together in the same chapter from the near resemblance which they bear to each other. They are all forms of apnœa, or sudden death beginning at the lungs, and naturally follow close upon the subject of sudden death, and of this, one of its most common forms.

DEATH BY DROWNING.

Causes of Death.—Different in Different Cases.—Death from Apnœa.—From Syncope.—From Concussion of the Brain.—From Apoplexy.—From Syncope supervening on Apnœa.—Post-Mortem Appearances.—Did Death take place by Drowning?—Value of the several Signs of Death by Drowning.—Water in the Stomach—in the Lungs.—Mucous Froth in the Air-passages.—Was the Drowning Accidental, Suicidal, or Homicidal?—Marks of Violence.

Although death from drowning is very properly regarded as a form of apnœa, or asphyxia, it is not always so; and when it is due to this cause, the appearances are not in all cases the same in degree, though they are in kind. Hence the subject of drowning is not quite so simple as it would at first sight appear to be. To make it intelligible it will be necessary to describe the various modes in which a man found in the water may have come by his death, *supposing him to have died in the water*.

A man in the perfect possession of all his faculties falls into the water. He sinks to a greater or less depth according to the depth of the water itself, and the height of the point from which he falls. He immediately rises to the surface again, and, if he is a swimmer, exhausts himself by efforts to save his life, and comes at length to the condition of one who cannot swim at all; with this difference, that he has already exhausted his strength by swimming, whilst the other has all his strength reserved for the death-struggles which are common to both. These struggles consist of irregular movements of the arms and legs, and graspings of the hand at all objects within reach, whether floating in the water or fixed at the bottom of it. In the course of these irregular movements he rises repeatedly to the surface, makes an effort to respire, and takes in air and water. The contact of the water with the larynx causes a cough, by which a part of the fluid is rejected, and with it, of course, a portion of the air contained in the

lungs. This takes place again and again, each new effort depriving the lungs of some of the air which they contain, till at length the body no longer rises to the surface, water alone is received in the vain efforts to respire, and involuntary and forced expirations still continue to drive the air out of the lungs. At length all these involuntary efforts cease, the body falls to the bottom of the water, and bubbles of air are forced from the chest by the elastic reaction of its parietes. The greater part of the water which has been taken in finds its way into the stomach, and a smaller proportion into the lungs; and this portion forms the foam constantly met with in persons who have perished in this way. The quantity of water found in the stomach and lungs, in this form of death from drowning, will differ in different cases. Where the individual is in possession of all his strength at the moment of immersion, his struggles will be violent and often repeated, and a considerable quantity of water will be swallowed. Where the person is weak, or already exhausted by efforts to save himself by swimming, his death-struggles will be of short continuance, and a smaller quantity of water will have entered the stomach and lungs.

A second form of death is where a person loses all consciousness at the moment of immersion. This may happen from fright, drunkenness, a sudden impression of cold, an attack of hysteria, or of catalepsy (of which the author has known one melancholy instance). In this case the body falls to the bottom of the water, rises again to a certain height, and falls again without a struggle. To this class of cases belongs death from syncope.

Again, a person may fall into the water with the head foremost, and, striking against a rock or fragment of wood, perish by concussion.

In a fourth case, cold may produce apoplexy.

A fifth is of a mixed character. A man falls into the water in the full possession of all his faculties; he preserves them for a time, till struck with horror at the death which threatens him, he faints, and thus perishes.

Each of these modes of death—from apnœa, from syncope, from concussion of the brain, from apoplexy, and from asphyxia and syncope combined,—must be admitted to be possible; but it is probable that all the other forms of death put together bear but a small proportion to the cases of death from apnœa.

The appearances presented by the body of the drowned after death will of course vary with the manner of their death.

1. In *apnœa*, the face is in general pale, sometimes of a slight violet hue; the hands, the feet, and other parts of the body, may also present the same discolouration. There is a frothy foam at the mouth, and the tongue is often found between the teeth. There is also a froth, sometimes, though rarely, tinged with blood, in the larynx, trachea, and bronchi. The mucous membrane of the trachea is generally colourless, but sometimes of a light rosy tint. There is a variable quantity of water in the trachea and in the first divisions of

the bronchia, and sometimes in their most minute ramifications. In general, the quantity does not amount to more than half a table-spoonful, but it may fill the entire bronchial tubes. The water occasionally carries with it portions of slime or mud, or the fragments of plants. The lungs themselves have a violet hue, and contain a large quantity of black fluid blood. Their volume is often so great, that their anterior edges meet, and even overlap each other on the division of the mediastinum. The right cavities of the heart and the venæ cavæ contain a considerable quantity of blood; while the left cavities and the aorta are comparatively empty. The stomach almost always contains a fluid analogous to that in which the body has been immersed, and the quantity is sometimes very considerable. The intestines have a rosy colour; the liver and spleen are gorged with blood. Sometimes the bladder contains some spoonsful of rose-coloured or sanguinolent urine. The vessels of the brain contain a small quantity of blood, and the medullary substance presents when sliced a number of bloody points. Sand or mud is often found in the hollow of the nails. Such are the appearances in the bodies of those who die of apnœa.

In those who die of *syncope*, the appearances are different. The face and the skin of the body are pale. The trachea is empty, or contains but a small quantity of water, but no froth. The lungs are but slightly developed, and natural in colour. There is a small quantity of blood in the right and left cavities of the heart, in the arteries and veins. The brain and other organs are in a natural state. There is no water in the stomach, unless the individual have taken it before submersion.

Death by *concussion* and by *apoplexy* will show the usual appearances in the brain. The latter mode of death, according to Devergie, is extremely rare; he has seen it only once.

In mixed cases of apnœa and syncope, we shall have a blending, in varying proportions, of the characters of the two modes of death. A small quantity of froth in the larynx, and little or no water; the lungs moderately distended with blood; both cavities of the heart and the arteries and veins containing blood, but somewhat more on the right than on the left side; the cerebral substance presenting bloody points; water in the stomach. The appearances described as belonging to this mixed state, are those which may be expected to occur in cases in which the struggles have not been violent, or of long continuance.

These appearances are probably faithfully described. A knowledge of them will answer two purposes: it will enable us to understand the variety of appearances presented by the drowned, and, in doubtful cases, may decide the question which of a number of persons falling into the water together perished first.*

The first question which suggests itself in reference to a body found in the water, is this:

* Devergie, De l'Asphyxie par Submersion.

Was Death caused by Drowning, or by some other Cause prior to Submersion? This question is not so easy as at first sight it might appear to be ; for the post-mortem appearances in the bodies of the drowned are not only not uniform (this may be explained in part by what has been already said on the different causes of death in drowning), but most of them are not peculiar to this mode of death. In order to answer this question, it will be necessary to examine the several appearances in turn, and to inquire, in respect to each of them, whether it is characteristic of death from drowning, or producible by causes acting before or after submersion.

The following are the several characters which have to be examined: *a.* The position of the tongue between the teeth. *b.* Injected state of the base of the tongue. *c.* The pallor, with rosy or violet discolouration of certain parts of the skin. *d.* The injected state of the brain. *e.* The fulness of the right cavities of the heart, and the emptiness of the left. *f.* The fluid state of the blood. *g.* The existence of bloody urine in the bladder. *h.* Excoriations of the fingers, with sand or mud in the hollow of the nails. *i.* The existence of water in the stomach. *k.* The existence of froth, water, mud, or sand, in the trachea or bronchial tubes. *l.* Froth at the mouth and nostrils.

a. The position of the Tongue between the Teeth.—The tip of the tongue is commonly found in close contact with the incisor teeth, more rarely between the closed jaws.* The jaws are in almost every instance firmly closed, and, according to Devergie, the tongue is often wounded.† This position, though not peculiar to this mode of death, would go far to strengthen the other probabilities in favour of death by submersion.

b. The Injected State of the Base of the Tongue.—This is not a sign of any great value. It exists in death by hanging, strangulation, and poisoning by the fumes of charcoal, and may be allowed to furnish a slight probability of death by apnœa.

c. Pallor, with Rosy or Violet Discolouration of certain parts of the Skin.—The appearance of the surface of the body varies greatly in different cases. Sometimes the whole surface is pale, at other times bloated and discoloured. It seems to be pretty well ascertained, that the chief cause of this difference in appearance is the time that the body has remained in the water. If soon removed, the surface is generally found pale ; if it has remained some days in the water, livid and bloated. The colour rapidly increases in intensity with the exposure of the body, especially in summer. This circumstance must be borne in mind ; it must also be understood, that these discolourations are not peculiar to death by drowning.

d. The Injected State of the Brain.—Supposing this state of the brain to exist in the drowned, it is of little diagnostic value, for it is present in many other forms of death. As it appears, on good authority, that

* Dr. Ogston in the Edinburgh Med. and Surg. Journal, vol. xlvii. p. 54, et seq. † Devergie, Méd. Légale

the brain, though frequently found injected with blood, is by no means always so, and sometimes even remarkably the reverse, this sign may be dismissed as altogether unimportant.

e. The Fulness of the Right Cavities of the Heart and the Emptiness of the Left—the fulness of the venous system in general, and the absence of blood from the arteries. This state of the vascular system is not peculiar to death by drowning; it exists equally in apnœa from other causes. It is, also, sometimes absent in death by submersion.

f. The Fluid State of the Blood.—This is another sign much insisted on by some authors. It seems, as a general rule, to hold good, for Orfila has seen only one case in which the blood was coagulated. Other authors, on the contrary, have found the blood coagulated in every case, and coagula have been repeatedly seen in the bodies of animals drowned for the sake of experiment. It must not be forgotten, too, that when putrefaction sets in, coagula actually existing are soon destroyed. So that a fluid state of the blood cannot be at all relied upon when putrefaction exists; and when the body is fresh it is by no means a certain sign; for, allowing it to exist, it may be the consequence of other forms of sudden death.

g. The existence of Bloody Urine in the Bladder.—This is mentioned by Devergie as a sign of rare occurrence. It has been observed in death by hanging, and in some cases of poisoning, and is not characteristic of death by drowning. Its presence would constitute a slight probability.

h. Excoriations of the Fingers, with sand or mud in the hollow of the Nails.—These excoriations are much more frequently absent than present, and when they exist may be produced immediately after death, and are not, on that account, a certain sign of death by submersion. It is obvious, too, that they might be caused previous to immersion by the rubbing of the fingers against any hard and rough body, should the party be drowned by force.

With regard to sand and mud in the hollows of the nails, this sign would of course be wanting where the bottom of the water does not consist of sand or mud, or where the drowning man does not struggle and grasp at the soil. If, moreover, the body has remained a long time in the water, mud or sand will be deposited in the hollow of the nails. This sign, then, is not always present, and, when present, is conclusive only where the body has not remained long in the water.

i. The existence of Water in the Stomach.—Let us admit this to be a vital sign, that it presupposes deglutition, and that without deglutition it could not get into that organ. It must be evident that the mere discovery of water in the stomach is no proof, that it got there in consequence of drowning: it might have been swallowed before submersion took place, and as we cannot prove that it was not so introduced, it will be necessary, in order to form a satisfactory opinion, to compare the water found in the stomach with that in which the party was drowned; and mixed up as it will be with mucus or with food,

what chemical analysis can enable us to prove its identity? It is possible that small fragments of plants floating on the water may be swallowed, and in such a case we should have a sign of considerable value.

It must be recollected that the quantity of water found in the stomach is very variable; sometimes being small in quantity, while at other times there is none at all. There are cases, then, in which we are deprived of this uncertain sign.

It has been assumed, that the presence of water in the stomach is a *vital* sign, and that it depends upon deglutition. This assumption is partly warranted by observation. Thus it is absent in animals which have been stunned; in animals which are kept under water from the first moment of submersion, and prevented from coming to the surface; it is also proportioned in quantity to the number of times that the animal is allowed to rise to the surface. Another circumstance which materially influences the quantity of water contained in the stomach is the depth of the water in which the individual is drowned. This is well shown by a comparative experiment instituted by Mr. Taylor. One cat was lowered to the depth of fifty-five feet in the Thames, another was held two feet below the surface: the stomach of the first cat contained a large quantity of water, that of the second scarcely any. A third cat was allowed to rise repeatedly to the surface of the water. The stomach of this cat was distended, but not so much as the one which had been lowered to the depth of fifty-five feet.* The influence of the columnar pressure of the water is, therefore, considerable; and it is probable, that where the water is very deep the pressure of the fluid may overcome the resistance offered by the collapse of the œsophagus, even though the animal died previously to submersion.

It appears, moreover, that water may enter the stomach in consequence of putrefaction producing a general relaxation of the tissues, and removing the obstacle which they offer in their more unyielding state. *Orfila* suggests, that water might be injected after death in order to raise a suspicion of drowning where life had been taken away by some other means. This is most improbable. Should such a case occur, it would offer precisely the same difficulty as arises in the case of water swallowed before immersion.

By way of making this question clear, let us suppose that water *is* found in the stomach. The medical jurist must endeavour to ascertain, in the first place, whether the body being dead before immersion, water might not have entered the stomach.

a. From the effects of putrefaction.

b. From the fact of the body having been sunk to a great depth.

c. From the water having been artificially injected after death.

And secondly, in the submersion either of a living or dead body,

* Elements of Medical Jurisprudence, p. 121.

whether the water had not been swallowed by the deceased before death.

If the medical jurist can satisfy himself that the introduction of water has been due to none of these causes, and he can ascertain that the fluid in the stomach is of the same nature as that in which the body was found, then he may be justified in laying great stress on the appearance in question.

We must now examine the negative supposition, that no water is found in the stomach. Does this prove that a person has not perished by drowning? We have already seen that water is not always present in those who have died from this cause; and that in persons recently dead it does not gain admission unless deglutition take place, except the body is lowered to a considerable depth. If, then, the body is found in comparatively shallow water, we should expect to find no water in the stomach, where asphyxia has been rapidly induced, where death has been caused by *syncope*, or where the individual has been previously *stunned*, or has been stunned by falling into the water head foremost. In some cases, too, the tendency to swallow may be voluntarily resisted, or the body may be, in some way or other, prevented from rising to the surface. Again, water may have entered the stomach, and yet not be found there after death. If, for instance, the head has been allowed to hang below the rest of the body, the water will flow out from the stomach. Mr. Taylor has shown this experimentally. Two cats were drowned in nine fathoms of water: consequently under circumstances for their stomachs to become perfectly filled. After having remained at this depth for half an hour, they were removed and suspended with the head downwards. Water drained freely from them, and on examination of the bodies three days afterwards, none was discovered in the stomach or alimentary canal.* If, moreover, the body is long exposed after its removal from the water, the fluid contained in the stomach may transude through its coats, and disappear.

The absence of fluid from the stomach, therefore, is no proof that a person has not been drowned, for it may have gained access to the stomach, and may have subsequently disappeared; or, on the other hand, it may never have entered the stomach at all. This *sign*, therefore, will have little or no value unless we are in a condition to discover all the circumstances in which a body may have been placed before, during, and after submersion.

k. The presence of froth, water, mud, or sand, in the Air Passages.— The mucous froth in the trachea and bronchi is often so abundant as to fill the entire length of the air passages. The cause of this appearance has been a subject of dispute; but the experiments of Piorry and Orfila have clearly shown that the presence of this mucus depends upon the circumstance of the body rising repeatedly to the surface for air.

* Taylor, op. cit. p. 123.

As it does not exist where the animal is kept entirely under water, cases must happen in which this appearance is not present. The absence of it, therefore, is no proof that death did not take place by drowning.

This froth may also be absent from other causes ; as from the body remaining in the water a long time after death, or from its long exposure to the air, after its removal from the water. When, again, the head is placed in a depending position the same result happens. But is the *presence* of froth in the lungs proof that a person has died from submersion ? It is not. For a mucous froth may exist in cases of death from apoplexy or epilepsy, and in the several forms of apnœa. An appearance somewhat similar is present in catarrhal affections.

With regard to the existence of *water in the lungs*, much difference of opinion has existed; but there is now no room for doubt that it is commonly present. The fact has been abundantly proved by experiments on animals, and by cases in the human subject in which not water only, but sand and mud have entered the air-passages. Orfila experimented with coloured liquids, and other experimenters have used oil, mercury, &c. By drowning rats in chalk and water, I have myself obtained effervescence by means of acids in every instance and in every part of the lungs. There is no doubt, therefore, of the fact ; but it is not universal, for some authors have failed to observe it. Like the existence of water in the stomach, it is influenced by the depth of water and the access to air.

Again, water may enter the lungs of those who have been thrown into the water after death. Orfila and Piorry found, that the quantity which thus gained admission to the lungs, varied according to the position of the body. When it remained upright there was a large quantity; less when horizontal. If the head were entirely dependent, it is probable that none would enter.

It has been suggested that water may be *injected* after death. This is most improbable.

The absence of water from the lungs is no presumption against death by drowning. For, as in the case of the stomach, so in that of the lungs, if the head is left depending, the water flows out. Long exposure, too, will cause it to transude and be lost.

1. *Froth at the Mouth and Nostrils.*—Where this exists it is a sign on which much dependence may be placed, but it is often absent, and, as has been already mentioned, it seems to depend either on its great abundance in the whole extent of the air passages, or on the development of the putrefactive process, the air generated forcing the froth in the larynx and trachea into the fauces. It is on this account that it is more frequently present in summer than in winter.

From this examination of the several signs of death by drowning, it appears that there is no single sign on which entire reliance can be placed. When many of these happen to coincide, we have a probability of more weight. It is with these signs as with symptoms

of disease ; taken separately they may be of little value, but combined they enable us to form a safe diagnosis. Some authors, and Orfila among the number, have thought, that the question, Was the death due to drowning? admits of no decision ; but from this opinion Devergie very properly dissents. In forming an opinion it will be necessary to take many different points into consideration,—as the depth of the stream, the time of the year, the position of the body, &c.

It is also important to bear in mind, that the appearances characteristic of death by drowning are not permanent. In winter they may continue after the body has lain from fifteen to eighteen days in the water, while in summer they would disappear from the third to the sixth or eighth day of immersion. The exposure of the body to the air also causes them rapidly to disappear, and in the height of summer a few hours would suffice to dissipate them.* When putrefaction has gone to any considerable extent, all the signs of death by drowning are of course completely removed.

The time that the body has remained in the water will be determined approximatively by the signs laid down at page 295, et seq.

But, in addition to the signs of death by drowning already discussed, we may obtain some clue to the mode of death by discovering marks of violence on the body. We must, therefore, discuss the value of the indications derived from this source.

Marks of Violence.—With regard to injuries discovered on the bodies of persons found in the water, three questions arise.

1. Were they inflicted before or after death ?

2. If inflicted during life, were they the result of accident or design, self-inflicted, or inflicted by others? And

3. If inflicted during life, are they of such a nature as to account for death before submersion ?

Now the first two questions—whether the injuries were inflicted before or after death ; and whether, if inflicted during life, they were accidental or designed, self-inflicted, or inflicted by others, are questions discussed under the head of wounds. The fact of the body having been immersed in water will influence the decision of these questions, only in so far as the injuries are altered in appearance by the continuance of the body in the water. The only question, then, which remains to be examined is this :—

Are the Injuries of such a nature as to account for Death before Submersion?

Now we may conceive of three different ways in which the body may come to exhibit marks of violence. In the first place, the body may be borne by the violence of the stream against some obstacle, or may be bruised by the struggles which the drowning man makes to save himself. 2. A man may be murdered, and, when dead, thrown into the water ; and 3. A man may receive severe injury from the

* Devergie, vol. ii. p. 348.

hands of others or himself, and may then be thrown (or throw himself) into the water whilst still alive.

On the supposition that a man has been murdered and thrown into the water quite dead, we should expect to find an absence of *all* those signs which have been mentioned as signs of *death* from drowning; with the exception only of such as may be present under certain circumstances already mentioned, such as uncommon depth of water, or advanced states of putrefaction.

On the supposition again that a man found in the water has first been severely injured and then thrown in whilst still alive, we shall expect to find some at least of the signs already mentioned, and these may be sufficiently marked to enable us to come to a decision; but this will, of course, depend on the strength still left to the drowning man, after the violence which he has suffered.

This question then ultimately resolves into another, viz.—

What Amount of Injury can be inflicted in the act of Drowning by the Obstacles with which the Body may come into contact?

Now, there can be no doubt that considerable injury may be inflicted if the person falls from a considerable height upon a bank or hard substance of any sort; fracture of the skull or limbs may be readily accounted for by this cause. Again a very great amount of injury may take place in consequence of the body being carried by the violence of the stream against hard and unyielding obstacles. The medical man should, therefore, first ascertain whether the drowned man fell from a height into the water, whether the stream is rapid, and what obstacles present themselves; and if on careful examination he finds that there are no such causes as these to account for the violence which the party has sustained, he may fairly trace that violence to some cause preceding the immersion; it may have been accidental, it may have been designed.

It is important to know that, besides bruises and abrasions, which may be accounted for on more than one supposition, and may have been inflicted either before or after submersion, dislocation of the extremities is a possible consequence of the mechanical obstacle presented by the water to the body falling into it from a great height.

Thus, Dr. Gordon Smith relates the case of a man who some years ago jumped from the parapet of London Bridge into the Thames for a wager. This exploit, it appears, the man had previously performed with impunity, but in this instance he sank and was drowned. Both his arms were found dislocated, in consequence, it is thought, of his having fallen with them in the horizontal position, instead of holding them close to his sides.

To what has been said on this part of the subject, it is only necessary to add, that the medical man must exercise his own acumen in discovering what amount of injury might be inflicted in known circumstances, either by the body falling into the water from a height, or by obstacles against which it may happen to be driven whilst in the water: injuries which

could not have been so inflicted, must have been sustained before immersion. It must also be borne in mind that, if the body has remained long in the water, the traces of injury will be magnified by putrefaction.

Having convinced ourselves, after a careful examination, that death took place by drowning, another question arises—

Was the drowning the result of Accident, Suicide, or Homicide? Now this question is exceedingly difficult to answer. For, let us suppose that there are no marks whatever of violence on the body, how are we to say whether the man fell in, or jumped in, or was pushed in? Then again suppose, that a body is found in a certain part of a stream of water, is it sure that it fell in, in the very part where it was found? if not, of what use are the ingenious directions of authors as to the necessity of observing the spot very narrowly?

Again, suppose the hands of the drowned man to be full of leaves or grass, showing that he struggled hard whilst in the water, does that prove that he was pushed in by others? certainly not; for, if he fell in, he would do precisely the same.

Again, it has been said, that the shallowness of the stream of water in which a person is drowned renders the idea of homicide improbable. Why should it? If a strong man were to hold the head of a weak or infirm one in a basin of water, he might drown him just as effectually as in a deep stream. In such a case, there must be of course great disproportion of strength. It is quite possible that more than one strong man may combine against another, and destroy him in this way.

It is evident, from what has been stated, that where there is no mark of violence on the body, we have no means of determining whether the drowning was the result of accident, suicide, or homicide. Nor does the discovery of external injuries throw any light upon the question, unless those injuries are of such a kind as that they could not have been inflicted by the person himself previous to immersion, or by the accidental striking of the body against an obstacle during the death struggle. There are certain injuries which could have been inflicted only by another, such as wounds on parts of the body not easily reached by the hand of the deceased himself; and there are others, again, which may have been either homicidal or suicidal. As this part of the inquiry belongs to the subject of wounds, it will not be pursued farther in this place. The questions which arise regarding them are not affected by the fact of the body having been found in the water.

There is one case which would at first sight seem conclusive as to homicide, and that is where a body is found in the water, tied hand and foot. Dr. Smith, however, relates the following case:—In July, 1816, the body of a gauging-instrument maker, who had been missing for some days from his home, was discovered floating down the Thames. On being taken out, his wrists were found tied together and made fast to his knees, which were in like manner secured to each other. He had been in a state of mental derangement for two years. The cord

with which he had tied himself was recognised as one that had hung from the ceiling over his bed, and by which he used to raise himself up, as he had been confined to bed for some weeks. He was a good swimmer, and it was presumed he had taken the precaution to prevent himself from employing that power. The verdict in this case was, "found drowned."* Two other cases of a similar kind are on record, one by Foderé, in which the hands and fingers were tied together with a silk riband, in numerous folds ; and another in the ninth volume of the Annales d'Hygiène, in which the feet, wrists, and neck were tied. Foderé in the one case, and the medical examiners (Marc, Guichard, &c.) in the other, gave their opinion in favour of suicide. In such cases as these it would be necessary to determine whether the knots or folds admitted of being made with the teeth, or by any movements of the hands or limbs.

The cases usually quoted in illustration of this subject, serve rather to show the imperfect nature of the medical evidence in former times, than to establish any general principle, or to clear up any disputed question. Some of these cases will be found at length in the works of Beck and Mr. Alfred Taylor.

DEATH BY HANGING.

Cause of Death in Hanging and Strangulation, Apnœa.—Experimental Proof.—Other Causes of Death.—Syncope.—Injury to the Spinal Marrow.—Symptoms and Post-mortem Appearances in Death by Hanging.—Was the Individual hanged during Life or after Death? —Marks of the Cord not always present.—Observations of M. Esquirol.—Was the Hanging Accidental, Suicidal, or Homicidal?— Case of Accident.—Position of the Body.

As the cause of death in hanging, strangulation, and suffocation is the same, it may be well to make a few preliminary observations on these modes of death, before proceeding to examine them separately.

Though, in common language, death from any of these three causes is due to *suffocation*, the term *suffocation* has in medico-legal language a meaning quite distinct from that of the other two. Whenever death is produced by any impediment to the respiration, which does not act by compressing the larynx or trachea, it is said to be due to *suffocation*. Thus a man is said to be suffocated if his mouth and nostrils are closed, or if the action of the muscles of respiration is prevented by mechanical pressure either on the chest or abdomen. Certain noxious gases, too, are said to destroy life by producing *suffocation*. The subject of suffocation then separates itself at once from those of suspension and strangulation, inasmuch as it includes all those cases of violent death in which the respiration is suspended, by causes other than pressure on

* Smith, p. 276.

the throat. Our attention, therefore, must be directed in the first place, to death by suspension and strangulation, in both of which pressure is exercised on the *air-tube* and *throat*.

Now this pressure may be applied to any part of the throat, and not only so, but it may be applied to the same part in very different degrees and ways. The most simple case, is that of strangulation produced by pressure with the fingers on the trachea. Here the cause of death is obvious ; it is the same as in the majority of cases of drowning ; the same as in suffocation—viz. *apnœa*, or *asphyxia*. Death takes place in consequence of the mechanical hindrance to the respiration. But the cause of death is not quite so clear where the entire circumference of the neck is subject to compression, for in this case not only is the larynx or trachea subject to pressure but the blood vessels also suffer. In some instances both the air passages and the vessels are implicated ; in others the air tubes suffer the chief compression and the vessels escape ; in others again the air tubes escape and the vessels suffer all the pressure. The cases in which the respiration and circulation are most completely impeded are when a cord is fixed round the lower part of the neck, embracing the trachea, and the large vessels at their entrance into and exit from the chest ; when the cord is applied between the lower jaw and the os hyoides both functions will be less interfered with, as the projection of the jaw-bone and occiput will defend the commencement of the air-passages and the vessels from pressure. Where the pressure is applied immediately over the os hyoides or thyroid cartilage, the respiration will be but slightly affected, unless great violence be used ; but the vessels will suffer scarcely less compression than in the lower part of the throat.

Now this difference in the position of the cord, and in the pressure which it exercises on the organs of respiration and circulation respectively, will tend to explain the difference in the length of time required to destroy life—that is to say, in those cases in which death is not almost instantaneous, for instantaneous death is due to a distinct cause—dislocation of the cervical vertebræ. Excepting, then, these cases of sudden death, which take place in suspension where great force is employed—we must inquire whether the compression of the air-tube or of the vessels, is the immediate cause of death. Is death, in other words, produced by *apnœa*, or by *apoplexy*? It was formerly the general belief that death was produced by *apoplexy*, but this opinion has lately given place to that which attributes it to *apnœa*. There is no doubt whatever that pressure on the carotid arteries and jugular veins will be productive of apoplexy ; it is well known, indeed, that mere pressure made by the finger on the carotid arteries will cause sleep, and it is confidently believed that this pressure if continued would end fatally. Nothing is more common, too, than to hear of apoplexy produced in persons predisposed to that disease, by the pressure of a cravat,—a pressure which would not affect the air-passages at all. The possibility, therefore, of apoplexy being produced by pressure exercised on the

large vessels of the head cannot be denied ; but the question returns upon us. In cases where both the air-tube and the vessels are compressed, to which of the two pressures shall we attribute the death ? It is not unlikely that both causes may combine to produce the fatal result, but there is every reason to regard the stoppage of the respiration as the essential cause ; for it is clear that apnœa would be much more speedily and certainly induced by a complete or partial stoppage of the breathing, than apoplexy by the complete or partial arrest of the circulation. Before the compression of the vessels, therefore, would have time to prove fatal, life would doubtless be effectually destroyed by apnœa. But we may appeal to actual experiment for the decision of the question we are now considering. " A dog was suspended by the neck with a cord, an opening having been previously made in the trachea below the place where the cord was applied, so that air could pass into the lungs nearly as freely as in ordinary respiration. After hanging in this style for about three quarters of an hour, during which time the circulation and the breathing went on as usual, the animal was cut down, and it did not appear to have suffered materially from the operation. The cord was then shifted from above to below the opening which had been made into the trachea ; so as totally to prevent the ingress of air into the lungs, and the animal being again suspended, was in a few minutes completely dead."* In this experiment the compression of the vessels was in all probability less than it would be in many cases of death from hanging, when the violence employed, the height of the fall, and the weight of the body would tend to draw the cord close, and exercise the strongest pressure on the vessels as well as on the air-tube.

" A man of the name of Gordon, was executed at Tyburn, in April, 1733. Mr. Chovet having, by frequent experiments on dogs, discovered that opening the wind-pipe would prevent the fatal consequences of the halter, undertook to save Gordon, and accordingly made an incision in his windpipe, the effect of which was, that when Gordon stopped his mouth, nostrils, and ears, for some time, air enough came through the opening to allow of the continuance of life. When hanged, he was observed to be alive after all the rest were dead ; and when he had hung three-quarters of an hour, being carried to a house in the Tyburn road, he opened his mouth several times and groaned ; and a vein being opened he bled freely. No further attempts succeeded in eliciting any other signs of life. The want of success probably was to be attributed to the great weight of the man, by which, the compression of the vessels of the neck, must have become more effectual than in ordinary cases, and perhaps at the same time the opening into the trachea was not sufficiently free."†

It appears, then, that where the larynx or trachea as well as the

* Cyclopædia of Practical Medicine, Asphyxia.
† Smith, Forensic Medicine, Appendix, p. 561.

large blood-vessels suffer compression, death may be attributed to apnœa ; where the respiration is free, or but slightly affected, pressure on the vessels may cause death by apoplexy, but more slowly ; and that where respiration and circulation are both impeded, both may contribute to the fatal result, though the stoppage of respiration will exercise the most baneful influence.

It has been supposed by some that the immediate cause of the stoppage of respiration is pressure on the nerves which are subordinate to that function, and Sir Benjamin Brodie's experiments are quoted in support of this view. According to Sir Benjamin Brodie, such pressure does not prove fatal until the lapse of many hours,—we do not therefore stand in need of such an explanation when we have so much more satisfactory and prompt a reason to assign.

Death takes place very suddenly in certain cases of death by suspension. This may arise from two causes ; the one, fear producing syncope as in the case of drowning ; the other, injury to the spinal cord from luxation of the cervical vertebræ, fracture of the odontoid process, or rupture of the intervertebral substance.

This latter form of death occurs only when great force is used, or when the body drops from a great height. Louis tells us of several French hangmen who saved the lives of some criminals while they killed others ; and he was informed that they were in the habit of causing laceration of the trachea, and luxation of the first cervical vertebra from the second, by placing the knot of the cord under the neck, and then giving a rotatory motion to the body at the moment when the ladder was taken from under the feet.

Death takes place then in different ways and in different intervals of time in hanging. Where it takes place most promptly it may be referred to injury sustained by the spinal marrow, above the origin of the nerves of respiration, and more rarely to syncope from fright. Next in point of rapidity will be the death from *apnœa*, and the least rapid that by apoplexy, using this term not in the sense of an actual rupture of the vessels, but of that distention of them which has been described by Abercromby and others as simple apoplexy. This is probably the syncopial or nervous apoplexy of the older authorities. In *strangulation* the cause of death is the same as in hanging ; but as greater force is commonly employed, death will take place somewhat more rapidly. Having now examined the questions which are common to death by hanging and strangulation it will be more convenient to give each of these subjects a separate consideration ; and first of death by hanging.

We are not without information as to the symptoms which accompany death from this cause. Suicides who have been saved from death, and philosophers, who have instituted experiments on themselves, have both contributed something to our knowledge of this subject. Devergie tells us that, during the unhappy times of the French

Revolution of 1793, a considerable number of persons who had voluntarily hanged themselves were recovered, and gave an account of their sensations. It appears, that the feelings produced are not always the same, and this difference probably depends on what has been already observed concerning the various degrees in which the windpipe and blood-vessels are compressed. Foderé has collected some curious cases. Wepfer mentions an instance of a man and woman who survived hanging. The woman recollected nothing, but the man stated, that, on the application of the cord, he felt no pain, but sank as it were into a profound sleep. Morgagni also mentions, that an individual who recovered under similar circumstances, informed him, that the first sensation was flashes of light before his eyes, and that he then sunk into the same sleep. A friend of Foderé's after having had a long discussion with him about the phenomena of asphyxia, suspended himself to his door, imagining that he could release himself when he pleased. Fortunately he was found suspended and cut down in time. Lord Bacon has given us the case of a philosopher who took a fancy to know, whether those who were hanged suffered much pain. He made the experiment upon himself by placing the cord round his neck, attaching it to a staple, and throwing himself off a low stool. He imagined that he should be able to mount on the stool again as soon as his curiosity was satisfied ; but he soon lost all sense and would have perished, if a friend had not entered the apartment and extricated him from his perilous situation.

From these and other similar cases, we learn that the symptoms induced by hanging are different in different cases. Sometimes there is an immediate loss of sense and motion, in others sleep passes into death ; and there are instances in which the sensations produced are stated to be extremely pleasurable, though of very short duration ; and followed, first, by an indistinctness of vision, and then by the appearance of a bluish flame, or of brilliant circles of colours, before the eyes. There is, at the same time, a singing or hissing sound in the ears. Very soon, however, the individual loses all consciousness, and death follows in a variable time afterwards. These symptoms are evidently due to compression of the vessels of the brain ; they resemble those which occur in other cases of disordered circulation, and are like those which often precede an epileptic fit. The occurrence of brilliant circles of colours before the eyes is one of the familiar symptoms of epilepsy.

But it is only in cases of suicide that these pleasurable sensations manifest themselves. In cases of homicide where much violence is used, the countenance expresses suffering; the eyes become brilliant and prominent, and seem to be bursting from their orbits ; the tongue is inmore or less protruded from the mouth, and, the jaws firmly contracting on each other, compress it between them ; the mouth presents various contortions, the upper extremities are stiff, the fingers are

closed with force, and the contraction is frequently so strong that the nails are forced into the flesh of the palm. To this convulsive state collapse and death speedily succeed.

This difference in the mode of death is important, as it explains the different appearances discovered after death in those who have perished by suicide and homicide respectively.

The post-mortem appearances usually described are the following—lividity and swelling of the face, especially of the lips, which appear distorted. The eyelids are swollen, and of a blueish colour; the eyes, red, projecting forwards, and sometimes partially forced out of the orbits; the tongue enlarged, livid, and compressed between the teeth, or frequently protruded. A sanguinous froth hangs about the lips and nostrils. A deep and ecchymosed impression round the neck indicates the course of the cord, and the skin is sometimes excoriated; laceration of the muscles and ligaments in the hyoideal region; laceration or contusion of the larynx, or of the upper part of the trachea. There are also, in many cases, circumscribed ecchymosed patches, of variable extent about the upper part of the trunk, and on the extremities, with a deep livid discolouration of the hands. The fingers are generally much contracted, or firmly clenched. The urine, the fæces, and the seminal fluid are sometimes involuntarily expelled at the moment of death. The body is much longer than usual in parting with its heat.

Internally we meet with the following appearances: Distention of the right side of the heart, and of the large veins, which distention, however, passes away, when the inspection is delayed several hours, as occurred in a case described by Morgagni. The vessels of the brain are usually congested, but extravasation is rarely present; there is also increased vascularity of the substance of the brain. This state of the vessels is common to all cases of death by apnœa. We cannot, therefore, attribute death to apoplexy in this more than in other forms of apnœa. A mucous froth, sometimes tinged with blood, is found in the trachea, the mucous membrane of the stomach is congested, which might lead to the supposition of poisoning. The lungs, according to Goodwyn, Roget, and others, are distended with air. This distention of the lungs with air, however, though it be the rule is not universal; for the lungs have been found collapsed. The most probable explanation of this exception to the rule is, that, in some instances, death is preceded by a deep inspiration, in others by an expiration.

The post-mortem appearances, then, are those which we encounter in cases of asphyxia in general, to which are added the marks of violence about the neck.

Two principal questions arise in regard to persons found hanged. 1. Was the individual hanged during life or after death? and, 2. Was the hanging accidental, suicidal, or homicidal?

1 *Was the Individual hanged during Life or after Death?*

The general description already given will assist us in answering this question ; but it is necessary to examine the principal signs a little more closely. Those which are most deserving of attention are, *a.* The mark of the cord. *b.* The state of the countenance. *c.* The position and state of the tongue. *d.* The condition of the genital organs.

a. *The Mark of the Cord.* In the majority of cases of hanging during life, the cord leaves an oblique indented mark, which is of the colour of a recent bruise on the anterior part of the neck, and yellowish brown, as if from a superficial burn, towards the angle of the jaw. Sometimes the discolouration on the anterior part of the neck corresponds with the whole breadth of the ligature ; at others there is a deep groove, bordered by two discoloured lines. The mark will of course vary with the size of the cord and the materials of which it consists, being less distinct when a soft material, such as a handkerchief, is used, than when a hard ligature, such as a rope, is employed.

This is the most common appearance produced by the cord applied during life ; and the older writers on Forensic Medicine knew of no other. But it is now known to be by no means of universal occurrence. De Haen and Foderé both speak of its occasional absence, but Esquirol has the merit of having first forcibly directed attention to the real value of this sign. The occasion was afforded him by an insane patient at the hospital of Salpêtrière, who was seen hanging herself in one of the gardens. An attendant immediately ran up and cut the rope ; but all attempts to restore animation proved unavailing. The features were composed and natural, and the skin not discoloured or ecchymosed. There was a double mark on the neck, for the rope had been twisted round it twice ; the mark was a simple depression, *without any change of colour.* In three hours and a-half, no alteration had taken place. In seven hours and a-half the body was cold, and began to stiffen ; the face was a little discoloured, the legs livid, and the rope-mark of a *light brownish tint.* In twenty hours the features were somewhat bloated, violet-coloured, but not distorted ; and the eyes were open and brilliant. The body was examined twenty-five hours after death. At that time the rope-mark was brown, as if the cuticle had been burnt ; but there was no ecchymosis in the vicinity. The cellular tissue beneath was dry and compressed, so as to form a *brilliant white band a line and a half in breadth.* The scalp was injected with black blood. The lungs and heart were quite natural, and *not gorged.**

Subsequent observations have shown that this case is by no means rare ; for, in eleven out of twelve bodies examined by Esquirol, in twenty-five examined by Devergie, and in fifteen observed by Dr. Klein there was no ecchymosis. On the other hand, of one hundred and one cases collected by Dr. Remer of Breslau, no less than eighty-

* Ed. Med. and Surg. Journal, vol. xix. p. 487.

nine presented a well-marked ecchymosis; one the shrunken and parchment-like appearance; in two the skin was excoriated; and in nine cases it is expressly stated, that ecchymosis was absent. In about one-tenth of the cases, therefore, there was no ecchymosis. Of six cases, also, observed by Dr. Fleichman, there was no ecchymosis in two.* These results have been confirmed by almost every modern writer on this subject. In one case of hanging, in which the cord was removed soon after the body had been cut down, I observed merely a depressed circle on the fore part of the neck, and a slight excoriation, with a burnt appearance over the angle of the jaw.

The appearances, then, produced by the cord in cases of hanging during life are not the same in all instances: in the majority, perhaps, ecchymosis is present, but in others there is either an entire absence of discolouration, or merely a condensed state of skin resembling old parchment, or slight excoriation, or an appearance like that produced by a superficial burn.

The different appearances present in different cases may probably be explained by the mode in which death takes place. If from syncope there will not be sufficient blood in the vessels of the surface to occasion ecchymosis; but where death takes place after violent and prolonged struggles, ecchymosis may be expected to be present.

The conclusion to which we are led, then, is this: that the presence of ecchymosis is a proof of death by hanging, (unless it can be shown that such ecchymosis may be produced after death,) but that the absence of it is not a proof of the contrary.

Here, then, a new question arises; viz., *can the appearances occasioned by the cord in an individual suspended during life, be produced after death?* This question must be answered in the affirmative. It will be shown, when speaking of the distinction between bruises inflicted during life and after death, that ecchymosis may be produced for some time after life is extinct. The rule which applies to bruises in general will of course hold good with respect to this particular form of ecchymosis; and accordingly Orfila† has proved, by experiments on the dead body, that, up to eighteen hours after death, precisely the same appearances may be produced as in suspension during life; and Devergie‡ has produced the parchment-like condition of the skin and subjacent cellular tissue, as well as the ecchymosed appearance bounding the depression. Dr. Casper, of Berlin, succeeded up to two hours after death in producing ecchymosis resembling that occurring in hanging during life.§ It follows, then, that neither ecchymosis, nor the peculiar parchment-like condensation of the skin is a sure sign of suspension during life; and that consequently the appearance of the neck, taken alone, is not conclusive as to the

* Br. and For. Med. Rev. vol. v. p. 615.
† Leçons de Méd. Lég. vol. ii. p. 381.
‡ Vol. ii. p. 394.
§ British and Foreign Medical Review, vol. v. p. 615.

question under consideration. A very considerable effusion of blood, a rupture of the trachea, a separation of its cartilages, a dislocation of the spine, a division of the coats of the vessels, or, indeed, any evidence of great violence would furnish a strong probability of suspension during life, for it is highly improbable that much force would be used in suspending a body which had been previously deprived of life by other means.

b. The State of the Countenance.—The mere expression of the countenance varies so much in different cases, both of suicidal and homicidal hanging, that it cannot assist us in deciding the present question. The degree of injection of the vessels of the head and face, however, may afford us some assistance. A congested state of those vessels, though it might be present in death from natural causes, as from apoplexy, would furnish a probability in favour of suspension during life; for, suspension after death, though it might produce discolouration of the neck itself, could not cause turgescence of the vessels of the head and face.

c. The Position and State of the Tongue.—An injected state of the base of the tongue is common to all forms of death by apnœa, and occurs in hanging. The tongue is also protruded in other forms of death, beginning at the lungs. Dr. Gordon Smith supposed that this protrusion of the tongue in hanging altogether depends on the position of the cord; but this is doubted by Devergie, and probably with reason. It is in any case a sign of little value.

d. The State of the Genital Organs.—The genital organs of both sexes are affected in death by hanging. In the female, redness of the labia and discharge of blood have been noted, and in the male a more or less complete state of erection of the penis, with discharge sometimes of urine, but more generally of mucus. Dr. Guyon, of Martinique, had an opportunity of observing and inspecting after death twenty-one criminals, of whom fourteen were hanged, and seven beheaded. In all of those who were hanged the penis became suddenly and forcibly erect, five urinated freely, and in the remaining nine the penis was found half-erect, and the canal of the urethra filled with a liquid which was thought too large in quantity to be derived solely from the prostate. Of the five who had urinated two presented traces of emission.* Subsequent observation has not fully confirmed these results. In twenty out of thirty-five cases reported by Dr. Remer, nothing was found, and in the remaining fifteen, ejaculation of semen or congestion of the penis. These appearances, were also absent in Dr. Klein's fifteen cases. But of seventy-seven cases collected by Dr. Casper, emission took place in nineteen; and evacuation of the fæces in four out of one-hundred and six. In one female out of twenty-nine, a congested state of the female organs of generation was observed.† On the other hand, it must be borne in mind, that these appearances, when they do occur,

* Revue Médicale, Sept., 1823.

† Br. and For. Med. Rev. vol. v. p. 615.

are not characteristic of death by hanging or strangulation, for they have been observed in other forms of violent death, as in the case of a suicide who blew his brains out, reported by Dr. Klein, and a second by Remer, in which the descending aorta was ruptured by a pistol shot. It is probable that the fluid ejected from the urethra is not semen but mucus; for, in the case of a criminal executed in America, reported in the American Journal of the Medical Sciences, for May, 1840, the fluid contained no seminal animalcules. In this case, too, the emission was unaccompanied with priapism.

This sign, then, is one of considerable importance, for it is strictly vital, and affords a sure proof of violent and sudden death; and combined with other signs of death by hanging, it would be nearly conclusive. On the other hand, the absence of erection and emission would be no evidence that death was not due to this cause.

The post-mortem appearances are deserving of close attention, and the presence of those which are characteristic of death by apnœa or apoplexy, would corroborate the evidence derived from the appearance of the neck, and of the genital organs. In cases of death by hanging, as in those of death by drowning, our opinion will have to be formed from a comparison of all the appearances present, and not from any one taken by itself.

2. *Was the Hanging accidental, suicidal or homicidal?*—Accidental hanging is of rare occurrence, but it has happened. Dr. Smith, mentions the case of a girl who was swinging in a brewhouse, and near the rope used by her for that purpose, was another for drawing up slaughtered sheep. In the course of the exercise her head got through a noose of this second rope, by which she was pulled out of the swing, and kept suspended at a considerable height, until she died.* Mr. Taylor relates a second case which was communicated to him by one of his pupils. A boy ten years old had been amusing himself by fastening a piece of plaid gown to a loop in a cord, which was suspended from a beam in the room. In the act of swinging he raised himself up, and gave himself a turn, when the loop of rope suddenly caught him under the chin, and suspended him until life was entirely extinct. A playmate was witness of the occurrence.†

These rare cases will occasion little difficulty, as the manner of the death would be readily ascertained.

The present question, then, is narrowed to this: *Was the Hanging suicidal or homicidal?* The probability is always strongly in favour of suicide, as it would obviously be extremely difficult for any single man, or even for two or three together to suspend another, and it is a mode of death which a murderer is little likely to resort to. This is all that can be said with certainty on the subject, for there is obviously no direct means of distinguishing the suicidal from the homicidal act. If a man were found suspended at a height from the

* Forensic Medicine, p. 236.
† Elements of Medical Jurisprudence, p. 173.

ground which he could not by any possibility have reached, and with no object near on which he could have mounted, we might reasonably conclude that he was suspended by another. It was once supposed that when a person was found with the feet or some part of the body touching the ground, he was more likely to have been hanged by another than by himself; but careful observation has shown this to be an error, for suicides have been found in every imaginary position, and very many in such a posture that death must have been produced by strangulation, the suicide leaning forward so as to compress the windpipe. Several cases of this kind are on record. The following may be taken as an example:—

In the year 1613, a number of persons, amongst whom was a man called Stewart, the juggler, were tried for witchcraft. The poor man complained to some ministers, who were sent to exhort him to repent of his league with the devil, "that he was so straitly guarded, that it lay not in his power to get his hand to take off his bonnet, nor to get bread to his mouth. And immediately after the departing of the two ministers from him, the juggler being sent for at the desire of my Lord of Eglintoune, to be confronted with a woman of the burgh of Air, called Janet Bous, who was apprehended by the magistrates of the burgh of Air for witchcraft, and sent to the burgh of Irvine purposely for that affair, he was found by the burgh officers who went about him, strangled and hanged by the cruik of the door, with a tait of hemp, supposed to have been his garter, or string of his bonnet, not above the length of two span long, his knees not being from the ground half a span, and was brought out of the house, his life not being totally expelled. But, notwithstanding of whatsoever means used in the contrary for remeid of his life, he revived not, but so ended his life miserably, by the help of the devil his master."*

In another case of undoubted suicide, the body was found partly reclining on the bed, but suspended by the neck from a cord, fastened to a nail.† A great many cases, illustrated by engravings, in which the bodies of suicides were found placed in every possible attitude, are given in an interesting paper in the Annales d'Hygiène.‡

As in most of the cases in which the body touches the ground the cord would not be so put on the stretch as to give it its usual oblique position, there would be no real difference between such cases and cases of strangulation, except, perhaps, that in the latter the mark would be more distinct, and extend round the greater part of the circumference of the neck.

The marks of violent struggles on the clothes or person of the deceased, or of severe injuries, might raise a suspicion of homicide; but as severe and extensive injuries have been known to be

* Sir Walter Scott, Demonology and Witchcraft, p. 323.
† Case of Mr. W. Elder, Times newspaper, October, 1838.
‡ Tom. v. p. 156.

produced by a suicide, or to take place accidentally, this criterion must be used with great caution.

It appears, then, that in death by hanging, the presumption is always strongly in favour of suicide, but that we can rarely have the means of converting this presumption into certainty, or even of adding materially to its force.

The two following cases, however, are related by Dr. Casper. A boy was found hanging. A round ecchymosed mark, the size of a shilling was seen on the larynx, with several impressions on the surrounding skin ; but there was neither depression nor ecchymosis in the course of the cord. The boy had been strangled and then hanged.

A man, 60 years of age, was found suspended to a hook in the door, so that the nates were only nine inches from the floor, and his legs were stretched out at full length. The cord by which he was suspended was from two to three feet long, and was loosely passed round his neck. The furniture of the room was in great disorder. Some marks of dried blood were seen on one part of the floor. The right side of the head and face was bruised and excoriated in several places. The cord had produced a circular impression without extravasation. A little above this was a strongly marked ecchymosis, extending round about one half of the neck to the occiput, and blood was found extravasated in the skin beneath this mark. The medical opinion given was, that the deceased had been murdered previous to suspension, and this was confirmed by evidence subsequently produced.*

For several interesting cases, and among others that of the Duc de Bourbon, the reader is referred to Beck's Medical Jurisprudence.†

DEATH BY STRANGULATION.

The Cause of Death the same as in Death by Hanging.—The marks of the Ligature more circular, and the amount of Injury greater.—Was Death caused by Strangulation, or was the constricting force applied after Death?—Case of Sir Edmundbury Godfrey.—Was the Strangulation accidental, suicidal, or homicidal?—Cases of Accident.

Death by hanging differs from death by strangulation, inasmuch as the one includes the idea of suspension, which the other does not. Strangulation may be effected either by the uniform pressure of a ligature round the neck, or by direct pressure on the trachea, and in rare instances the two may be combined, some object being introduced into the folds of the ligature, and placed immediately over the windpipe.

From this distinction between death by hanging and death by strangulation, it follows that, as a general rule, the mark on the neck

* Br. and For. Med. Rev., vol. v. p. 615.
† Seventh Edition, p. 634.

will differ in the two cases; being oblique and high in the neck in death by hanging, circular and low down in death by strangulation. From this general rule, however, those cases of hanging must be excepted in which the body is not completely suspended, but touches the ground; and those rare cases of strangulation in which the ligature happens to be fixed somewhat obliquely. The mark in hanging, therefore, may happen to be circular, and that in strangulation more or less oblique. Another difference is, that in strangulation much more force is used than in hanging; hence the mark on the neck will be more visible, and the injury to the subjacent parts more considerable, and this will be especially the case in homicidal hanging, for the murderer generally uses more violence than is necessary to effect his purpose.

The same questions arise in the case of strangulation, as in that of death by hanging—viz., 1. Was death caused by strangulation; or, was the constricting force applied after death? 2. Was the strangulation accidental, suicidal, or homicidal?

1. *Was Death caused by Strangulation, or was the constricting force applied after Death?*—A cord applied within a few hours of death would produce a certain degree of ecchymosis, but not that degree of it which would result from the violent application of the cord during life, and the turgescence of the countenance, as well as the post-mortem appearance on the throat itself, and in the chest, would be wanting. It is only, therefore, in the scarcely conceivable case of slight force being used, and death taking place suddenly, as from syncope, that the appearances produced by a cord applied during life could resemble those due to its application after death. The same observations apply to direct pressure on the windpipe. As, moreover, strangulation is rarely resorted to by a suicide, the murderer is very unlikely to hide the real mode of death by applying a cord after he has despatched his victim by other means. It is much more probable that having strangled his victim, he should endeavour to conceal the real mode of death, by placing the body in a position and under circumstances suggestive of suicide.

This was done by the murderers of Sir Edmundbury Godfrey, an eminent magistrate of Middlesex, who had been active in suppressing the political disturbance of 1677. He was found lying in a ditch in the neighbourhood of Islington, with his own sword passed through his chest, and his gloves and other articles of dress so disposed as to lead to the belief that he had committed suicide. On examination there was no blood found at the wound, though the sword had passed through the heart, and on further examination an ecchymosed mark an inch broad, was found extending round the neck; the face which during life was remarkably pale, was livid and suffused, and the eyes blood-shot. The cervical vertebræ were found fractured, and the neck so flexible that it could be turned from one shoulder to the other. The manner of his death, as proved by accomplices, on the trial of Green,

Berry, and Hill, for his murder, was thus: having enticed him, under a false pretence, to a remote situation about Somerset House, a man came behind him, twisted a handkerchief, and threw it about his neck, when four of them threw him down, and strangled him. Not entirely accomplishing their purpose in this way, the person who fixed the handkerchief, twisted his neck round, using violence to the body with his knee. This was on Saturday night. The body was concealed till the Wednesday night following, when about twelve o'clock it was carried away in a sedan chair, and thrown into a ditch. They then passed his own sword through him, and laid his gloves and some other things on the bank, so as to excite the belief that he had committed suicide.*

In another case, that of Bartholomew Pourpre, the deceased was first strangled and then suspended, and the mark of the cord being at the lower part of the neck, instead of the upper, and the teeth knocked in and bloody, strongly confirmed the other evidence; and the murderer was convicted.

2. *Was the Strangulation accidental, suicidal, or homicidal?* — Strangulation, like hanging, may take place accidentally. Of the possibility of such an occurrence, the following case related by Dr. Smith, is an example:—

A young man of a particular turn for mechanical and other inventions, having lost in a great degree the use of his upper extremities, was accustomed to assist himself in moving a heavy weight by means of a cord attached to it and passed round his neck. One morning, shortly after having retired from the family to his own room, his sister discovered him sitting in a chair apparently lifeless. He was found to be quite dead, and the cord, by which he moved the weight, was twisted round the neck. On cutting the cord, the weight which was appended to it, fell on the floor. There was but little doubt from the appearance of the furniture around the body, that the deceased had attempted to move the weight in the usual way, but that, in this attempt, the weight had slipped behind and had caused a compression of the trachea sufficient to produce strangulation.

The following case of accidental strangulation occurred in the month of July, 1839:—An extremely dissipated, drunken, and disorderly woman of the name of Elizabeth Kenchan, went to bed intoxicated, and on Tuesday morning was found strangled in her bonnet strings. It appears that she went to bed with her bonnet on, and falling out of bed, her bonnet became fastened between the bedstead and the wall; and she, being so drunk as to be unable to loosen the strings, was consequently strangled.

These rare cases of accident would be easily known to be such by the position of the body and the circumstances of the case.

It is very unlikely that accidental strangulation would occur in any

* State Trials.

other way than by means of a cord or string; but in the following case an attempt was made to attribute the death to the accidental pressure of the fingers:—

In 1763, a man named Beddingfield was found dead in his bedroom, and the charge was laid against his wife and man-servant. The medical testimony was very unsatisfactory, as no dissection had taken place, but, it was proved that there were marks about the neck resembling those of fingers. A contradictory account was, however, given of the number; one surgeon said a thumb and *three* fingers; the other, a thumb and *four fingers;* while another witness, who also saw the marks at the inquest, spoke of *two* only, "which looked as if the blood was set in the skin." The defence was, that the deceased had fallen out of bed, and was found lying on the floor on his face, with one hand round his neck. The discrepancies in the testimony, and the omission of dissection, might however have led to subsequent doubts, had not one of the condemned persons confessed that he had strangled Beddingfield, by seizing his throat with his left hand, while asleep, and that though the deceased struggled violently and made some noise, yet he soon accomplished his purpose.

There are a few cases, then, in which death by strangulation has been due to accident; but on the supposition that we have convinced ourselves that death did not take place in this way, the question is narrowed, and assumes this shape:—

Was the Strangulation suicidal or homicidal? — Strangulation is rarely the act of a suicide, unless we consider the cases already alluded to under the head of death by hanging, in which the body, being partially supported, is forcibly thrown on the ligature, as cases of strangulation. It would be extremely difficult for a man to strangle himself by the pressure of his hands even with the assistance of a ligature; but a case is related by Orfila, of a suicide who was found lying dead in his bed, with two cravats twisted several times round his neck. More commonly a stick, or some such object, is used as a means of producing the necessary compression. Thus, a case is recorded in the Times newspaper, Nov. 1838, of a Mr. Watson, aged 88, who strangled himself by placing the poker through the tie of his handkerchief and twisting it round and round. Dunlop relates the case of a Malay who used a small stick for the same purpose. In another instance, the handle of a pot was employed. Other examples of the same sort have been put on record. The place in which the body was found, and the circumstances of the case, would assist in determining whether such cases were suicidal or homicidal. The same means might be resorted to either by a suicide or a murderer.

Strangulation by means of pressure on the trachea may be assumed as in all probability homicidal. The following is a case of this kind. A trial for murder by strangulation took place at the Chester assizes, in April, 1835. The murder was committed in the following manner: The prisoner, who was a robust man, upon some slight provocation,

seized the deceased by the cravat, and pressed him firmly by the neck against a wall, until he was dead. On examination of the body, the face was found to be livid and swollen, and the features distorted. There was also a considerable discolouration and depression on that part of the neck to which the pressure had been applied. The prisoner was seen to commit the crime by several witnesses. The case was clearly proved against him, but he was acquitted on the ground of insanity.* The following case is usually quoted, as an instance of murder by strangulation:—

Dr. Clench, a London physician, was called out of bed by two persons on the night of the 4th of January, 1692, to visit a friend who was not well. He entered a hackney-coach with them, and drove about several streets in the city for an hour and a quarter. The two individuals then left the coach, and sent the driver on an errand. When the coachman returned, he found Dr. Clench sitting on the bottom of the coach, against the front seat, with his head on the cushion. Thinking him in liquor, he shook him, but obtained no answer. He then called the watch, and they found him strangled by a coal wrapped in a handkerchief, and applied directly over the windpipe. The coachman had heard no noise while driving the carriage.†

In comparing death by hanging, and death by strangulation, in reference to the question of suicide or homicide, we may say, that while death by hanging is most probably a suicidal act, that by strangulation is more likely to be homicidal. To the former rule there are few, to the latter many exceptions.

DEATH BY SUFFOCATION.

Different ways in which Suffocation may take place.—Stoppage of the Mouth and Nostrils.—Pressure on the Chest.—Closure of the Glottis. Post-mortem Appearances.

Under this head it is intended to comprise all cases of apnœa, not produced by direct pressure on the windpipe, with the exception of drowning, which has already been treated separately.

Suffocation may take place in a great variety of ways. *The mouth and nostrils may be stopped* by accident or by force. A person in a state of helplessness, from whatever cause, may fall on the face and be suffocated by water or loose earth; and new-born children by the discharges, or by being overlaid in bed. Murderers also have sometimes despatched their victims by this means. Another cause of suffocation is,

Mechanical Pressure on the Chest.—This may occur from accident as by a quantity of earth or rubbish falling upon a man. This mode

* Taylor's Elements of Medical Jurisprudence, p. 194. † State Trials.

of death is sometimes combined with strangulation; the murderer pressing with his whole weight upon the body, and then compressing the larynx or trachea with the hand. Sometimes suffocation is effected, as in the case of Burke and M'Dougal, by compressing the chest and closing the mouth and nostrils at the same time.

Suffocation by pressure on the chest was resorted to in barbarous times as a torture. This constituted the *peine forte et dure* of our ancient law, inflicted upon prisoners who stood mute out of malice, or feigned themselves mad, or challenged peremptorily more than the number of jurors allowed by law, thus refusing their legal trial. "The manner of inflicting this punishment may be best found from the books of entries, and other law books, all of which generally agree, that the prisoner shall be remanded to the place from whence he came, and put into some low dark room, and there laid on his back without any manner of covering, except for the privy parts, and that as many weights be laid upon him as he can bear, and more, and that he shall have no manner of sustenance but the worst bread and water, and that he shall not eat the same day on which he drinks, nor drink the same day on which he eats, and that he shall so continue till he die." Some authorities say till he answers.

A curious case of accidental suffocation from pressure on the chest which nearly proved fatal, is mentioned by Dr. Roget: "An athletic black, of pugilistic celebrity, had been selected, from the fine form of his chest, and well-marked expression of his muscles, as an academic model. It was wished to obtain a cast of his body; but this being attempted at one operation, and in one entire piece, as soon as the plaster began to set, he felt on a sudden deprived of the power of respiration, and, to add to his misfortune, was cut off from the means of expressing his distress. His situation, however, was fortunately perceived just in time to save his life, by breaking his bonds and releasing him from the extreme peril in which they had placed him."*

Persons have been pressed to death in a crowd. On the 14th of June, 1837, no less than twenty-three persons lost their lives at the Champs de Mars, in this way, death being due partly to suffocation and partly to severe injury to the chest.

Another cause of suffocation is the *closure of the glottis*. This is sometimes intentional, and sometimes accidental, or the result of disease. Galen states, that the slaves, when brought into the presence of their judges or executioners, suffocated themselves by swallowing their tongue; and this statement is rendered probable, by a case related by Dr. Walsh, on the authority of a friend of his, who was passing through the carioca when a slave was tied up and flogged. After a few lashes he hung his head, apparently lifeless, and when taken down he was actually dead, and his tongue found wedged in the œsophagus so as completely to close the trachea.†

* Cyc. Pr. Med. vol. i. p. 177. † Notices of Brazil.

The following curious case, which occurred in Austria, in 1833, is quoted from Dr. Wagner: "A criminal who had been shut up alone in a dark dungeon, when visited by his keeper not long after, was found lying dead on the floor. It was thought that he had had a fit of apoplexy, and a vein was opened, but to no purpose. It was for the first time noticed that he had a foreign body in his mouth, and it proved to be a piece of woollen cloth, two ells long, and a quarter broad; a shawl, in fact, which the wretched man had thrust into his throat." * This mode of suffocation by means of foreign bodies thrust into the mouth has been employed in cases of infanticide.

Suffocation has been produced by objects accidentally swallowed. Anacreon is said to have died from swallowing a grape-seed; Gilbert the poet from swallowing a piece of mutton. There is a case on record of suffocation caused by swallowing a bee in some honey; another in which death was caused by slake lime getting into the larynx, and producing violent inflammation there. Tumours in the glottis have led to the same result. Suffocation is also apt to be produced by the contents of the stomach, rejected during a fit of intoxication, getting into the windpipe. Thus Paris and Fonblanque quote a case that occurred in St. James's workhouse, and fell under the particular notice of Mr. Alcock. "The patient was seized, after a hearty meal of pork, with an epileptic fit, during which he died; when, upon opening the trachea, it was found to contain a quantity of animal matter, resembling the pork on which he had recently dined."

Suffocation has not a very extensive medico-legal application. It is not a mode of death sufficiently sure to be frequently adopted either by a murderer or a suicide. Where it is employed it will not be easy to ascertain the fact by inspection of the body, unless the appearances characteristic of asphyxia are present in a very marked form, and traces of violence are at the same time found on the corpse. Where the body is very weak from any cause, as in the new-born infant, the old man, or the intoxicated, suffocation is not very difficult to effect, and, if unaccompanied by violence, would not leave sufficient marks on the body to guide us to a decision.

The post-mortem appearances present in well-marked cases of suffocation may be deduced from the account given by Dr. Ollivier of Angers, of the persons suffocated in the Champs de Mars. In all the twenty-three persons, without exception, the skin of the face and neck was of a uniform violet tint, spotted with blackish ecchymoses. In nine there was infiltration of blood under the conjunctiva of the eye; in four, sero-sanguineous froth running from the mouth and nose; in four, blood flowing from the nostrils; in three, blood flowing from the ears; in seven, fractures of the ribs; in two females, fracture of the sternum. In sixteen bodies that were opened, the blood was black, diffluent, and filling all the large veins at the

* Dr. Cummin, Med. Gazette, vol. xiii. p. 973.

right side of the heart. The pulmonary tissue was mostly of a reddish brown, and in three-quarters of each lung, posteriorly, there was a considerable accumulation of black and liquid blood ; but there was no ecchymosis, either on the surface or in the substance of the lungs, except in one case. In all the cases in which there was infiltration of blood beneath the conjunctiva, and in those in which blood flowed from the ears, the vessels of the pia mater and substance of the brain were gorged with blood.*

In consequence of the comparatively slight traces of injury left after death by suffocation, this mode of death was, previous to the passing of the Anatomy Act, selected by murderers anxious to dispose of the bodies of their victims. It was in this way that the victims of Burke and Bishop were destroyed. The following are some of the particulars of the trial of Wm. Burke and Ellen Macdougall, for the murder of Margery Campbell, which trial took place 24th December, 1828, before the Justiciary Court of Edinburgh.

The deceased was last seen alive by several witnesses drinking in the house of Burke, about eleven o'clock on the evening of the murder. On the following day she was missed by some of these witnesses, and on searching the premises of Burke, her dead body was found lying concealed in some straw. Information was speedily given to the police, but when a search was made by the officers, the body of the deceased could not be found. They succeeded, however, in tracing it to a dissecting-room to which it had been, in the meantime, conveyed in a tea-chest. From the confession of an accomplice, it subsequently appeared, that Burke had destroyed the deceased by sitting on her body, at the same time that he covered her mouth and nostrils with one hand, and applied the other forcibly under the chin.

The body when examined by Dr. Christison and Mr. Newbegging, about fifty-nine hours after death, presented the following appearances: the face was livid ; features composed, but somewhat more turgid than natural ; the lips of a dark colour ; and the conjunctivæ of the eyes blood-shot. There was a little fluid blood on the left cheek, apparently from the nostrils ; the tongue was not protruded or torn by the teeth; the cuticle under the chin was much ruffled, and the surface of the true skin, when laid bare, was dry and brown ; but there was no ecchymosis. There was no effusion of blood or laceration of the parts around the windpipe, and no injury of the cartilages, but the os hyoides and thyroid cartilage were further apart than usual, in consequence of the stretching of the interposed ligament. The integuments, except on the face, were perfectly free from lividity, and the joints were flaccid. The following were the internal appearances: The membrane of the windpipe healthy, with here and there some tough mucus, not frothy, and a few points of blood between it and the membrane. The organs within the chest were

* Annales d'Hygiène, vol. xviii. p. 485.

perfectly natural; the lungs remarkably so, and but little distended with blood. The blood throughout the body was black and fluid, and accumulated in the large veins, and in the right cavities of the heart. There were some marks of violence on the limbs, and in the spinal canal, which were shown to have been occasioned by the forcible doubling up of the body.

In this case there is no doubt that death was caused by suffocation, and yet the appearance of the body was not such as to lead at once to the conclusion, that death had happened in this way; for Dr. Christison admits that, before he was aware of the manner in which the deceased was destroyed, he was inclined to ascribe her death to the injury done to the spine. In allusion to the opinion expressed by some medical men, that the signs of suffocation are so strongly marked as of themselves to arrest attention, Dr. Christison observes, "In the body of the woman Campbell, no person of skill, whose attention was pointedly excited by being told that from general circumstances murder was probable, but the manner of death unknown, could have failed to remark signs that would raise a suspicion of suffocation. But if his attention had not been roused; if, for example, he had examined it in the anatomical theatre of an hospital, without knowing that suspicions from general circumstances were entertained regarding it, he might have inspected it even minutely, and yet neglected the appearances in question. Nay, a person of skill and experience would have been more likely to do so than another, because every one who is conversant with pathological anatomy must be familiar with such or similar appearances, as arising from various natural diseases."*

In the case of Carlo Ferrari, the victim of Hare and Bishop, the appearances from which suffocation might have been inferred were even less strongly marked. The face, it is true, was swollen, and the eyes were blood-shot; but the lungs were quite healthy and not congested, the heart was contracted, and all its cavities quite empty. In this case, the medical witnesses attributed the death to injury to the spine, and the consequent effusion of blood on the spinal marrow, which, as in the foregoing case, was produced after death; and they stated, that death could not have been caused by any mode of suffocation, as by drowning, hanging, or strangulation. From the confession of the murderers, however, it appears, that, having stifled the deceased, they lowered his body into a well with the head downwards, taking care to keep his mouth below the level of the water.

It would appear, then, that the external and internal appearances in cases of death by suffocation, are not always of so marked a character as to arrest attention, though they may serve, more or less, to corroborate the statements made as to the cause of death.

* Ed. Med. and Surg. Journal, vol. xxxi. p. 243.

CHAPTER IX.

WOUNDS.

Meaning of the Term.—Synonymous with Mechanical Injury.—Subdivisions of the Subject. — CHARACTERS OF CONTUSED WOUNDS, AND OF INJURIES UNACCOMPANIED BY SOLUTION OF CONTINUITY.—*Description of a Bruise or Ecchymosis.—Correspondence of its Shape with the Cause which produced it.—The Discolouration affects the Substance of the True Skin.—The Appearance of a Bruise may be produced after Death.—Distinctions between Bruises produced before and after Death.—Effusion of Blood into the deeper seated Parts.— Can it take place after Death?—Experiments of Christison.—Fractures.*— CHARACTERS OF INCISED WOUNDS, AND THOSE ACCOMPANIED BY A SOLUTION OF CONTINUITY.—*Characters of incised Wounds inflicted during Life and after Death.—Experiments of Mr. Taylor.— Lacerated, punctured, and gun-shot Wounds.—Detection of Spots of Blood on articles of Steel, and on Linen.*—QUESTIONS COMMON TO ALL FORMS OF MECHANICAL INJURY.— *Was the Wound the Cause of Death?—Circumstances which affect the question— Was the Wound accidental, suicidal, or homicidal?—Is the Wound dangerous to Life?— Of many Wounds which was mortal?— When was the Wound inflicted?* —WOUNDS AS THEY AFFECT THE SEVERAL PARTS OF THE BODY. —*Wounds of the Head.—Fractures of the Skull.—Concussion— Compression—Inflammation of the Brain.—Injuries to the Spine.— Wounds of the Face—of the Throat—of the Chest—of the Lungs—of the Heart—of the Large Vessels—of the Diaphragm—of the Abdomen—of the Liver—of the Spleen—of the Stomach and Intestines— of the Kidneys and Bladder—of the Genital Organs.*

Under this head it is intended to include all injuries inflicted on the body by mechanical means. These are minutely specified in a recent statute, as follows :—

" 2. And be it enacted, that whosoever shall administer to, or cause to be taken by, any person, any poison or other destructive thing, or shall *stab, cut, or wound any person, or shall by any means whatsoever, cause to any person any bodily injury dangerous to life*, with intent in any of the cases aforesaid to commit murder, shall be guilty of felony, and being convicted thereof shall suffer death.

" 3. And be it enacted, that whosoever shall attempt to administer to any person any poison or other destructive thing, *or shall shoot at*

any person, or shall, by drawing a trigger, or in any other manner attempt to discharge any kind of loaded arms at any person, or shall attempt to drown, suffocate, or strangle any person, with intent in any of the cases aforesaid to commit the crime of murder, shall, although no bodily injury shall be effected, be guilty of felony, and being convicted thereof, shall be liable, at the discretion of the court, to be transported beyond the seas for the term of his or her natural life, or for any term not less than fifteen years, or to be imprisoned for any term not exceeding three years.

" 4. And be it enacted, that whosoever unlawfully and maliciously *shall shoot at any person, or shall, by drawing a trigger, or in any other manner, attempt to discharge any kind of loaded arms at any person, or shall stab, cut, or wound any person, with intent in any of the cases aforesaid, to maim, disfigure, or disable such person, or to do some other grievous bodily harm to such person, or with intent to resist or prevent the lawful apprehension or detainer of any person,* shall be guilty of felony, and being convicted thereof, shall be liable at the discretion of the court, to be transported beyond the seas for the term of his or her natural life, or for any term not less than fifteen years, or to be imprisoned for any term not exceeding three years." Section 5 awards the same punishment for sending explosive substances, or throwing destructive matter with intent to do bodily harm.

This law seems to meet every possible mischief which the malice of man can inflict ; and hence it becomes less necessary than formerly for medico-legal purposes, to define the term *wound.*

By using the term *wound* in the sense of an injury inflicted by mechanical means, injury by fire or escharotics is excluded, and these subjects are reserved for separate consideration.

All injuries, therefore, which one man inflicts on another, whether by cutting or bruising instruments, by his own person, or by forcing him against an obstacle will have to be considered under this head. The law provides punishment for all such injuries by the insertion of the words " or shall by any means whatever cause to any person any bodily injury dangerous to life."

In examining a subject of such great extent, it will be necessary to adopt some sort of arrangement, and perhaps the best is that suggested by the surgical definition of a *wound.*

This definition makes a *wound* to consist in a *solution* of *continuity.* We cannot do better, therefore, than to divide *wounds* into such as are *without solution* of *continuity* and such as are *with solution of continuity.* The first will include, *contusions, concussions, simple fractures, dislocations,* and *sprains,* The second comprises, *incisions, punctures,* and *lacerations,* and *gun-shot wounds,* which are a mixture of the last two.

The two classes of injuries, whatever may be the parts which they affect, have some points common to all the forms of violence included in the class. Thus almost all injuries affecting the deeper-

seated parts of the body are accompanied by external traces of the violence which produced them, whether that violence caused a solution of continuity or not. Hence, in the greater number of cases we shall have traces of the injury on the *surface*, and on this account it will be necessary to examine minutely the subject of bruises and incisions involving the external parts of the body. Having discussed the questions connected with these two forms of injury, those which affect the several parts and organs of the body, will have to be considered. Then, as there are some questions common to all forms of injury, these will be separately examined.

The following arrangement will be found convenient. 1. Of the characters of contused wounds, and of injuries unaccompanied by solution of continuity. 2. Of the characters of incised wounds, and of those accompanied by a solution of continuity. 3. Of the questions common to all forms of mechanical injury. 4. Of wounds as they affect the several important organs of the economy.

1. OF THE CHARACTERS OF CONTUSED WOUNDS, AND OF INJURIES UNACCOMPANIED BY SOLUTION OF CONTINUITY.

The superficial effect of a blow with a blunt instrument is, in the greater number of cases, what is termed, in common language, a bruise, and, in scientific language, *ecchymosis*. As most injuries inflicted by blunt instruments affect the surface in this way, it is important to examine the characters of bruises.

A bruise, or ecchymosis, (from ἐκχύω, to pour out,) is a discolouration of the skin produced by extravasation of blood into the cellular membrane. The blood thus effused may be thrown out in the superficial or in the deep-seated parts. When thrown out in the superficial parts, and especially in the lax and yielding portions of the skin, the colour makes its appearance at once. When the effusion is deeper seated, days may elapse before any discolouration of the skin takes place, and then it is not blue, as in superficial parts, but of a violet, greenish, or yellowish hue. It is also not always immediately over the effusion of blood.

The colour produced in the *superficial* parts is not developed to its full extent at once ; but it continues to deepen for five or six hours. After a time serum is effused, and inflammation is set up, by which the extent of the bruise is increased. This leads to changes in the colour of the bruise, which passes from deep blue through shades of green, yellow, and lemon colour, till all trace of the injury is finally removed by absorption. The change of colour commences in the circumference, and travels inwards towards the centre, which retains its deep blue colour after the other parts have completely changed their appearance. The extent of the ecchymosis, and the rapidity of the changes which it undergoes will depend on a variety of circumstances,

as the force used, the size of the weapon, the age and constitution, the full or empty state of the vessels, the density or laxity of the skin.

The form of the bruise will of course depend on the shape of the weapon with which it has been inflicted, and this fact admits of very useful application. The subjects of death by hanging and strangulation furnish familiar examples of the correspondence of bruises with the cause that has produced them. Starkie mentions a case in which the form of a bruise furnished very strong presumptive evidence against an accused party. In an attempt at murder the prosecutor, in his own defence, struck the assassin violently in the face with the key of the house-door, this being the only weapon he had near at hand. The bruise which followed the blow, corresponded precisely in shape to the wards of the key, and it was chiefly through this very singular and unexpected piece of evidence, that the assassin was afterwards identified and brought to trial.*

The seat of this discolouration, as has been stated, is the cellular membrane ; it is not, however, confined to this, but involves more or less the whole substance of the cutis. This distinguishes ecchymosis from cadaveric lividity, and from all similar appearances occurring in the dead body. In severe cases of scurvy the slightest touch will produce a bruise closely resembling that produced in healthy persons by greater degrees of violence. As the appearance is the same in both cases, it may be necessary to distinguish them by a careful examination of the gums, of the surface of the skin generally, and of the mucous membranes. Without such an examination we might attribute to severe violence what was due to simple pressure.

Can the Appearance of a Bruise be produced after Death?

Dr. Christison has instituted experiments by which this question may be answered in the affirmative. From these experiments it appears, that, up to two hours after death, and, in rare cases, after three hours and a quarter, appearances may be produced more or less closely resembling bruises inflicted during life. The difference, indeed, is merely in degree ; for not only is blood effused into the cellular membrane, and on the surface of the cutis, after death, but even into its substance ; and the blood thus effused is found to coagulate.

A striking illustration of the resemblance which bruises inflicted after death may bear to those produced during life is furnished by the following anecdote related to Mr. Taylor by Dr. Christison.†

It appears that, while he was performing his experiments to ascertain whether blows inflicted after death would produce similar appearances to those produced during life, he selected as a subject for a series of these experiments the body of a female who had died in the infirmary. A very short time after this woman had ceased to breathe he caused to be produced upon the members and trunk several severe

* Starkie's Law of Evidence, vol. i. Tit. Circumstantial Evidence.
† Elements, p. 279.

contusions. The body was subsequently carried to the dead-house, and it was accidentally seen, while lying there, by some parties who had not known of the performance of these experiments. A report was circulated immediately, that the woman had been barbarously treated before death, and it was rumoured, that she died in consequence of the injuries which she had sustained. So strong was this prejudice, that the interment was not allowed to take place until a full inquiry had been instituted into the circumstances. Dr. Christison attended, and gave a satisfactory explanation of the facts.

Means of distinguishing Bruises inflicted during Life from those inflicted after Death.—In certain cases this distinction is easy. If there is much swelling, the injury was, in all probability, inflicted during life. So, also, if there is *any* change of colour or sign of inflammation; for these changes are vital ones. Coagula afford a remote presumption, but no certainty; for coagula may be found in bruises produced soon after death, and the same observation applies to incised wounds. Fluidity of blood, on the other hand, does not prove the contusion to have been inflicted during life, for blood effused into the brain and spinal canal is often fluid. The *extent of the effusion* also forms a means of distinction; for, in bruises inflicted after death, unless some large vein be ruptured, there is little or no effusion.

According to Christison, the best diagnostic mark of bruises inflicted during life, and after death, is the discolouration of the cutis from the effusion of blood into its texture. This diagnostic mark will serve us in most cases, but in the case of bruises inflicted within a few minutes after death we may, from the analogy of incised wound, expect the same appearances as in those produced during life.

It is necessary to understand, that blows, even though very severe, do not always produce marks of injury on the surface. This is especially the case in blows on the abdomen, where the viscera are apt to be ruptured, whilst the skin entirely escapes. In order that the appearance of a bruise may be produced, it is necessary that there should be comparatively hard and unyielding parts beneath the skin; and, on the other hand, where we find severe injuries of the hard parts, such as fractures of bones, without any trace of bruises on the skin, we should be cautious how we attribute such injuries to the blows.

The foregoing observations apply to bruises in the common sense of that term; but the same effusion of blood, which, on the surface of the body gives rise to the appearance of a bruise, may occur in the internal parts as the result of violence, and yet leave very slight traces on the surface.

Now, it is important to ascertain whether such effusions of blood in deep-seated parts may take place after death as well as during life. Two cases already referred to under the head of suffocation will supply the answer to this question. In the body of Margery Campbell, the victim of Burke, in addition to the signs of suffocation, there were marks of severe injury to the back, to which Dr. Christison was at

first inclined to attribute her death. On examining the back, blood in a semi-fluid state was found under the trapezius muscle, near the inferior angle of the scapula, as also in the left lumbar region, but there was no corresponding bruise on the integuments. Blood was also found in the cervical and dorsal regions, especially in the former. The ligaments connecting the vertebræ posteriorly were ruptured, but there was no fracture. On the sheath of the spinal cord opposite to the rupture, there was a mass of semi-fluid black blood, about the thickness of a penny-piece, and one inch in diameter; from this a thin layer of the same kind of blood extended along the posterior surface of the sheath, as far down as the lowest dorsal vertebræ. The spinal cord was uninjured, and there was no blood under its sheath. Dr. Christison, as it has been stated, was at first inclined to attribute the death to this injury of the spine, but, by subsequent experiments on the dead body, he was enabled to prove, that all these marks of violence might be produced as much as seventeen hours after death; for he succeeded in producing them by bending the head forcibly down upon the chest in a subject which was cold, and in which all the joints were stiff. In the body of Carlo Ferrari, a similar effusion of blood was discovered. Coagulated blood to the amount of five or six ounces was found extravasated among the deep-seated muscles of the neck, from the occiput to the last cervical vertebra. A large quantity of fluid blood was also found both in the upper and lower part of the spinal canal, exterior to the sheath of the cord. There was no appearance of injury either to the vertebræ or their ligaments; there was no blood within the sheath, and the cord was healthy. In this case the marks of death by suffocation were still less apparent, and there appeared even more reason to attribute the death to the injury of the spine. The experiments of Dr. Christison render it highly probable, that in both these cases death was really due to suffocation, and that the injury to the spine was produced after death, a conclusion confirmed by the confession of the criminals themselves.

These cases suggest an important caution in ascertaining the real cause of effusions of blood into the deeper seated parts of the body. As a general rule, if we find no marks of contusion on the surface, we should hesitate to attribute the effusion to a blow; but in the case of a soft viscus being injured, we must not expect to find corresponding external marks.

The difficulty which in some cases exists in determining whether a bruise was inflicted during life or soon after death, will be greatly increased, if the body we are called upon to examine is in a state of putrefaction. For the effect of putrefaction is to exaggerate the appearances of injury, and to produce alterations of consistence and colour, which would make it very difficult indeed to answer this question satisfactorily.

In a case, however, which occurred at Paris, the effusion of blood produced by strangulation was discovered as a black mass twenty

years after death. Here, however, the cord with which the murder had been effected was found round the neck, and removed all the difficulty which might otherwise have existed.

In respect to *fractures* the same observations apply, and in nearly the same degree, as to contusions affecting the surface of the body. There is every reason to believe, that a fracture produced within a short period after death, and one produced during life, but speedily followed by death, would present very nearly the same appearances; but here, as in the case of a bruise on the skin, if the effusion of blood were very considerable, we should have strong reasons for regarding it as produced during life. A fracture produced some time before death would be readily distinguished by the inflammation set up about it.

It has been stated that contusions may be, in certain cases, recognised long after death. The same remark applies in a still greater degree to fractures, which, from the very nature of the injury, may be detected as long as the body holds together. Thus, in the case of Clarke, who was murdered many years since by Eugene Aram, the traces of the fracture and indentation of the temporal bone, were plainly distinguished on the exhumation of the skeleton of the deceased, although it had been buried thirteen years. The manner in which the murder was committed was confessed by an accomplice, and the medical evidence corroborated this confession. In all such cases we must remember, that the bones may be broken in the exhumation of the body, by the spade or mattock, and that as medical men we can only say, that a fracture exists, and point out the kind of instrument by which it was inflicted; but we cannot say whether it was inflicted before or after death, or during the process of exhumation. In such cases it is not the medical evidence which leads to conviction, but the correspondence of the injury with the description or confession of the mode in which it was inflicted.

2. OF THE CHARACTERS OF INCISED WOUNDS, AND THOSE ACCOMPANIED WITH A SOLUTION OF CONTINUITY.

Under this head are comprised incised, punctured, lacerated, and gun-shot wounds. Of these, incised wounds are of most frequent occurrence, and to them the following observations chiefly apply.

The immediate and most obvious consequence of wounds with solution of continuity is hæmorrhage, the more remote effect inflammation; it is by means of these marks that we shall be enabled to answer the question,

Was the Wound inflicted during Life, or after Death?—The ascertained presence of copious hæmorrhage will be a reason for supposing a wound to have been inflicted during life, and the entire absence of it, as in the case of Sir Edmundbury Godfrey, (p. 276,) an equally strong reason for attributing death to some other cause. There is one class of wounds, however, that forms an exception to this rule, viz.,

lacerated wounds, which are often unattended with hæmorrhage. In the well-known instance reported by Cheselden of a man's arm torn off by a windmill, and in a case recently reported by Mr. Bransby Cooper,* there was little or no hæmorrhage. On the other hand, a very considerable amount of hæmorrhage may take place after death, if any large vein happen to be wounded. Thus, in cases of sudden death, it is not unusual to see a large quantity of blood issuing from the vein of the arm, which had been opened during life.

In a recent incised wound, inflicted during life, the edges are everted, the cellular tissue is filled with blood, and there are coagula between the lips of the wound. After the lapse of from eighteen to twenty-four hours there are the signs of inflammation, increased redness, swelling, and effusion of coagulable lymph. In the case of incised wounds, as in that of bruises, it is important to determine whether the same appearances that exist in wounds inflicted during life may be produced after death.

Characters of Wounds produced after Death.—

The experiments of Orfila on the dog have shown, that the appearances proper to such wounds inflicted during life may be produced immediately after death, and the following experiments of Mr. Taylor made on limbs recently removed by amputation, show to what degree the resemblance may be carried.

An incised wound, about three inches in length, was made in the upper part of the calf of the leg, ten minutes after its separation from the body, by which the gastrocnemii muscles and the fascia covering the deep-seated layer of the leg were divided. At the moment that the wound was made, the skin retracted considerably, causing a protrusion of the adipose substance underneath: the quantity of blood which escaped was small, the cellular membrane, by its sudden protrusion forwards, seeming mechanically to prevent its exit. The wound was examined after the lapse of twenty-four hours; the edges were red, bloody, and everted; the skin was not in the least degree swollen, but merely somewhat flaccid; and on separating the edges, a small quantity of fluid blood escaped, but no coagula were seen adhering to the muscles. At the bottom of the wound, however, and in close contact with the fascia, a quantity of coagulated blood was found, but the coagula were so loose as readily to break down under the finger.

In the second experiment, an incision of similar extent was made on the outer side of the leg, penetrating through the peronæi and into the flexor longus pollicis of the deep-seated layer of muscles, ten minutes after the separation of the limb from the body. In this case the skin appeared to have lost its elasticity, for the edges of the wound became but very slightly everted; scarcely any blood escaped from it. On examining the leg twenty-four hours afterwards, the

* Guy's Hospital Reports.

edges of the incision were pale and perfectly collapsed, presenting none of the characters of a wound inflicted during life. Still at the bottom of the wound, and enclosed by the divided muscular fibres, there were some coagula of blood, but fewer than in the former experiment ; and a portion of liquid blood had evidently escaped, owing to the leg having been moved.

Other experiments were performed at a still later period, after the removal of the limbs, and it was found that in proportion to the length of time suffered to elapse before the production of the wound, the appearances were less distinctly marked, that is to say, the less likely were they to be confounded with similar injuries inflicted on the living body. When the incised wound was not made until *two or three hours* after the removal of the limb, although a small quantity of liquid blood was effused, no coagula were found. The edges of an incised wound made twenty-four hours after death, are yielding, inelastic, in close approximation, and free from any coagula of blood.*

Such are the characters of *incised* wounds inflicted after death. *Lacerated* wounds combine the characters of incised and contused wounds, being accompanied with a less amount of hæmorrhage than the former, and some degree of the discolouration attending the latter. For these reasons the distinction between such wounds inflicted during life and after death is less easily made.

Punctured wounds are intermediate between incised and lacerated wounds, resembling the former when inflicted with a sharp instrument, and being accompanied by profuse hæmorrhage ; but when made with a blunt object, being more nearly allied to lacerated wounds, and productive of but little loss of blood. *Sword*-wounds, traversing the body, are marked by a large depressed orifice of entrance, and a small and raised orifice of exit. This difference may require to be borne in mind. *Gun-shot* wounds partake of the character of contused and lacerated wounds. The orifice of entrance is usually small, depressed, and contused ; that of exit larger, lacerated, and its edges everted. The clothes present a similar difference, the point at which the bullet enters being small, round, and cleanly cut, while that from which it passes out is larger and more irregular. These characters, too, should be carefully attended to. They will vary in distinctness with the distance and force of the shot.

There is one subject connected with the present class of wounds which requires to be examined in this place, viz., the means of identifying *spots of blood* found on the body itself, on the soil, furniture, or clothes, or on the instrument with which death has been inflicted. We are indebted to the researches of the French medical jurists, Lassaigne, Chevallier, Orfila, and Barruel, for our knowledge of this subject.

1. *Of the Detection of Spots of Blood on Articles of Steel.*—When the

* Taylor's Elements of Medical Jurisprudence, p. 275.

quantity of blood is small it forms a transparent red spot on the surface of the steel, but in greater quantity a deep reddish brown crust. The application of a moderate heat causes these crusts to scale off, leaving a tolerably clean surface beneath. On placing these detached spots in a tube, and submitting them to a high temperature, ammonia is given off, which may be detected by its alkaline reaction on test paper.

Distilled water dissolves out the colouring matter of the spot, and leaves a white filamentous mass on the surface of the metal. The solution in water has no decided reaction ; heat, nitric and sulphuric acid, and a strong solution of chlorine, throw down a white precipitate, (a weak solution of chlorine renders the solution green, but produces no precipitate,) and the infusion of galls precipitates the red colouring matter. Ferrocyanate of potash produces no effect, nor is the colour sensibly affected by ammonia which distinguishes the colouring matter of blood from the red vegetable dyes, such as cochineal and Brazil wood. If the steel instrument has been long exposed to the air, spots of rust will be mixed with those of blood, and will be partially detached by maceration in water. They can, however, be readily separated by filtration.

Such being the characters of spots of blood on steel, are there any other spots which may be mistaken for them ? According to Orfila there are two kinds of spots which somewhat closely resemble those of blood. These are spots produced by *lemon-juice*, and common *rust.*

Spots of Lemon-juice.—In order to show that these spots may be confounded with those of blood, Orfila tells us of a man who was suspected of having murdered another, and in whose possession a knife apparently covered with blood was found. This was naturally considered as a strong confirmation of the man's guilt ; but on submitting the knife to examination, it was found that the spots were due to citric acid. The instrument had been used some days before for cutting a lemon, and had been put by without being wiped. The thinner spots have a reddish yellow colour, the thicker spots a reddish brown, nearly resembling those of blood. They separate, like blood-spots, on the application of a moderate heat. When heated in a tube they give off a volatile matter, which has an *acid* reaction—spots of blood have an *alkaline* reaction. The solution in distilled water is *light yellow*—that of blood is *red ;* it has an *acid* reaction—that of blood is *neutral:* with infusion of galls it yields a *black* precipitate, and a *blue* with ferrocyanate of potash—blood yields a *red* precipitate with the former, and is unaffected by the latter. The oxide of iron is thrown down by alkalies.

Spots of Rust.—These resemble the spots just mentioned in colour, but they differ from both in not scaling off on the application of heat. Heated in a glass tube they give off, like blood spots, a small quantity of ammonia, which has an alkaline reaction on test paper. The spot of rust is not dissolved by maceration, but merely detached, so that it

may be completely separated by filtration, leaving the water quite clear, and not affected by the tests for iron. A drop of muriatic acid placed on the spot of rust dissolves it, and leaves the metal clean, and on diluting the solution with distilled water, evidence of the existence of iron may be obtained by appropriate tests. The same effect takes place when the citric acid spot is similarly treated; but the blood-spot is not removed, nor is the resulting solution affected by the tests for iron.

Spots of Blood on the Clothes.—To determine whether a red spot on linen or other stuffs consists of blood, the piece must be cut out, and macerated in distilled water. If the spot is of any thickness, the albumen and colouring matter will separate and sink to the bottom of the liquid, while the fibrin adheres to the surface in the form of a white filamentary mass. If attempts have been made to remove the stain, or if it has been formed merely by contact with another stain, no fibrin will be found attached to the cloth. In such cases we must rely entirely on the application to the solution of the tests already mentioned when speaking of stains on steel. Orfila places great confidence in the tests for blood, but Raspail objects to them, and asserts, that stains produced by madder in a weak solution of albumen give all the characteristic reactions of blood. Berzelius, however, points out a mode of distinguishing alizarine, the colouring principle of madder, from the colouring matter of blood. He states that the colour of madder is rendered yellow by acids, and violet by alkalies. If, then, on adding a drop of acetic acid to the spot, we find that it changes from red to yellow, this is a proof, that the spot was produced by madder, for the blood-spot is unaltered by acetic acid at a low temperature, and is rendered of a deep-brownish hue by boiling. The infusion of galls throws down the colouring matter of blood without altering it, but it precipitates an albuminous solution of alizarine of a bright yellow.

Mr. Taylor states, that among the tests proposed for the detection of blood in solution, as obtained either from the allowing steel instruments, or stuffs spotted with blood, to remain in water, there are only two which he considers of any value,—"The ready separation of the colouring matter by water with the tint which the liquid acquires when cold, and the coagulation of the solution with the entire destruction of colour on boiling. The colouring matter of blood in solution is known from most other kinds of red colouring matter, by its remaining unaltered on the addition of ammonia; and the presence of the albuminous part of the blood, is detected on boiling, or on the addition of a mineral acid."* But the albumen cannot be detected in a dilute solution. The distinction between stains of blood and red dyes is very simple. On macerating both in water the former will be dissolved, whilst the latter will remain unaffected.

* Taylor's Elements of Medical Jurisprudence, p. 382.

Iron-moulds on linen have sometimes been mistaken for spots of blood. Thus, Devergie relates a case in which he, with others, was required to determine the nature of some red-coloured stains found on the shirt of a young man, whose body was taken out of the Seine, after having lain about three weeks in the river. There were many marks of violence about the person, and it was deemed important to ascertain whether the spots on his linen were owing to blood or not. It was satisfactorily determined that the marks were owing to the rusting of a steel neck-chain and a bunch of keys, which the deceased had about him.*

The distinction is very simple. Water dissolves out the colouring matter of blood, but not that of iron. Muriatic acid dissolves out the iron, which may be discovered by its characteristic tests. In these examinations it may be well to compare the stain we are examining with an unstained portion of the same material, as we may thus avoid some sources of fallacy.

Supposing it to be clearly made out that the stain we have been examining is a blood-stain, the question may arise—Is it man's blood, or does it belong to some animal?

It has been proposed to make the well-known difference in the microscopic character of the blood of birds, fishes, and mammalia, available for the purpose of distinction; but as this is obviously unsafe, except in the hands of experienced persons, and even in their hands would fail, unless the spot had been quite undisturbed, it must admit of very rare application. Barruel's proposal of distinguishing the blood of different animals by the characteristic odour given off on the addition of strong sulphuric acid, is open to still stronger objection, for it would be obviously most unsafe to lay any stress upon evidence derived from such an uncertain sense as that of smell, unless it were used as merely corroborative of other tests, showing that the substance under examination was the blood of some animal. The following case will show with what confidence this latter test has been used in France:—

Three men were charged with murder, and MM. Orfila, Barruel, and Chevallier were called upon to examine the clothes of the deceased, and a piece of blue stuff which had formed part of a female's dress. It was important to determine whether the stains which were found on both these articles of clothing, were produced by blood, and if so, whether by the same blood. A small portion of the clothes of the deceased was macerated in water, and a coloured solution was procured, which presented all the characters of a solution of blood. It coagulated, and was rendered colourless by heat; it was rendered of a green colour, and was afterwards discoloured by chlorine; and yielded a reddish-grey precipitate with infusion of galls. It had also the other properties of blood. To a considerable quantity of the

* Devergie Méd. Légale, vol. i. p, 237.

solution sulphuric acid was added, and the mixture was well stirred. An odour, like that of human perspiration was instantly perceived, which proved that it was human blood. The blue stuff was now macerated in water, and one half of the solution was submitted to the action of the same re-agents, with similar results, rendering it probable that these stains also were due to blood. The other half of the solution was treated with strong sulphuric acid, when the odour which escaped was recognised by one of the examiners as that of the catamenia, while another pronounced it excrementitial. This difference was considered unimportant, as whichever opinion was correct, they felt themselves justified in considering, that the stains on the dress of the female, were not produced by the same liquid as those on the dress of the deceased.*

This case illustrates the little dependence to be placed upon the sense of smell.

3. OF THE QUESTIONS COMMON TO ALL FORMS OF MECHANICAL INJURY.

Having by the means pointed out in the preceding sections answered the question, Was the wound inflicted during life or after death? and ascertained that it was a *vital* one, we have next to inquire,

WAS THE WOUND THE CAUSE OF DEATH?

The answer to this question will not be difficult, where a man in the enjoyment of perfect health receives an injury, and dies soon after, before sufficient time has elapsed for disease to arise, or unskilful treatment on the part of the medical man to prove injurious: before, in fact, any fresh cause of illness or death has supervened to complicate the original question proposed. But, on the other hand, where any considerable interval elapses between the receipt of the injury and the fatal event, disease the consequence of the injury, but depending upon some peculiarity in the constitution of the sufferer, or disease entirely unconnected with the original injury, may spring up and complicate the question; or, medical aid having been called in, the question may arise whether the treatment employed was such as to give the deceased the best possible chance of recovery; or, an operation may be performed and death may follow upon the operation—and here a question may arise whether death ought to be attributed to the operation, or to the wound by which it was necessitated. A variety of circumstances, then, may occur to complicate the original question —*Was the wound the cause of death?*

It has been already stated, that where death takes place soon after the infliction of the injury, the medical man will encounter but little difficulty in answering this question, whether not having seen the

* Annales d'Hygiène, Oct. 1835.

deceased during life, he derives his information from a post-mortem examination, or having been called to him whilst on the point of death, he judges of the mortality of the wound from the symptoms present. The only cases in which he can entertain any doubt, are those in which a wound of inconsiderable extent proves fatal on account of some peculiarity of constitution in the deceased, such as unusual debility, or infirmity, or in consequence of the abnormal position of the parts injured.

With regard to debility or infirmity, this may be the consequence of a tender or of an advanced age, or may arise from previous disease or intemperance. Here, though the injury be but slight, provided it can be proved that it was the cause of death, the accused will be as guilty as if the deceased had been in the enjoyment of strength and vigour.

The abnormal formation or situation of the part injured has a more important bearing on the question, Was the wound the cause of death? As an instance of the abnormal formation of a part may be cited a case from Dr. Paris. A man caught a boy in the act of robbing an orchard, and struck him a blow on the head with a stick. This caused a fracture of the skull, and the boy subsequently died. On the trial it was clearly made out in evidence, that a mere chastisement was intended, for the stick was not of such a size as to have occasioned any serious injury under common circumstances ; but in this case the skull of the deceased was preternaturally thin.

Of the abnormal position of parts as affecting the same question, the following is an example:—

" Many years since a woman was tried at the Old Bailey for the murder of her husband, by kicking him in the groin. The surgeon who examined the body of the deceased, stated that there existed an old inguinal hernia at the spot where the violence was inflicted, and that the intestine, contained within the hernial sac, was very much injured ; a circumstance which, in his opinion, satisfactorily accounted for death. He was then asked whether a similar blow, inflicted upon a healthy individual, would have given rise to fatal consequences. He answered in the negative, and the woman was immediately acquitted on the capital charge."

The following are cases in which disease pre-existing in the part injured had the same influence upon the result of the injury as the abnormal situation of the part itself:—

" A gentleman in India, was tried for the murder of his servant, whom he had killed by a blow on the loins. It was proved in evidence, that the kidney of the deceased contained a calculus, the rugged points of which, by puncturing the blood vessels, had occasioned a fatal hæmorrhage. The prisoner was instantly acquitted on the capital charge, the violence having proved accidentally mortal from disease."

" In the year 1721, a Dr. Fabricius was tried at the Old Bailey

for the murder of his female servant, by striking her behind the ear, owing to a large abscess situated at the part becoming ruptured. The chief question on the trial was, whether the deceased had died from the effects of the violence, or of the disease under which she was labouring. It was urged in the prisoner's defence, that he had inflicted the blow simply with the design of opening the abscess. The jury, however, did not agree in taking this scientific view of the injury, and returned a verdict of manslaughter against him."

In cases similar to the foregoing, the person who inflicts the injury is ignorant of the existence of any cause by which that injury, though comparatively slight, may be rendered mortal. There is one case, however, in which, according to Orfila, the aggressor ought to be made amenable for the consequences of the violence, however slight, and that is, when a woman is far advanced in pregnancy; as he could not be supposed ignorant of her state.

The English law, in respect to the cases just quoted, is thus laid down by Lord Hale: "It is sufficient to prove that the death of the party was *accelerated* by the malicious act of the prisoner, although the former laboured under a *mortal* disease at the time of the accident." And the same rule will obviously apply not merely to disease, but to any other cause by which comparatively trifling injuries are rendered fatal. In every instance the jury will have to decide on the intention of the prisoner in committing the injury.

In the foregoing cases death occurred soon after the infliction of the wound, but the same general remarks will apply also to those instances in which an interval elapses before the wound proves mortal. Here, also, a slight injury may, from accidental circumstances, prove fatal, without any doubt arising as to the propriety of the treatment adopted.

Those cases must now be examined in which an interval, more or less considerable, elapses between the infliction of the wound and the death of the wounded party,—an interval during which a variety of circumstances may intervene to give a fatal complexion to an injury originally, and, under ordinary circumstances, insufficient, to cause death.

Where this interval between the injury and the fatal result is of any considerable duration, it is always possible that neglect of treatment, or injudicious treatment, may aggravate the original mischief, and the question, therefore, may in all such cases arise—Was the injury the real cause of death? Still there are some cases in which the injury is of such a kind, that this question may be safely answered in the affirmative,—as where a man's spine is fractured or dislocated. In such instances, however long the interval which elapses before the fatal result, the death may be fairly attributed to the injury alone. But strange to say, in spite of this fact, that there are certain cases in which death may be traced to the injury, even where the fatal result takes place at a long interval, the law of almost every country lays down a certain fixed period, within which

death occurring shall constitute murder, and beyond which the perpetrator of the most atrocious violence shall escape unpunished.

Thus, in Prussia, though the law is not very precise, it appears, that to constitute murder the wounded party must die within nine days; in France, the term is fixed at forty days; in New York, at six months; and in England, it is limited by the common law to one year and one day; in Scotland, there is at present no limitation on the subject.

It will not be difficult to prove the inherent absurdity of such limitations. Thus a case is related by Sir Astley Cooper of a gentleman at Yarmouth, who died from the effects of an injury to the head, received about two years previously. In this case the connexion of death with the wound was clearly made out, by the continuance of the symptoms of cerebral disturbance during the long period which he survived.

In a case quoted by Mr. Taylor from a foreign authority, a musket-ball remained in the lungs during twenty-five years, and was the acknowledged cause of death.

This provision of the common law, by which the period of a man's guilt is limited to a year and a-day, seems to meet with the approbation of juries, who on more than one occasion have shown a disposition to abridge it. Thus "Richard Mevin was indicted for the manslaughter of a boy. It appeared, that the prisoner and the deceased were employed at a colliery near Whitehaven. On the day on which the blow was given, they were working in the pit together; when, on the deceased making a reply to the prisoner who had desired him to work harder, the latter threw a stick, which hit the deceased on the head with such force as to knock him down. He did not complain much of the blow at the time, but in about a week the scalp ulcerated at the part where he had been struck, and he soon afterwards died. A medical witness stated, that, in his opinion, the wound on the head was clearly the cause of the deceased's death. His lordship charged the jury, who in a few minutes returned a verdict of not guilty. Mr. Justice Alderson expressed surprise at the verdict, and inquired of the jury, if they could doubt that the boy had died of the wound inflicted by the prisoner. The foreman of the jury said, that they acquitted the prisoner on account of *the time that had elapsed after the blow before the boy's death.* The judge observed, that a mitigating circumstance of that kind should not weigh with the jury. It would be advisable for them always to find the simple fact, and leave other considerations in mitigation of punishment to the Bench. In the present instance, had the prisoner been found guilty, the punishment would have been light; and certainly juries should take care that their verdicts did not hold out encouragement to people to strike blows in fits of passion!* This rebuke was certainly well merited.

* Taylor's Elements, p. 304.

Another circumstance deserving of notice in reference to this question is the existence of some constitutional peculiarity, in consequence of which a trifling wound proves fatal after a lapse of time, either from the wound itself taking on an unhealthy character, or from the supervention of some disease not necessarily or usually resulting from it.

The following are some examples of this sort:—

"Wm. M'Ewan was tried at Perth, September, 1830, for the homicide of a boy, whose shoulder he had dislocated by a blow; which injury had led to a fatal result. But the boy being of a weakly and scrofulous constitution, and his arm having been subjected to the operations of an ignorant bone-setter, inflammation and white-swelling ensued, which caused his death." The panel was acquitted by the direction of the court.

"Christian Paterson, who quarrelled with another inmate of a house of ill-fame, was tried at Edinburgh, December 1823, for the murder of the latter, by having struck her on the head with a pair of tongs, and caused a wound, which though not very severe, was followed by *erysipelas*, which proved fatal." The charge was restricted to one of culpable homicide.

The previous existence of injury or disease is another circumstance which affects the question—Was the wound the cause of death?

"Two coal-drivers quarrelled. One of them (M'Donald) gave the other a blow on the left breast. This did not make him fall, but he stepped back a little, and then fell forwards on his face, exclaiming, 'see how he has struck me!' He then gave a few groans and expired. Extravasated blood was found in the ventricles of the brain."

"J. Donaldson tripped up the heels of David Stobo at Glasgow, April 1835, by which Stobo fell forward upon the street. He rose up, but again fell, and very soon died. On inspection Dr. Cockindale found a slight contusion on the forehead above the right eyebrow. The contents of the head and belly were in their natural healthy state. The lungs adhered to the sides of the chest, and the pericardium adhered to the heart. The aorta was dilated near its origin, into a large aneurismal sac, which, by having recently burst, had discharged a great quantity of blood into the chest and proved fatal."

Such cases as these can occasion no serious difficulty; but cases of a much more intricate character occasionally occur, which require for their decision much practical and theoretical knowledge, and presuppose an extensive acquaintance with pathology. The following is such a case:—

"David Kennaway was tried for parricide in the High Court of Justiciary in December 1825. One Sunday evening, Kennaway's sister left him at home in a state of furious intoxication, quarrelling and struggling with his father, an old man of seventy. On leaving the house she went down stairs to a neighbour's, where she heard the noise of the two scuffling above, and soon afterwards the prisoner

followed her down stairs, and went away. She immediately returned to the room where her father was, and there, about seven minutes after she had seen him sitting in a corner reading his Bible, and apparently in good health, she found him stretched dead on the floor, with a slight wound on the nose, and a severer one on the forehead. When the body was opened, there was found half a pint of red serosity in the ventricles of the brain, but no fracture of the skull, no extravasation of blood beneath it, no laceration of the brain. There was also discovered a considerable effusion of reddish serum in each pleural sac, but no other morbid appearances in the chest or elsewhere. The quantity of this effusion was not accurately ascertained.

We have in this case an effusion of half a pint of bloody serum in the ventricles of the brain, and this is the only sufficient cause of death. Now the first question which we should have to determine is this, Was the effusion a vital one, or was it one of those pseudo-morbid appearances which occur after death, and are apt to simulate the results of disease? We may safely attribute the effusion to a vital change — it being, as far as we know, impossible that so large a quantity of serum should be poured out from the vessels after death. Assuming then, that the effusion took place during life, the question arises, Was it the result of the injury which the deceased had sustained in the struggle with his son, or did it exist previously, without producing any symptoms of disordered health? In the first place, there was no trace of any injury, however slight, on the scalp, skull, membranes, or on the brain itself, unless we admit the effusion itself to be a mark of such injury; and if the brain had sustained any violent shock, the effusion would not have been an effusion of serum, but of blood. It is contrary to all experience, that an injury proving so speedily fatal, should give rise to so considerable an effusion of what must be regarded as a sort of secretion or separation from the blood. The existence, moreover, of the same sort of bloody serum in the cavities of the pleura, would seem to negative the supposition of such effusion in the brain being the result of violence. All reasoning then goes to show, that this serum was effused previously to the injury, and the only difficulty which we encounter, is that of the existence of this effusion unproductive of any symptom of disease. If, however, it can be made out that, in cases where no violence has been suffered, such effusion has nevertheless existed without producing any single symptom during life, then we have proved the possibility of the effusion in this particular case being altogether unconnected with the violence offered.

A similar process of reasoning to that which is here employed led Mr. Watson to the conclusion, that the effusion in this case was unconnected with the injury, and formed a sort of latent hydrocephalus. In confirmation of this view he quotes the following cases :—

"A young woman, who had complained for four days of some headache and occasional vomiting, but was able to go about, was suddenly seized with rattling in the throat, and died unexpectedly, and

in full possession of her senses. The case having become the subject of a medico-legal examination, the body was examined, and there was found in the ventricles of the brain three ounces of serosity, and a watery vesicle."

This case is from Pyl. Another similar case is quoted from Morgagni. It was one of fatal pneumonia, where no less than eight ounces of serosity were found in the ventricles of the brain after death, without any corresponding symptoms during life, a case, therefore, of true latent hydrocephalus.

In the case of Kennaway, the surgeons who examined the body attempted to get rid of the difficulties by ascribing the effusion to the blows, and death to the effusion. But this opinion is manifestly at variance with sound pathology. Kennaway was convicted of culpable homicide, and transported for life.*

This and similar cases shew the difficulty and intricacy of the questions which we have to solve, and the utility of the science which draws from scattered and unconnected sources the materials for the solution.

Having now illustrated the effect of previously existing injury or disease, in modifying the state of wounds, and alluded to the supervention of diseases strictly connected with the wound inflicted, but arising in consequence of some peculiarity of constitution; the next point requiring notice as affecting the question, *Was the wound the cause of death?* is the supervention of mortal diseases arising independently of the wound.

The following is an example of this sort:—

Janet M'Laren (a deaf and dumb girl) received from another woman an injury upon the head, in July, 1823. For this she was admitted into the infirmary of Glasgow. It was found that the scalp was wounded, and the skull fractured and depressed; but there was no symptom of cerebral affection. Inflammatory fever supervened, and several weeks *after* the injury of the head, violent inflammation of the chest came on, which proved fatal in two days. In the chest there were found three pounds of serous effusion mixed with flakes of lymph. The right lung adhered to the walls of the chest, and formed an abscess. There was also purulent matter in the substance of the lung. In this case the medical inspectors were of opinion, that the diseased states of the head and chest, were each sufficient to have caused death separately; but that the immediate cause of death was the transference of the inflammation of the head to the chest.

The next circumstance or circumstances bearing on the question Was the wound the cause of death? is the improper management of the wounded party.

Now this improper management may consist in the neglect of assistance, medical or otherwise, (which neglect may be intentional, accidental, or inevitable,) in irregularities and misgovernment on the part

* Watson's Medico-Legal Treatise on Homicide, p. 218.

of the patient himself, or in mala praxis on the part of the medical attendant.

There are a good many somewhat intricate questions mixed up in this inquiry, which cannot be better stated than in the language of Baron Hume.

"If an assault is made with a knife, or other cutting weapon, whereby some artery or large blood-vessel is divided, and the person bleeds to death upon the spot; it is no answer to the charge of homicide, that of itself this wound was not necessarily mortal, and that, with the immediate assistance of a surgeon, if one could have been procured, the effusions of blood might have been stopped and the man's life preserved. Or, put the case, that a surgeon is procured, who staunches the blood for a time, but after he is gone the wound breaks out afresh, and the man dies before assistance can again be had; this incident is also at the hazard of the panel. Or, what if a person receive a gun-shot wound at some remote place in the country, where no surgeon skilled in the treatment of such wounds is to be had, and of this wound he dies, notwithstanding the best care of the practitioners in that quarter such as they are? Or, let us imagine that a person has been robbed, and unmercifully beaten in the night, in hard weather and in a solitary place, so that lying exposed to the cold till day, he dies upon the spot, or of the consequences shortly after. In all these and the like cases, there is an undoubted homicide. It is still true, that, of this very injury done him by the panel, the man dies. It has its natural course and issue, in the circumstances of the situation, such as they happened to be where the assailant did the deed, and which the sufferer has done nothing to aggravate, and everything in his power to relieve. If those circumstances have been unfavourable, this he must answer and run the risk of, whose wilful deed then and there done has made them of moment to the loss or preservation of the life of a fellow-creature. Besides, the uncertainty must be considered which attends all cases of outrageous injury, whether by any course of treatment the life of the sufferer could have been saved. That he was actually killed by this violence is proved, and that he would have survived in more favourable circumstances is matter of conjecture; only a probability at the best."

Here the absence of assistance is necessary; but if it is intentional, or if a man calls to his aid an ignorant quack, when he might have procured the attendance of a regular practitioner, and death takes place, the accused party cannot be held responsible for all the injury done, and he will have the benefit of what has occurred in the mitigation of his punishment. Irregularities or misgovernment on the part of the patient would likewise form a reasonable and valid plea in mitigation of the crime, and of its attendant punishment. This fault on the part of the patient may arise from several causes; from negligence and delay in putting into operation the prescription of his medical attendant, from his refusal to use the proper means

for his recovery; or, from his exposing himself improperly to cold, fatigue, or fresh injury, or to such causes as may induce inflammation and fever. Amongst these by far the most frequent is indulgence in spirituous liquors.

Dr. Christison relates the following case:—

"A prostitute of the name of Macdonald, in a state of drunken wantonness and fury, struck a brothel-keeper with a smoothing-iron, and inflicted a denuding wound of the skull. The wound never healed; the woman constantly complained of headache; and eight weeks after the accident she was attacked with erysipelas of the head and face, which ended fatally in ten days. The usual effects of erysipelas were found on the body; and the seat of the wound was occupied by an indolent ulcer, from the bottom of which a small hole proceeded inwards and perforated the bone. But this woman, after meeting with the injury, kept up an old custom of getting often intoxicated; and, on one occasion, a few days before the erysipelas began, she actually danced with great spirit, and got dead drunk at a ball. Here, even supposing the erysipelas had begun around the wound, which was not proved, the woman nevertheless led, in every particular, the kind of life which was calculated to induce serious consequences. The medical witnesses, therefore, declared that the death of the deceased could not with any certainty be ascribed to the wound. The prosecutor, therefore, departed from the charge of murder; and the prisoner was convicted of the assault."

As an illustration of the effect of mala praxis on the part of the medical attendant, the reader is referred to the case of Houston, reported at length by Mr. Watson. A boy, three years of age, received a severe injury to the head, from a large stone recklessly thrown into a crowd: There was fracture with depression of the right parietal bone, but contrary to the opinion of the most eminent surgeons, who recommend the removal of the depressed portion of bone, the injury was allowed to take its own course. The prisoner was acquitted.*

Enough has now been said on the subject of the various circumstances which may modify the severity of wounds, augment their danger, or tend to raise a doubt whether the wound was, or was not, the actual and sufficient cause of death.

On this part of the subject of wounds no general rules can be laid down for the guidance of the medical man. The circumstance of pleas in mitigation being generally urged by the counsel for the defence, should make the medical man very cautious to show no neglect of any sort in the treatment of external injuries, and prepare him to refute accusations often unjustly brought against the treatment he has adopted. The next question which would offer itself for decision, is the following:—

Was the Wound the result of Accident, of Suicide, or of Homicide?

* Medico-legal Treatise on Homicide, p. 233.

The question of *accident* does not play a very important part in this inquiry. In quarrels, injuries are often inflicted, and it is essential to know whether they have been the immediate consequence of the blows received, or the result of falling against some hard obstacle capable of producing them. Here an examination of the soil or spot on which the party falls will decide the question. There is always a probability of accident when a body is found in a dangerous situation, as at the foot of a precipice, or in a river with steep banks ; and the probability is, of course, greatly strengthened if the person has been drinking previously.

It is unnecessary to enlarge upon this part of the subject, as the considerations connected with it are very obvious.

If we exclude the alternative of accident, the original inquiry is narrowed to this, *Was the injury suicidal or homicidal ?*

The probability is always in favour of suicide ; for it appears that in France cases of suicide are to those of murder as about five to two, and it is probable that in this country the proportion is not very different. This probability is somewhat strengthened if the deceased be middle-aged, for suicide is comparatively rare in children and old people. Such considerations as these, however, will be of little use in individual cases ; we must, therefore, search for more precise means of determining the question. The following are some of the principal elements in the decision of it :—*a*. The situation of the body. *b*. The situation of the wound. *c*. The nature of the wound. *d*. The extent of the wound. *e*. The direction of the wound. *f*. The number of wounds.

a. *Situation of the Body.*—If a person is found dead from a wound, in a room with the windows and door fastened on the inside, the circumstances are conclusive as to suicide. If, on the other hand, another party could have had access to the room, the absence of the instrument of death would be conclusive as to murder. So also, if the blood from a mortal wound has been washed from the body or floor, or the body itself has been placed in a position inconsistent with the mode of death, or been buried, there could be no doubt as to the party having perished by the hand of another. In the case of a body found in the water, in a situation precluding the idea of accident, there is always a strong presumption of suicide. So also, in cases of death by falls, if accident be unlikely, suicide is the more probable.

b. *The Situation of the Wound.*—Suicidal wounds are generally situated on the anterior and lateral parts of the body ; incised wounds on the throat ; gun-shot wounds on the head and face ; punctured wounds on the chest or belly. It may be laid down as a general rule, that if the wound is in such a situation as that the instrument of death when placed in the hand of the deceased, cannot be made to reach it, whether by the motion of the hand itself, or by that of the part injured, or by both jointly, the probability in favour of homicide amounts to certainty. It must be borne in mind, however, that a murderer will often make choice of a mode of death which shall most nearly resemble

suicide. Wounds inflicted on concealed parts of the person, as within the labia, and beneath the breast of the female, are in all probability homicidal.

c. *The Nature of the Wound.*—Contused wounds are rarely inflicted by suicides, who generally prefer incised or punctured wounds; severe contusions, therefore, are most probably homicidal, unless the body is lying near a height from which it might have fallen accidentally, or from which the deceased might have thrown himself. Occasionally suicides have attempted self-destruction by knocking their heads against the wall, and have in this way, inflicted on themselves considerable injury. Thus, a German author relates a case in which a man first attempted self-destruction by knocking his head against a wall, and subsequently accomplished his purpose, by striking himself repeatedly on the forehead with a cleaver. He was seen to commit the act.

The *cleanness and evenness* of an incised wound have been mentioned as characters of importance in reference to the question of suicide or homicide. It is generally asserted, that a self-inflicted wound is likely to be jagged and uneven, and that such a wound, therefore, would furnish a strong probability of suicide. This supposition, however, is ill-founded, for it is much less likely that a man who has once made up his mind to commit suicide should waver in his resolution, than that a man should struggle under the hands of a murderer. The reverse of the general statement, therefore, is probably correct. It is not, however, a point of much importance. A probability is also afforded by the number of wounds. Thus, as a general rule, the suicide makes but one wound, the murderer several; but there are many exceptions to both these rules. A very remarkable one is related by Mr. Watson, in which a suicide had inflicted no less than ten wounds on his throat.* Death by stabbing is commonly homicidal, rarely suicidal. As a general rule, again, suicides employ but one instrument of death, murderers more than one. All these rules, however, are very general, and admit of many exceptions.

The *shape* of the wound sometimes gives us still more precise information, enabling us not merely to determine the question of suicide or homicide, but to point out the kind of instrument with which the wound was inflicted, and the occupation of the murderer. Thus, in the case of a man found lying with his throat cut, the fact of its having been cut from within to without, as butchers slaughter sheep, pointed out the occupation of the murderer. He had been a butcher. In another case mentioned by Orfila,† a body was found divided into two parts by means of a cutting instrument passed into the fibro-cartilage uniting the third and fourth lumbar vertebræ. The articulating processes of the vertebræ had been cut transversely through, as butchers are accustomed to cut through the spines of animals. M. Ouy-

* Watson on Homicide, Case 72.
† Traité des Exhumations.

rard was led to suspect, that the man who had committed the murder was a butcher ; and this turned out to be the case.

d. The Extent of the Wound.—It has been thought, that a suicide cannot inflict a very extensive wound upon himself, inasmuch as his courage or strength is presumed to fail before he has completed it. Experience, however, is opposed to this view, and it is but reasonable to expect that the suicide committing the fatal act in a fit of desperation, will put forth at once all the strength necessary to the completion of his purpose. In the case of Sellis, for instance, in which the proof of suicide was almost as strong as it could have been, the wound in the throat was deep and extensive ; and in newspaper accounts of cases of suicide nothing is more common than to read of the head being nearly severed from the body.

e. The Direction of the Wound.—Suicidal wounds generally pass from left to right, and from above to below, such being the most natural movement of the arm. In the case of left-handed persons, the direction would be from right to left ; there are many exceptions, however, to this rule, for suicidal wounds of the throat are often transverse. When persons of different statures fight together, it is natural to suppose, that a wound inflicted by the taller man would pass from above downwards, and the reverse if given by the shorter. But this will only be the case if the wound is inflicted whilst both combatants are in the erect posture. In wounds inflicted by a sword, or by fire-arms, it is important to notice both the direction of the wound, and the orifices of entrance and exit.

f. The Number of Wounds.—Does the co-existence of several wounds furnish a probability in favour either of suicide or homicide? If several mortal wounds are found on the same person it is improbable that they have been self-inflicted, but not impossible, for even after wounds necessarily mortal, there may be strength and determination enough left to inflict one or more others. The following, related by Orfila, is a case in point :—

A gentleman of Rouen was found dead in his chamber. Two pistols were lying in the room, one near the body, and the other on the bed, at some distance from it. An investigation was made on the spot, and it was then discovered, that the deceased had shot himself in two places. One wound, which had apparently been inflicted while he was lying on the bed, had completely traversed the left side of the chest, breaking a rib before and behind, perforating the lung through its middle portion, and passing near to the roots of the pulmonary veins. A very large quantity of blood had become extravasated in the thorax. In spite of the existence of so serious an injury, it appeared, that the deceased must have risen from his bed, walked to a closet to procure another pistol, with which he produced a second wound that must have proved instantly mortal. The ball had entered at the frontal bone, and, after traversing the left hemisphere of the

brain, had become lodged against the os occipitis. There was not the least doubt of this having been an act of deliberate suicide.

This case, then, shows the possibility of two wounds of an extremely severe and mortal character being inflicted on himself by a suicide.

Such are some of the points to be attended to in relation to the question of suicide or homicide. It is evident that there is here much room for caution, as most of the probabilities just established are liable to lead to error if too implicitly relied upon. In this place also, it is necessary to caution the medical man against assuming that an injury, actually inflicted by another, is the real cause of death. Thus in an instance related by Wildberg, a girl died while her father was chastising her for theft, but on examination she was found to have taken poison.

The *circumstantial evidence* in the case of wounds is of the first importance, and has been already alluded to under the head of persons found dead. Thus Sellis, a servant of the Duke of Cumberland, now King of Hanover, was found lying dead in his bed-room with his throat cut, while his master was severely wounded in the head and hand. His Royal Highness stated, that he was roused from sleep by a blow on the head, followed by several others, one of which caused an immense effusion of blood. He leaped out of bed, and followed his assailant, who repeatedly struck at him, and would doubtless have murdered him, but that the doors protected his person from some of the blows. Every part of this statement was confirmed by the circumstantial evidence. The coloured drapery at the head of his Royal Highness' bed was sprinkled with blood; there were traces of blood on the passages and staircase, and on the doors of all the state apartments; and Sellis's coat was found hanging on a chair out of reach of blood from his bed, but the sleeve was sprinkled from the shoulder to the wrist "with blood, quite dry, and evidently from a wounded artery."*

In the case of Courvoisier, tried for the murder of Lord William Russell, the fact that the instrument of death did not lie near the body, and that a napkin was placed over the face, were in themselves conclusive as to the question of suicide or homicide; and left no doubt whatever that Lord William Russell had been barbarously murdered. Again, it was proved that a woman of the name of Norkott, who was found dead in her bed with her throat cut, had been murdered, by the fact that, on the *left hand* of the deceased, there was a bloody mark of a *left hand*.

Besides the questions already examined, viz., Was the wound inflicted during life or after death? Was it the cause of death? and, was it accidental, suicidal, or homicidal? there are others of com-

* Evidence of Sir E. Home.

paratively slight importance, and readily answered by the aid of an ordinary amount of medical knowledge. These will be briefly noticed.

Is the Wound dangerous to Life?—This question must be answered in every instance without any assistance from mere medico-legal inquiries. Formerly much time was wasted in laying down rules for determining the mortality of wounds, or the degree of danger which they entailed. The question is much too simple to require all the learning that has been bestowed upon it, or if at any time difficult, it is scarcely to be simplified by an appeal to learned authorities. In the first place, in the case of injury to parts obviously important to life, such as the large blood vessels or the heart, but little difficulty can arise. Severe injury of these parts must almost of necessity be mortal. Again, very slight injuries, to parts altogether unimportant, may, in peculiar states of constitution, prove fatal, and, on the other hand, injuries of the most severe and extensive nature may, in rare instances, be sustained without injury to life. Such, for example, was the case of Mr. Tipper, who was pinned against a stable-door by the shaft of a gig traversing his chest. It will be useless, therefore, to dwell upon the divisions and classifications, which have been so laboriously made into wounds which are *necessarily* mortal, wounds which are *accidentally* mortal, and wounds which are *not* mortal.

Of many Wounds which was mortal?—This question may become important in a medico-legal point of view. Thus, if several wounds have been inflicted upon a deceased party, of which some were punctured and others contused, and the indictment laid, that death had ensued from the punctured wounds only, it would become of the highest importance to counsel, in defending the prisoner, to draw from the medical witness a clear statement of the kind of wound which proved mortal.

In May 1835, a trial took place in the Central Criminal Court, in which a question of this kind was raised. A soldier was indicted for the wilful murder of a woman at Woolwich. From the depositions of several of the witnesses it appeared, that the prisoner struck the deceased violently on the head with his fist. She fell stunned by the blows, and did not speak afterwards. The prisoner then drew his bayonet, and stabbed the deceased several times; the surgeon who examined the body deposed, that there were five wounds, two of which were flesh wounds above the breast, corresponding in shape to the bayonet produced. Two of these wounds were, in his opinion, decidedly mortal, one penetrating the lungs and the other the liver. The jury, before deciding on their verdict, requested the opinion of the judge whether, if the deceased had died in consequence of the first blows with the fist, the law would apply differently to the case. Mr. Justice Park, who tried the case, observed, " that it would, if it were not so laid in the indictment. The murder is alleged to have been committed by a

deadly weapon, but the jury must take the whole case. There were mortal wounds inflicted by the bayonet, and there is no evidence that the deceased died from the blows of the fist, but only that she was stunned." The prisoner was convicted; but if the surgeon could have sworn that the blows had been decidedly mortal, the case would probably have had a very different termination.

When was the Wound inflicted?—This question may arise either during life or after death.

During life the question may be decided by noticing, in the case of contused wounds, the extent of the ecchymosis and the colours which it assumes ; in the cases of incised and punctured wounds, by the state of the divided parts, whether they are filled with extravasated blood or not, and, if containing blood, whether that blood is coagulated or not; whether the edges are at all enlarged, and the surrounding skin inflamed. A careful examination may enable the medical man to fix the time approximatively.

After death the question resolves itself into this, How long has the deceased been dead? or it may consist of this and the former question together. The presence or absence of animal heat, the existence or non-existence of rigidity ; the progress which putrefaction may have made, must be taken into the account, and, as has been already observed, these questions cannot be answered with any great precision.

4. OF WOUNDS AS THEY AFFECT THE SEVERAL PARTS OF THE BODY.

There are two ways in which this division of the subject may be treated ; each region and part of the body may be handled separately, or the great systems, as the nervous, circulating, respiratory, &c., may be considered in turn. The former plan has been preferred ; and, accordingly, the several parts of the body will be passed briefly in review.

Wounds of the Head.—Injuries to the *scalp* are of more importance than those of the integuments of other parts of the body. The danger arises partly from the peculiar tendency of the skin itself to take on the erysipelatous inflammation, partly from the great liability to injury of the tendon of the occipito-frontalis, and partly to the near proximity of the brain. As a general rule, incised wounds are attended with little danger, but punctured and contused wounds are of more importance ; the former by injuring the tendon, the latter by disorganizing the texture of the skin, and thus giving rise to a great degree of inflammation. In wounds of the scalp, as of other parts of the body, there is the greatest possible difference in different cases, a slight injury leading to fatal consequences in one instance, while in another, the nearly entire separation of the integuments from the bone will not be followed by a single bad symptom.

Fractures of the Skull are not of more importance than those of other bones, unless they are accompanied by injury to the brain or its membranes. But in this case, as in that of wounds of the scalp, a slight injury may lead to fatal consequences, while complete recovery may take place from one accompanied with the most severe and extensive injury to the brain. The force which occasions the fracture may, at the same time, produce concussion, or other injury to the brain. It is important also to understand, that a blow does not always fracture the bone on which it alights, but that it may produce a counter fracture at an opposite part of the skull. A severe blow on the vertex of the head, for instance, will often occasion a fracture at the base of the skull, and this is most likely to happen when the force is applied at once to a large surface.

In forming an estimate of the danger attending fractures of the skull, it is necessary to bear in mind the variable thickness of its several parts. Thus, a blow on the temple would be productive of greater injury than one of equal force applied to other parts of the cranium. The orbitar plate is another part which by its extreme thinness exposes the brain to serious injury from thrusts with pointed instruments. The cribriform plate of the æthmoid bone again would be easily fractured, and the base of the brain be readily injured by a sharp-pointed instrument thrust up the nostril.

Injury to the Brain itself may prove fatal, either by concussion, compression, or inflammation.

Concussion.—This is a common effect of severe blows or violent shocks. The symptoms often follow immediately on the accident, and death takes place without re-action, or any improvement from the usual remedial means. In other cases the symptoms of concussion and compression are combined, and in others, again, concussion is followed by compression or inflammation. Several cases of death by concussion are on record, in which no lesion of the brain could be discovered.

"A prize-fighter was taken off the ground insensible, and apparently apoplectic, and died in eight hours. No lesion or extravasation could be discovered on careful inspection of the brain."* The interval which elapses between the receipt of this form of injury, and the fatal termination is very various. It may prove fatal, as in the case just quoted, in a few hours, or after the lapse of several days, weeks, or even months.

It is a remarkable circumstance connected with this class of injuries, that the patient sometimes seems to suffer little or no immediate inconvenience; but, after the lapse of some days, is seized with symptoms of compression or of inflammation of the brain. The following are cases in illustration:—A woman, mentioned by Mr. Pott, received an injury on the head, and remained well for twelve days. She then fell ill, and died with symptoms of compression of the brain. The ventricles

* Travers on Constitutional Irritation.

were found to contain bloody serum, and a small coagulum of blood.* A girl, aged thirteen, fell from a swing, and struck her head violently against the ground. For six weeks after the accident she complained of headache, but was not otherwise ill. Feverish symptoms then came on, followed by slight delirium and coma, and she died two months after the fall. Upon dissection the ventricles were found distended with serous fluid, without any other morbid appearance.† It is easy to understand how such cases as these might originate difficult questions in a court of law.

A difficult question is apt to arise, when, in consequence of a fight between two parties, one of them falls, his head being first struck by his adversary, and then striking against the ground. In such a case it may be important to determine to which blow the injury and death are attributable. We shall derive material assistance in these cases from a comparison of the injury itself with the spot on which it took place.

Compression.—This may be caused by depressed bone, or by the effusion of blood or serum. The symptoms come on suddenly or gradually, according to the nature of the compressing cause, and the fatal result follows in varying intervals of time. In cases of compression produced by depressed bone, the cause of death is obvious, and can give rise to little difficulty ; but when it arises from effusion of blood or serum following an injury, it is easy to allege that the effusion and consequent fatal result were due, not to the injury itself, but to some concomitant circumstance. Thus, if in the course of a struggle a man is thrown down or struck, and dies soon after, with symptoms of compression, and it appears that an effusion of blood has taken place, the effusion may be attributed to the excitement of the contest, and not to the injury itself ; and the question will be even more difficult if the deceased was given to habits of intoxication, or was of a plethoric habit, and apoplectic make, or of an advanced age. Again, the inquiry will be still more difficult, if on dissection the vessels of the brain are found in a diseased state. The situation of the effused blood will assist us in determining this class of questions. It may be stated as a general rule, liable to few exceptions, that effusion rarely takes place *on the surface of the brain* from disease ; its more common situation being the base, the ventricles, or the substance of the organ.

The following case illustrates this class of questions :—A woman who had been much addicted to drinking, died soon after being struck by her husband, in a quarrel following a drunken fit. Several slight marks of contusions were found on the head, and blood was extravasated at the base of the brain from a ruptured artery. Sir Charles Bell gave it as his opinion, that the rupture might have taken place

* Pott on Fractures. Case 38.
† Abercrombie on Diseases of the Brain.

from a slight injury or shock in this case, in consequence of morbid predisposition to it by the habits of the individual, and the excitement from the struggle with her husband.*

The points which will chiefly demand our attention in such cases, will be the age of the deceased, and the relation which the effusion bears to the external injury. Spontaneous effusions of blood are very rare in young and middle-aged persons.

Inflammation of the Brain.—It is necessary to bear in mind that inflammation of the brain is apt to follow upon injuries, not only to the organ itself, but to those of the scalp, and of the parts most nearly connected with the brain, such as the orbit, ear, &c. With regard to inflammations and affections of the brain, the same observations hold good which apply to the injuries already considered. A slight injury may give rise to very severe inflammation, a severe injury to very slight effects. The period at which inflammation sets in is also very variable. As a general rule, it does not follow directly upon the injury, but some days or weeks may elapse before it takes place. In some cases it is a consequence of concussion or follows upon symptoms of compression, in others it is quite independent of both. The following case illustrates this point:—

J. Bell was tried at Edinburgh, November 1836, for the murder of J. Kerr, aged twenty-two, by having struck him on the forehead with a hoe. The blow caused a compound, much comminuted, and depressed fracture of the skull. On the day after receiving the injury, Kerr was brought to the Royal Infirmary. He walked up stairs to his bed, and did not seem very ill. Symptoms of inflammation came on, and he died seven days after the injury. On dissection, there was inflammation of the membranes, and an abscess in the substance of the brain, below the seat of the injury.†

Injuries of the head, then, have this peculiarity, that at first they often appear of little consequence, but after a considerable interval dangerous symptoms may arise and prove fatal. In the interval which elapses between the receipt of the injury and the accession of dangerous symptoms, there is always room for neglect or mismanagement, on the part of the patient, his friends, or the medical attendant, which may materially affect the question,—Was the injury the cause of death? This question, therefore, has a peculiar application to injuries of the head.

Injuries to the Spine may be mentioned in this place, as being closely connected with those of the head. These injuries generally prove fatal, the interval varying according to the degree of violence used and the part of the spine which has been wounded. Serious injury to the upper part of the cord proves immediately fatal by paralyzing the muscles of respiration; but when the lower part of the cord is injured,

* Shaw's Manual of Anatomy.
† Watson's Medico-legal Treatise on Homicide, p. 63.

there is loss of power and sensation in the parts below the seat of injury, and disturbance of the functions of the viscera, which sooner or later prove fatal. Many injuries to the brain principally affect the base, and by causing pressure on the medulla oblongata paralyze the nerves supplying the muscles of respiration. Injuries to the spinal cord are comparatively rare, and seldom give rise to questions of a medico-legal nature.

Wounds of the Face. — This class of injuries obviously produces great disfigurement, and, in consequence of the large distribution of important nerves over the face, still more grave inconvenience. From the near proximity of the principal features to the brain, there is also a risk of injury to that organ, as well as of inflammation extending from the seat of the wound. In this respect the wounds of the integuments of the face come next in importance to those affecting the scalp.

Wounds of the Throat.—These injuries are important from their frequency. They are the chosen mode of death with a great majority of suicides, and sometimes a murderer inflicts a wound on the same part in the hope that his victim will be supposed to have committed suicide. The degree of danger depends upon the position and the parts implicated. Wounds of the anterior part of the throat are less dangerous than those of the side of the neck; those of the lower part of the throat, less so than those of the upper part. A division of the carotid artery is almost necessarily fatal, and that of the internal jugular vein is attended with great danger from the hæmorrhage as well as from the risk of phlebitis. Wounds of the larynx or trachea are attended with comparatively little danger, and those of the trachea are less important than those of the larynx. The points which most require attention in wounds of the throat are the extent and direction of the wound, its regularity or irregularity, and the position of the instrument of death. These points have been already referred to. The question, Was the wound the cause of death? finds less place in this class of injuries than in those affecting the head; but there is one question of considerable interest relating to wounds of the throat, and that is, What amount of voluntary motion is possible after the receipt of a severe wound? This inquiry has an important bearing on the question, Was the wound suicidal or homicidal?

The case of Captain Wright, who shared the captivity of Sir Sidney Smith, in France, and his celebrated escape from the Temple, and who had the misfortune to be taken a second time and imprisoned in the same place, illustrates the importance of this question. He was one morning found dead in his bed with his throat cut, and the razor closed in his hand. It appears from the procès verbal, that the "corpse had the throat cut, and held a razor shut in the right hand." M. Soufé, who inspected the body, deposed, "That on examining the corpse, he observed a transverse wound situated on the anterior and superior parts of the throat, above the bone termed juxoid, in

length about eighteen centimêtres, penetrating into the cervical vertebra, which wound appears to have been effected by an edged instrument, such as a razor, which in its course has cut the skin, the muscles, the tracheal artery, the œsophagus, and sanguineous vessels of the part, whence has issued a considerable effusion of blood, and the prompt death of the said Wright." The fact of the razor being found closed in the hand, is corroborated by one of the witnesses, who, on seeing the body, exclaimed, " the man who cuts his own throat does not shut the razor for the use of another."

The circumstances of the case are involved in so much mystery that it is impossible to determine by the evidence collected with great pains by Sir Sidney Smith, whether Wright really committed suicide or not. But it is easy to show that the mere fact of the deceased being found with the razor closed in his hand does not militate very strongly against the supposition of suicide ; for, in the case of the suicide of a military officer, which occurred in September 1838, the head was found nearly severed from the body, and there was no room to doubt the fact of suicide, yet the razor did not fall from the hand, but was placed upon the dressing-table. In a more recent case, a madman after inflicting a severe wound on his throat had time to struggle with the maid-servant before he fell down dead. In October 1833, a man committed suicide while walking along Oxford-street, by cutting his throat with a razor. After having inflicted the wound, he was observed to hold a handkerchief to his neck, and run forwards. He fell dead on the pavement, having run about four yards from the spot where he wounded himself. The razor was found firmly grasped in his hand. On an examination of the body, it was ascertained that the carotid artery and several of its branches, with the jugular vein on one side, as also the trachea, had been completely cut through. The surgeon gave it as his opinion at the inquest, that from the character of the wound the deceased must have fallen dead on the spot; and although it was possible that he might have run so far as stated after the infliction of the wound, yet such a circumstance would be quite unusual.*

In the remarkable case of Mary Green, who was murdered in 1832 by John Danks, the confession of the culprit, and the circumstantial evidence coincided to prove that, after a wound which divided *the trunk of the carotid artery, and all the principal branches of the external carotid, with the jugulars*, the female must have risen from the ground, run a distance of *twenty-three yards*, and climbed over a low gate. From actual trial it appeared that it must have taken at least from fifteen to twenty seconds to run from the spot on which the murder was committed to that on which the body was found.†

Wounds of the Chest.—Incised wounds of the parietes of the chest

* Taylor's Elements of Medical Jurisprudence, p. 444.
† See the case more at length in Mr. Taylor's work, p. 442.

are not attended with any peculiar danger, but severe contused wounds by causing fracture of the bones, and consequent injury of the internal parts, often prove fatal. The fatal result is due either to extensive rupture of the viscera, to hæmorrhage, or to inflammation. Severe contusions of the chest may also terminate fatally by the shock which they occasion. This class of injuries is of common occurrence in prize-fights, in falls from great heights, and from heavy objects crushing the chest. Penetrating wounds of the chest are dangerous, inasmuch as they can scarcely fail to injure some important organ, occasioning thereby fatal hæmorrhage or severe subsequent inflammation.

Wounds of the Lungs.—Hæmorrhage is the immediate consequence of this class of injuries. The blood may be discharged by the wound, or by expectoration, or it may accumulate in the cavity of the pleura. When the large vessels are wounded the hæmorrhage is copious and speedily fatal. An injury to the substance of the lung itself is not necessarily fatal, for patients have recovered after removal of a portion of the lung, and, in rare instances, foreign bodies, such as bullets, have remained in the lung for years, and have been enclosed in a cyst. Inflammation is a common consequence of wounds of the lung, especially when a foreign substance has been forced into the wound, as happens in injuries with fire-arms. Cases of wounds of the lungs require careful management, and long-continued rest, as without it injuries which have been repaired may be reproduced. Emphysema is a familiar effect of this class of wounds. When judiciously treated it does not materially increase the danger.

Wounds of the Heart.—Penetrating wounds of the heart, are necessarily speedily fatal from hæmorrhage, unless they pass so obliquely through the parietes that the flap acts like a valve, or a foreign body happen to plug the orifice; death may be delayed, in these cases, for some hours, or even days. The rapidity with which death takes place will depend upon the situation of the wound. Thus wounds of the base will prove less speedily fatal than those of the apex, and superficial wounds dividing the vessels of the heart less promptly than those which penetrate its cavities. John Bell gives the case of a soldier, in whom the apex of the heart was cut with the point of a very long and slender sword, and this soldier lived twelve hours, during which time, as appeared after his death, the heart had, at every stroke, been losing a small quantity of blood, till, in twelve hours, it entirely filled the chest, and the patient was suffocated and died. Another man was wounded with a sword, the point of which cut the coronary artery, which threw out its blood so slowly, that it was two hours before the pericardium filled with blood, and then, after great anxiety, the patient died.* In very rare instances, when the wound does not prove fatal by hæmorrhage, complete recovery has taken place. A case, for instance, is related by Fournier, and authenticated by M.

* Principles of Surgery, vol. i. p. 468.

Mansen, chief surgeon to the hospital at Orleans, of a patient, who not only survived a wound of the heart, but may be said to have made a perfect recovery from it, inasmuch as he died at the distance of six years after the receipt of the injury, from disease unconnected with it, and the ball was found embedded in the heart. M.M. Ollivier and Sanson have collected a number of cases of penetrating wounds of the heart, with a view of determining the probable period at which these injuries prove fatal. Out of twenty-nine cases of wounds of the cavities of the heart only two proved fatal within forty-eight hours. In the remaining cases, death took place in periods varying from four to twenty-eight days.*

Wounds of the Aorta and Pulmonary Artery are necessarily fatal; but patients have been known to live a few days after small punctured wounds even of the aorta.

Wounds of the Œsophagus and Thoracic Duct.—Such injuries are necessarily rare from the great depth at which these parts lie. They would be dangerous from the extravasation of their contents. Orfila, however, mentions a case of recovery from a bayonet-wound of the œsophagus.†

Wounds of the Diaphragm.—Punctured wounds of the diaphragm itself do not appear to be attended with great danger, but they are rarely uncombined with injury to the parts above or below. Hernia of the stomach has sometimes followed these injuries, and proved fatal. Rupture of the diaphragm from severe blows or falls is not an uncommon occurrence. In the majority of cases the rupture is attended by a fatal shock to the nervous system, and death is immediate. In other instances it takes place after a longer interval, from the protrusion of the viscera of the abdomen into the chest, and the consequent disturbance of the functions of the organs contained in one or both of those cavities.

Wounds of the Abdomen.—Wounds of the parietes of the abdomen may be attended with serious consequences. Death may take place in incised wounds from a division of the epigastric artery. As in the scalp, so here, there is additional danger from wounds of the tendons of the muscles, and the consequent accumulation of matter beneath them. Ventral hernia is a remote consequence of wounds of the parietes of the abdomen. Contusions of the abdomen are generally attended with serious consequences. Sudden death from shock, hæmorrhage from rupture of the viscera, and inflammation, are the chief causes of death. The liver and spleen are the organs most liable to suffer injury, and rupture of their substance is not uncommon.

Wounds of the Liver.—Penetrating wounds of this organ, when they extend to any depth, are apt to prove fatal by dividing some of the large vessels. In other cases the danger arises from inflammation of the organ. Wounds of the gall-bladder prove fatal by causing effusion of bile, and consequent peritonæal inflammation.

* Dict. des Sciences Médicales, art. *Cas rares.*
† Vol. ii. p. 483.

Wounds of the Spleen.—Deep wounds are fatal by hæmorrhage; but recovery may take place from superficial wounds.

Wounds of the Stomach.—These prove fatal by the shock to the nervous system, by hæmorrhage, if the large vessels are divided, by the extravasation of the contents and consequent peritonæal inflammation, and by inflammation of the viscus itself. Wounds of the stomach, however, are not necessarily fatal, and many cases of recovery are recorded, even when the wound was extensive, and the stomach distended with food at the time of the injury.

Wounds of the Intestines.—These injuries may prove fatal in the same ways as those of the stomach, viz., by hæmorrhage, by effusion of their contents, and consequent peritonæal inflammation, or by inflammation of the part itself. The danger is greater in the small than in the large intestines, in consequence of the more fluid state of their contents, and the greater risk of extravasation. For the same reason, wounds of the duodenum are more dangerous than those of the other small intestines. In the absence of extravasation, there is a fair chance of recovery from wounds of the intestines by the effusion and organization of coagulable lymph about the edges of the incision.

Wounds of the Kidneys.—The kidneys are chiefly exposed to injury from blows and stabs in the loins. Penetrating wounds of these organs may prove fatal, in consequence of hæmorrhage, extravasation of urine, or inflammation. If means are taken to prevent the urine from being effused into the peritonæal cavity, recovery may take place.

Wounds of the Bladder are chiefly dangerous from extravasation of urine, which is, of course, most apt to occur when the organ is distended. In the absence of effusion they may prove fatal by the inflammation to which they lead.

Wounds of the Genital Organs.—A removal of the penis, if not fatal by hæmorrhage, is not dangerous; but an incised wound of the urethra entails the risk of extravasation of urine into the cellular membrane and fatal sloughing. The removal of the testicles is attended with less danger than a contusion. This latter injury sometimes proves fatal by the shock to the nervous system. Wounds of the spermatic cord occasion dangerous hæmorrhage. The complete removal of all the parts of generation of the male has in many instances led to no bad result. Deep wounds of the labia of the female are dangerous from hæmorrhage. Fatal injuries have been inflicted on the uterus, bladder, or rectum, or on the large vessels of the pelvis, by instruments introduced into the vagina.

The narrow limits of this work preclude a more detailed notice of injuries as they affect the several organs of the body. The reader is, therefore, referred for more minute information on this subject to Mr. Watson's Medico-legal Treatise on Homicide, and to Mr. Alfred Taylor's Elements of Medical Jurisprudence, p. 264 to p. 501.

CHAPTER X.

DEATH BY FIRE.—SPONTANEOUS COMBUSTION.—DEATH BY LIGHTNING.—COLD.—STARVATION.

THESE subjects are included in the same chapter, not from any resemblance which they bear to each other, but because they have no immediate connexion with any of the foregoing, and are not of sufficient importance to form the subject of distinct chapters.

DEATH BY FIRE.

Was the Burn inflicted during Life or after Death?—Cases.—Experiments of Christison.—Characters of Burns produced after Death.

The questions which arise in reference to death by fire, are similar to those relating to other forms of external injury, except that the alternatives of suicide and homicide seem to be, from the nature of the case, excluded ; for it is highly improbable, that either a suicide or a murderer would choose such a mode of death. The main question then is, whether the burning was accidental or intentional. If accidental we shall have marks of the burning having taken place during life; intentional burning of a body would be resorted to after death by a murderer anxious to conceal the real cause and mode of death, and in such a case these marks would be absent. Hence the question *Did the Burning take place during Life or after Death?* becomes of unusual importance. It may be well to illustrate this question by two cases, one of which occurred before we were furnished with any means of discrimination, and the other after.

A man of the name of Gilchrist, some time ago, was condemned and executed at Glasgow. He and his wife lived in an irregular rambling sort of way, getting drunk sometimes for days together. On one occasion, after their return home in the evening, the people who lived on the floor above them, heard a noise like that of two persons struggling, and soon afterwards a rattling, or gurgling, and moaning, as of one choking or bleeding to death. They so strongly suspected that all was not right, that they called down to Gilchrist, through the floor, that they were afraid he was killing his wife. In no long time they were alarmed by the smell of fire, and the filling of the house with smoke, upon which they went down to Gilchrist's

apartment and demanded admission. After some delay he admitted them, and in doing so appeared to them to have come out of an inner room, where he said he had been asleep in bed. On letting them in he stumbled over the dead body of his wife, which was in the outer apartment, in a kneeling posture, supported by a chair, and very much burnt. Gilchrist was accused of having murdered his wife, and burned the body to conceal the manner of her death. He, on the other hand, alleged, that he had gone to bed tired, and knew nothing of what had befallen her until he was awakened ; and, that he presumed her clothes had caught fire while she was intoxicated, and that she was thus burnt to death. What remained of the body was examined by medical men ; but their report was merely, that the body was so much burnt that nothing could be learnt from it as to the cause of death. The man was hanged, to the last vehemently and solemnly denying that he was guilty.

Now this man may have been justly or unjustly condemned. The case is quoted to show, that at the time at which this trial took place the medical man did not possess any means of distinguishing a burn inflicted during life from one produced after death. This was the point on which the question of murder chiefly hinged, and there can be little doubt, that if such means of discrimination had existed, the body was not too much injured to prevent the employment of them.

The following case closely resembles the foregoing, and the circumstances connected with it were equally suspicious. It is extremely instructive, because the medical evidence, so unfortunately defective in the former case, led, in this instance, to the acquittal of the accused party.

A woman was found dead and severely burnt. Her husband was suspected of having killed her, and of having afterwards burned the body. He and his wife lived together on bad terms. On the night of her death the woman had returned home at a late hour, after having lighted a candle and got some whiskey at a neighbour's house. At this time certainly the husband was in bed ; but, some time afterwards, there was heard a considerable noise, like that of struggling, and of chairs pushed up and down the room. Not very long after, the neighbours were alarmed by a strong smell of fire, proceeding from the apartments which the man and his wife occupied. They therefore knocked at his door for admission, but in vain ; all the noise they could make did not bring him to the door. At last a man forced his way in, by breaking the window of the outer room, and on entering found the room full of smoke, and observed something burning red in the corner, over which he instantly threw a pitcher of water :—it was the body of the woman burning on the hearth. Several persons now entered the inner room ; they found the husband either asleep, or feigning to be so. On being roused and told of his wife's death, he expressed neither surprise nor sorrow, but coolly demanded by what authority the people had broken into his house. The presumptions were strong against him ; they were completely removed by the result of a

scientific investigation suggested by certain appearances on the dead body. The burns on those parts of the body which were not reduced to a cinder, exhibited peculiar characters, which appeared to the medical examiners to indicate that the burning had taken place during life. This idea led to the institution of a series of experiments, with a view to ascertain whether a part of the body burnt during life, and a part burnt after the extinction of life, present the same or different appearances ; and, if different, whether the differences are definite and constant. The result of this inquiry was, the discovery of the means of determining with precision, in every case in which the whole of the body is not reduced to a cinder, whether the body were alive or dead when burnt. In this case it was proved, that the woman had been set on fire whilst still alive, and had died in consequence of the burning.

We owe our knowledge of the diagnostic marks of burns inflicted during life and after death to the experiments of Dr. Christison. A burn inflicted *during life* has the following appearances:—Immediately surrounding the burnt spot there is a narrow white line ; external to this a second of a deep-red tint ; and this latter, at its outer edge, runs by insensible degrees into a diffused redness. The diffused redness may be removed by gentle pressure, and disappears after death ; the deep red line, however, is permanent. These appearances are observable in from five to fifteen, and occasionally as late as thirty seconds after the burn. The next appearance in point of order is that of *blisters filled with serum*. The period at which the blisters rise has not been accurately determined, but in most cases a very few minutes suffice to produce them. If, therefore, life is extinct within a few minutes of the injury, blisters may be altogether absent. After scalds, vesications make their appearance in a very few minutes, but in young children it is said that they are some hours before they appear. Vesication is not an invariable effect of the application of heated bodies.

The appearances *after death* according to the experiments of Christison, vary with the time which has elapsed since the death.

Dr. Christison was unable, in any case, to produce the deep red line, not removable by pressure; and although blisters were produced in some of the experiments, they were filled with air, not with fluid ; and on the removal of the cuticle, the cutis was found free from moisture. As some of the experiments were made ten minutes after death, the distinctive marks thus established apply to all periods beyond that time.

In about an hour after death, it seems that it is not possible to produce any appearances which can be mistaken for vital changes; the application of heat merely having the effect of ruffling the cuticle, and drying up the parts to which the heated body is applied.

In one of Christison's experiments, boiling water was poured in a continued stream on the breast, and on the outside of one of the legs ten minutes after death. The body was examined within thirty-six hours. On the leg no trace whatever of the action of heat could be

discovered. The breast was of a very pale brownish hue, the cuticle slightly shrivelled, dry, brittle, and easily scratched off. The surface of the true skin below was dry, and around the burnt part there was not a vestige of redness or blistering. In another instance, in which heat was applied to an amputated leg, ten minutes after its removal, a blister was raised which contained air, but no water. The deep red line, and the vesicle filled with serum, may therefore be regarded as vital changes.

Another question which may arise in the case of persons found burnt is, whether the burning originated in causes external or internal to the body; in other words, whether it is possible that the body could have been consumed by internal heat, spontaneously generated. This question must be the subject of a separate heading.

SPONTANEOUS COMBUSTION.

Medico-Legal Case.—Case of Grace Pett.—Orfila's Description of its Phænomena.—Consists in an unusual Combustibility of the Body.

The following case, which rests on the authority of Le Cat, a firm believer in the doctrine of spontaneous combustion, forms a fitting introduction to this subject. It is said to have taken place in 1725.

A man of the name of Millet, living at Rheims, was charged with the murder of his wife. It appears that the body of the deceased was found lying in the kitchen of the house at a short distance from the hearth, entirely consumed. A part of the head only, with a portion of the lower extremities, and a few of the vertebræ, had escaped combustion. The floor beneath the body was partially burnt. The prisoner in his defence, stated that he and his wife had retired to rest the previous evening,—that his wife, not being able to sleep, got up and went into the kitchen, as he supposed to warm herself. He was awakened by the smell of fire, and going down into the kitchen, discovered the deceased lying near the hearth in the manner stated. The prisoner was condemned to death for the murder, but, on appeal to a higher court, the sentence was revoked, and it was pronounced to have been a case of spontaneous human combustion.

In this case the extent to which the body was consumed might lend some support to the opinion, that it was more combustible than human bodies in general, but it gives no countenance to the notion that the fire originated in the body itself. It was certainly in the most favourable circumstances for being *set on fire*. Now what occurred in this case seems to have happened in all the reported cases of spontaneous combustion; that is to say, the body was found in such a position as that it might have been set on fire. This remark applies to the following case, which occurred, so recently as 1774, in our own country, at Ipswich.

A fisherman's wife of the name of Grace Pett, of the Parish of St. Clements, had been in the habit for several years of going down stairs every night after she was half-undressed, to smoke a pipe. She did this on the evening of the 9th of April, 1774. Her daughter, who lay in the same bed with her, had fallen asleep, and did not miss her mother till she awoke early in the morning. Upon dressing herself, and going down stairs she found her mother's body lying on the right side with her head against the grate, and extended over the hearth with her legs on the deal floor, and appearing like a block of wood burning with a glowing fire without flame. Upon quenching the fire with two bowls of water, the neighbours, whom the cries of the daughter had brought in, were almost stifled with the smell. The trunk of the unfortunate woman was nearly consumed, and appeared like a heap of charcoal covered with white ashes. The head, arms, legs, and thighs, were also much burned. There was no fire whatever in the grate, and the candle was burned out in the socket of the candlestick, which stood by her. The clothes of a child on one side of her, and a paper screen on the other, were untouched; and the deal floor was neither singed nor discoloured. It was said that the woman had drank plentifully of gin over night, in welcoming a daughter who had recently returned from Gibraltar.*

All the other cases, which are given with sufficient minuteness, resemble the two foregoing, in the fact of the parties having had access to fire.

Orfila testifies his belief in spontaneous human combustion by thus describing the phænomena which accompany it: A light blue flame appears over the part which is about to be attacked: this flame is not readily extinguished by water, and indeed frequently the addition of this liquid only serves to increase its activity. Deep eschars now form in the part affected, accompanied by convulsions, delirium, vomiting, and diarrhœa, followed by a peculiar state of putrefaction, and death. The process is said to advance with extreme rapidity, but the body is never entirely consumed: some parts are only half burnt, while others are completely incinerated, a carbonaceous, fetid, unctuous ash remaining. The hands and feet commonly escape destruction, while the trunk is usually entirely dissipated. The wooden and other combustible articles of furniture situated near the individual, are either uninjured, or but imperfectly consumed; the clothes, however, covering the body, are commonly destroyed. The walls and furniture of the apartment are covered with a thick greasy soot, and the air is impregnated with an offensive empyreumatic odour. This phenomenon is stated to have been chiefly observed in corpulent females, advanced in life, and especially in those subjects who had been long addicted to the abuse of spirituous liquors.

It is, perhaps, practically of little consequence whether the doctrine

* Brewster, Natural Magic, pp. 324-5.

of *spontaneous* combustion be true or false. The cases on record may be fairly allowed to prove an unusual degree of combustibility of the human body, occurring in rare instances and, for the most part, in corpulent spirit-drinking females, merely requiring to be set on fire, and needing no other fuel but their clothes, or night-dress.

Till we possess cases better authenticated, and more accurately reported, we must content ourselves with this amount of knowledge. The arguments advanced on both sides of the question have little weight; for, to those who assert the extreme improbability of a human body, which ordinarily requires for its destruction a large amount of fuel, being ever consumed when the only fuel consists of a night-dress, the cases reported in the last section may be opposed ; for in those cases a very large part of the body was consumed. On the other hand, to those who strive to explain spontaneous combustion by an electric theory, it may be objected, that though well authenticated cases of the body becoming highly electric, are recorded, no phænomena allied to spontaneous combustion occurred in those cases.

The spontaneous combustion of inorganic substances is a subject of much interest and importance, but it has no medico-legal bearing.

DEATH BY LIGHTNING.

Post-mortem Appearances.—Cause of Death.—State of the Dress and of Objects found on the Person.—Cases.

Death by lightning rarely gives rise to questions of a medico-legal nature; but inasmuch as the effects sometimes produced on the body, both externally and internally, resemble those inflicted by mechanical violence, a question might possibly arise, whether a person found dead, under unknown circumstances, had perished from the effects of lightning, or had been murdered.

In the majority of cases we shall have a clue to the cause of death, by knowing that a thunder-storm has taken place near the spot on which a body is found. This fact being ascertained, we shall next have to inquire what probability there was of the body having been struck by lightning.

As a general rule it may be stated, that the electric fluid prefers and seeks out good conductors; and as the human body is a very good conductor of electricity, it is as likely to be struck as any object similarly situated, unless, perhaps, that object be of metal.

Lofty objects are more likely to be struck than low ones. Hence we might expect that where the human body is surrounded by objects much more elevated than itself it should escape. Although this is a general rule, it does not hold universally. Thus, in a remarkable case quoted by Mr. Taylor,* two persons were struck though they were

* Elements, p. 228.

situated in a deep hollow, surmounted by a lofty tree. They were travelling in a vehicle, which contained, of course, a large quantity of metal, and furnished a better conductor than surrounding objects of greater elevation. It is well known that trees are often struck by lightning ; and the danger of remaining under a tree during a storm is proverbial.

It has been thought that a person is tolerably safe in an open space far from any object which could attract the electric fluid ; but this is an error. The human body may be, in these circumstances, the most prominent object, and, at the same, the best conductor.

It is now understood that death may be caused by an electric shock, other than the lightning stroke. This takes place when a cloud, in near proximity to the earth, is negatively electrified, whilst the earth is positive. The human body is here made the conductor, by means of which the equilibrium is restored. This is called the *ascending* or *returning stroke*.

It is not necessary to enlarge on the difference which exists in the relative conducting power of different substances. It is well known that metals are good conductors. It is on this account that they are employed to protect houses and ships from lightning. So, also, substances which, in their dry state, are bad conductors of electricity, become very good ones when moistened. It happens, therefore, that the string of a kite moistened by a shower, or the moistened ropes of a vessel, becomes a good conductor of lightning.

The violent effects produced by the electric discharge—the disruption of the several parts of a building; the violent separation of the good conductors from the bad ones; the fusion of metallic substances; the ignition of inflammable ones; the magnetic properties communicated to articles of iron and steel—are familiarly known.

The *Post-mortem appearances* in the bodies of those who have been struck by lightning are very various. Sometimes no marks of violence are found on the body, and this is said to occur most commonly in cases of death produced by the *returning* stroke. At other times the body presents marks of violence, such as contusion and laceration about the spot where the electric fluid has entered ; occasionally there is merely a small round hole at the point of exit ; at other times there is an extensive ecchymosis, and this is most commonly found on the back, the electric fluid appearing to prefer the track of the spinal marrow. Fracture of the bones is a rare occurrence. One case of extensive fracture of the bones of the skull is related by Pouillet. Marks of burns are not frequently met with, and probably never, except in cases where the clothes have been set on fire. The blood is said to be fluid, and this was the opinion of John Hunter. Sir C. Scudamore, however, has found, on examining the bodies of animals killed by electricity, that the blood in the veins was always coagulated. It is said, that the bodies of persons killed by lightning do not grow rigid. This opinion, too, is erroneous, for Sir B. Brodie has observed, that animals

killed by the electrive spark become rigid after death. Dr. Francis also states, that the bodies of those who are struck by lightning do not always remain flaccid, and that he has seen a case where the muscles became immediately excessively rigid. He also refers to Beccaria for a similar example. Putrefaction is also said to be hastened. But this admits of doubt. It must at least be recollected, that these accidents usually occur in summer, when putrefaction takes place very speedily.

The fact is, that with regard to the fluid state of the blood, and the occurrence of cadaverous rigidity and putrefaction, fresh observations are required. But even should it be clearly made out that the blood is fluid, cadaverous rigidity absent, and putrefaction hastened, these circumstances could not be considered peculiar to death by lightning, for there is reason to believe, that all of them may occur in other modes of sudden death.

But we are not always dependent upon such doubtful signs as these. The state of the objects which are carried about the person may furnish very complete evidence of the cause of death. The clothes may be torn and burnt ; the several metallic bodies contained in the pockets of the deceased may be fused, and, at the same time, forcibly carried to a distance from the body ; and, in some cases, we shall find articles of iron or steel rendered strongly magnetic. This has happened with regard to the steel of the stays, or the main-spring of a watch.

Cause of Death.—When the body is struck by lightning the nervous system is the part which chiefly suffers. If death takes place, it is through the shock sustained by it ; or if a less degree of injury is inflicted, it is manifested on the brain, spinal marrow, or nerves. Hence the loss of sight, of sensation, or of voluntary motion, temporarily or permanently due to this cause.

On account of the unimportant medico-legal bearing of this subject, it is unnecessary to treat it with any degree of minuteness. It will be sufficient, therefore, to add one or two cases by way of illustration.

Professor Rickman, of St. Petersburg, was killed by electricity in the year 1753. He was engaged in some experiments upon atmospheric electricity, with his engraver, Sokolow. Having placed himself near the apparatus during a storm, in order to examine the electrometer, a large ball of fire appeared to flash from the conducting-rod to the head of the professor, and he instantly fell lifeless. On examining the body, there was found a single red spot on the forehead, at the point where the electric current entered ; it appeared to have completely traversed his body, bursting open his shoe, and singeing part of his dress, but without producing any other marks of violence on his person.

The following case is quoted from Pouillet's work :—

" In July, 1819, the electric fluid struck the church of the village of Châteauneuf-les-Moustiers, situated on one of the summits of the Lower Alps. Divine service was being performed, when three loud

claps of thunder were heard, the Missal was suddenly torn out of the hands of a person officiating, and, at the same instant, this person, with the curate and the greater number of the congregation was violently thrown down, and all were more or less injured. The Curate, who was taken up in a state of insensibility, was soon restored by the application of proper means. On examination, it was found that the electric current had first struck the gold lace on the upper part of his dress, thence it had taken its course down his body, producing some severe injuries, and probably the greater part of it escaped by the seat on which he was sitting, for this was found broken to pieces. A portion of the current had gone down to his foot, had broken the metallic button of the shoe, which was torn open, and had transported it to some distance. The arms of this person remained in a state of paralysis for two months afterwards; eight individuals were killed on the spot, and eighty-two were more or less injured, a great number of whom suffered from paralysis of the legs. One of the priests who was dressed in a silk robe, escaped without any injury. The steeple of the church was subsequently found at some distance from the spot, and the floor of the chapel was pierced in several places by large holes, through which it is supposed the electric current had passed into the earth."*

It appears, then, that the effects produced by lightning are similar to those of various forms of mechanical injury, sometimes resembling a bruise, sometimes a burn; but that occasionally no marks whatever of the injury are present. We shall generally be able to discover the real cause of death by the knowledge that a thunder-storm has taken place;—by the injury sustained by surrounding objects; by the state of the dress; the fusion or ignition of metallic or other substances carried about the person; and sometimes by the magnetic properties communicated to articles of iron or steel. The pathological appearances are not in themselves sufficiently marked to enable us to speak with certainty.

DEATH FROM COLD.

Effects of intense Cold.—Closely resemble those of Intoxication. — Vary in different Persons.—Circumstances which increase the Effect of Cold on the Body.—Post-mortem Appearances—not in themselves conclusive.

Death from cold is an uncommon event in this country, though death by cold and inanition combined is not of very rare occurrence in severe winters. The first effect of intense cold is a sensation of numbness and stiffness in the muscles of the limbs and face, with pallor of the skin. This is followed by speedy loss of sensibility, torpor, and profound sleep, from which the person is with great difficulty roused. All the vital functions gradually cease, and death finally ensues.

* Traité de Physique, Art. Electricité Atmosphérique.

Whilst the cold drives the blood from the surface, it, of course, tends to accumulate it in the interior of the body, so that the great vessels of the spleen, liver, lungs, and brain are more or less gorged with blood. The temperature of the blood itself is lowered; the heart contracts slowly and feebly, and the pulse becomes small and thready. Priapism sometimes results from congestion of the vessels of the penis.

On the nervous system the effects of cold are manifested by numbness, torpor, somnolency, giddiness, dimness of sight, tetanus, and paralysis.

The appearance of persons suffering from intense cold, indeed, closely resembles the effect of intoxication. This effect of severe cold has been often witnessed in expeditions to the North Pole, and Captain Parry thus describes the state of some of his crew, on their return to the vessel, after long exposure to cold:—"When I sent for them into my cabin, they looked wild, spoke thick and indistinctly, and it was impossible to draw from them a rational answer to any of our questions. After being on board for a short time, the mental faculties appeared gradually to return with the returning circulation, and it was not till then that a looker-on could easily persuade himself that they had not been drinking too freely." "I have more than once seen our people in a state so exactly resembling that of the most stupid intoxication, that I should certainly have charged them with that offence, had I not been quite sure that no possible means were afforded them in Melville Island, to procure anything stronger than snow-water." *

All the symptoms here mentioned seem to point to the nervous system as that chiefly affected by cold, and the cause of death is therefore in some way or other connected with this effect on the nervous centres.

The effect of cold varies in intensity in different persons with variations in age, strength, &c.: the young, the aged, the infirm, persons worn out by disease or fatigue, and those addicted to the use of intoxicating liquors, perish most promptly in the depth of winter. We often hear of the death of such persons in the streets of London. It, would appear, too, that independent of these circumstances, some persons have a great advantage over others in their power of resisting cold, a fact frequently observed by voyagers and travellers in the Arctic regions.

It may be well to allude to some of the circumstances which cause the impression of cold on the body to be severely felt, and which give rise to effects not indicated by the height at which the thermometer stands.

The body is cooled in three ways—by cutaneous exhalation; by conduction from the direct contact of air; and by radiation.

* Expedition to the North Pole, vol. i. p. 108.

The *cutaneous exhalation* is increased by dry air, and suppressed by moisture, and so far the heat of the body is affected by this cause.

On the other hand the body is cooled by *conduction*, when the air is moist ; so that the body is cooled alike by dry cold air and by cold moist air.

Of the effect of cold humid winds in lowering the temperature of the body, a good example is given by Dr. Currie in the Philosophical Transactions of 1792 :

" Of several individuals that clung to a wreck, two sat on the only part that was not submerged ; of the others, all were constantly immersed in the sea, and most of them up to the shoulders. Three only perished, two of whom were generally out of the sea, but frequently overwhelmed by the surge, and at all other times exposed to heavy showers of sleet and snow, and to a high and piercing wind. Of these two, one died after four hours' exposure,—the second died three hours later, although a strong healthy adult, and inured to cold and hardship. The third that perished was a weakly man. The remaining eleven who had been more or less completely submerged, were taken from the wreck next day after twenty-three hours' exposure and recovered. The person among the whole who seemed to have suffered least was a negro : of the other survivors, several were by no means strong men, and most of them had been inured to the warm climate of Carolina."

A rapid renewal of the air, as in a brisk cold wind, lowers the temperature of the body by evaporation and by conduction at the same time, and the effect of a slight breeze in increasing the feeling of cold is familiar to every one, and was remarkably exhibited in the expeditions to the polar seas.

Post-mortem Appearances.—The surface of the body is pallid, and the viscera of the head, chest, and abdomen, are congested. There is congestion of the vessels of the brain, but extravasation does not appear to have been noticed, though the old opinion of the cause of death was in favour of apoplexy. In two cases reported by Dr. Kellie, of Leith, there was a large effusion of serum in the ventricles of the brain. The blood in the aorta and left cavities of the heart is stated by Dr. Paris, on the authority of Sir B. Brodie, to be florid. It will be seen that none of these appearances are so characteristic as to be in themselves conclusive as to the cause of death.

DEATH FROM STARVATION.

Of rare Occurrence.—Symptoms.—Period required to prove Fatal.—Post-mortem Appearances.—Case of Elizabeth Canning.

This is an extremely rare event ; but death from cold in persons insufficiently nourished is perhaps not infrequent. Cases of homicide

by the deprivation of food, are probably extremely rare, but insane persons, and those who seek to avoid some greater calamity, such as capital punishment, sometimes commit suicide by obstinately refusing to take sustenance.

The Symptoms produced by protracted Abstinence are pain in the epigastrium, relieved by pressure; emaciation, the eyes and cheeks sunken, the bones projecting, the face pale and ghastly, the eyes wild and glistening, the breath hot, the mouth dry and parched, intolerable thirst, delirium, extreme prostration of strength.

After a longer interval the body exhales a fetid odour, the mucous membranes of the outlets become red and inflamed, and death takes place in a fit of maniacal delirium, or in horrible convulsions.

The period required to produce fatal effects varies with the age, sex, and strength, and depends in a great degree on the command of liquids, for the experiments of Redi have shown, that animals live more than twice as long when they have access to water as when they are kept without it.

Cases are on record in which life has been prolonged under voluntary starvation for a considerable period; in one case, (that of Viterbi) twenty-one days, and in a still more remarkable one, fifty-eight days. This which occurred in the south of France, and was reported to the Academy of Medicine, is as follows:—

Guillaume Granet was a prisoner at Toulouse, and he resorted to starvation to avoid punishment. For the first seven days the symptoms were not very remarkable; his face was flushed, his breath foul, and his pulse small and feeble. After this period he was compelled to drink water occasionally, to relieve the excessive thirst which he suffered, but in spite of the close watch which was kept over him, he frequently drank his urine, or the water of the prison-kennel. His strength did not appear to fail him during the greater part of the time, and, with varying symptoms of constitutional disturbance and acute sufferings, he lingered till the fifty-eighth day, when he expired, after struggling for four hours in convulsions.*

If, in this case, there had been an entire abstinence from liquids the fatal event would, doubtless, have happened much sooner.

Post-mortem Appearances.—The body is much emaciated, exhales a fetid odour, the eyes are red and open, the skin, mouth, and fauces dry, the stomach and intestines empty and contracted; the gall-bladder is distended with bile; the heart, lungs, and large vessels collapsed, and destitute of blood; and putrefaction runs a rapid course.† These appearances are not so characteristic as to be decisive of the mode of death; but in the absence of any disease productive of extreme emaciation, such a state of body will furnish a strong presumption of death by starvation. It must be recollected, that there are maladies such as stricture of the œsophagus, and organic disease of the

* London Med. Gaz. vol. viii. p. 730.
† Foderé. vol. ii. p. 276.

stomach, which prove fatal by starvation. Search should, therefore, be made for such causes of death.

The time that a person may remain without food, or may support life on a very scanty supply of it, may become a question of some importance, as will appear from the following case :—

Mary Squires, an old gipsy, was prosecuted for robbery, and sentenced to death. Elizabeth Canning, a girl of about eighteen years of age, deposed on oath, that on the night of new-year's day, 1753, she was returning to her master's house, in Aldermanbury, when she was stopped near Bethlem-wall, Moorfields, by two men, who robbed her of her gown, apron, hat, and half-a-guinea, tied her hands behind her, and, on her struggling, swore at her, and gave her a violent blow on the temple. She was then dragged to the house of one Mother Wells, at Enfield-Wash, where she saw Mary Squires. Squires made her overtures, as Canning understood her, to become a prostitute, and, on her refusing, ripped up her stays, which she took from her, and after many threats, thrust her into a back-room, or hay-loft, where she was confined for twenty-eight days, without fire, and with no food but some pieces of bread, amounting altogether to about a quartern loaf, about a gallon of water in a pitcher, and a small minced pie which she happened to have in her pocket. Canning further stated, that no human being had visited her during this time, and that, when her provision of bread and water was exhausted, she broke down a window-shutter which was fastened with nails, got out of the window on to a sort of pent-house, and thence jumped to the ground, nine or ten feet below. She reached home by walking as fast as her little remaining strength allowed. The case was soon known, and excited the sympathy and indignation of the public. A subscription was got up for Canning. Squires and Wells were taken into custody, tried at the Old Bailey, and Squires was senteneed to death. But Sir Crisp Gascoyne, the Lord Mayor, saw that there were many contradictory points in Canning's evidence. Her description of the loft in which she was confined did not exactly tally with the room in Wells's house, a witness for the prosecution retracted her evidence, and at length, a memorial being presented to the king, the convict was respited, and ultimately pardoned. It was now Canning's turn to be put on her trial, for it was clear, that if the old woman was innocent, Canning must be guilty. She was accordingly indicted for perjury.

A physician and an apothecary were examined as to her state of health at the time of her alleged escape from Mother Wells's loft. They stated that she appeared like one who had suffered extreme hunger, thirst, and cold, but they acknowledged that a person might be as she was from other causes. After mature consideration of all the circumstances of the case, the jury brought in a verdict of " wilful and corrupt perjury," and the prisoner was sentenced to transportation for seven years. In spite of the verdict and sentence, many persons still believed Canning to be innocent, the newspapers and periodicals of the

time were full of discussions concerning her, and Fielding wrote a pamphlet in her favour. In pursuance of the sentence, however, she was transported to New England, where she married advantageously, bringing to her husband, by way of dowry, a legacy of 500*l.*, which was left to her by one of her original supporters.

On this case, which is taken, with occasional omissions and abbreviations, from a very full account of the transaction by Dr. Cummin,* the author remarks, that there were many circumstances on which medical science might have thrown much valuable light. In the first place,—Could the girl have subsisted twenty-eight days on a quartern loaf and a gallon of water, and if so, could she have reserved sufficient strength to effect her escape in the manner mentioned? To these questions we should be strongly inclined to return an answer in the negative. The cases which have been alluded to, and especially that of Guillaume Granet, give us good ground for believing, that life might have been prolonged for twenty-eight days, or even more, on this scanty supply of nourishment; but it is extremely improbable that, at the end of this time, she would have had strength enough left to effect her escape.

This case is also curious in its bearing on the question of identity, for which purpose it is quoted by Dr. Cummin.

* Lectures, Medical Gazette, vol. xix.

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TOXICOLOGY.

THE frequent occurrence of cases of real or supposed poisoning, and the complicated nature of the questions to which they give rise, render this the most important division of Forensic Medicine. It is proposed to treat the subject in successive chapters, of which the first will comprise the considerations relating to poisoning in general; while the succeeding ones will be devoted to the individual poisons arranged in distinct classes.

CHAPTER XI.

OF POISONS IN GENERAL.

Definition af a Poison.—MODE OF ACTION OF POISONS.—*Local.*—*Remote.*—*Specific.*—*Organs remotely affected.*—*Cause of Death from Poison.*—*Absorption.*—*Experimental proof.*—*Experiments of Mr. Blake.*—CAUSES WHICH MODIFY THE ACTION OF POISONS.—*Their Quantity and Form.*—*The Part to which they are applied.*—*The Condition of the Body.*—*Habit, Idiosyncrasy, Disease.*—GENERAL EVIDENCE OF POISONING.—*Symptoms.*—*Post-mortem Appearances.*—*Experiments on Animals.*—*Chemical Analysis.*—*Circumstantial Evidence.*—*Rules for Medico-legal Examination in cases of Poisoning.*—General Observations in explanation of the Plan of the succeeding Chapters.—*Classification of Poisons.*

In the statute already referred to (p. 343), it is enacted, *interalia*, "that whosoever shall administer to, or cause to be taken by, any person, any *poison* or *other destructive thing*, with intent to commit murder, shall be guilty of felony, and being convicted thereof shall suffer death." The *attempt* to administer such poison or destructive thing with intent to commit murder is felony, and punishable by transportation for life, or for any term not less than fifteen years, or by imprisonment for any term not exceeding three years.*

There are two terms here used which require definition, viz. *poison*, and *destructive thing*.

The term *poison* does not admit of strict definition. It is more easy to say what it is not, than what it is. A substance which affects one person in consequence of some peculiarity of constitution, but has no effect upon others, is not a poison: a substance which proves fatal in

* 1 Vict. c. 85.

consequence of some temporary condition of system, as cold water swallowed by a person heated by exercise, is not a poison: substances which prove fatal in consequence of the mechanical irritation which they set up in the internal parts, such as pins and needles, and particles of steel or glass, are not poisons: again, hot water may prove fatal when swallowed, but it is not regarded as a poison. Hence, it is obvious, that substances which owe their occasionally fatal effects to some peculiarity of constitution, or to some unusual condition of the body; as well as mechanical irritants, and substances naturally harmless, but rendered injurious by extraneous causes, are not to be considered as poisons. The mode in which a substance is applied to the body forms also no part of a definition of the term poison. It may be applied to the skin, or inhaled by the lungs, or swallowed, or introduced into the anus or vagina, but it is still a poison. The quantity of a given substance which may prove fatal, or the time during which it may continue to act before death takes place, cannot be allowed to enter into the definition; for in both these respects undoubted poisons differ widely from each other. These exclusions have narrowed the possible definition of a poison; and although from the nature of things precision is impossible, the following may be adopted as the nearest approach to a definition:—A poison is any substance which, when applied to the body externally, or in any way introduced into the system, without acting mechanically, but by its own inherent qualities, is capable of destroying life.

In by far the greater number of medico-legal cases poisons are swallowed; hence the definition of a poison has been sometimes so framed as to exclude all other modes of application. The words, *administer*, and *cause to be taken by*, which are used in the statute, imply this mode of introducing a poison into the system, and render such a limited definition of a poison unnecessary, as well as incorrect.

Although, as has been stated, the quantity of any substance which may be required to prove fatal cannot properly enter into the definition of a poison, it may render necessary the use of some qualifying term, such as active, virulent, deadly. The last of these terms is generally used in indictments, but has been very justly objected to. A *deadly* poison may mean either a substance which proves fatal in a small dose, or one which, irrespective of the dose, is more likely to prove fatal, or more difficult to counteract, than others. Such ambiguous terms ought to be very carefully avoided. The medical witness, on his part, should observe the caution, already more than once insisted on, not to give any general definition, but to confine himself to the question actually before the court, whether a given substance was capable of destroying life. The intent with which it was used will appear from the general evidence.

Similar difficulties attach to the other term contained in the statute. A *destructive thing*, if not a poison, in the sense ordinarily attached to it, must be some substance destroying life by a mechanical action on

the internal parts, or by some property not inherent in it, such as heat. Some substances, such as sponge, or plaster of Paris, may destroy life by presenting an obstacle to the passage of the contents of the intestines; others, as large particles of glass, steel, &c., by irritating the lining membrane of the alimentary canal; and pins, needles, &c., by causing inflammation in the parts which they traverse. All of these may possibly destroy life; but as they have been swallowed with impunity, a general question as to their destructive properties may be raised in a court of law. All that the medical man can do in such cases is to state that the event is possible; whether death in any particular instance has been due to the alleged cause can be determined only by a post-mortem examination. In the case of sharp-pointed instruments, the fatal result is contingent upon the parts which such instruments happen to traverse.

Having defined the term poison with sufficient precision to indicate the class of substances which will have to be examined in the following pages, certain general questions relating to poisons will have to be considered. These are,—1. *Their mode of action.* 2. *The causes which modify their action.* 3. *Evidence of poisoning.* 4. *Rules for medico-legal examination in cases of poisoning.* 5. *General observations in explanation of the plan of the succeeding chapters.* 6. *Classification of poisons.*

MODE OF ACTION OF POISONS.

The action of poisons is two-fold, *local* and *remote.*

The *local* action of poisons may consist in *corrosion*, or chemical decomposition, as when a concentrated mineral or vegetable acid, or a pure alkali, or a corrosive salt, is applied externally or taken internally: in *irritation* or *inflammation*, in various degrees, and followed by the several terminations of suppuration, ulceration, or gangrene, as from the application of arsenic, tartar emetic, cantharides, &c.: and lastly, in an effect on the nerves of sensation or motion; thus the chewing of monkshood produces numbness and tingling of the lips and tongue, and the vapour of prussic acid of the skin with which it is brought into contact, while opium, ticunas, and prussic acid, paralyze the muscles to which they are directly applied.

The *remote* action of poisons is of two kinds, *common* and *specific:* the first resembling the effect of other forms of severe injury inflicted on the same part, and varying in intensity with the amount of that injury; the last being peculiar to the poison itself. Thus, arsenic taken into the stomach, and coming in contact with the mucous membrane of the alimentary canal, gives rise to those severe cramps in the extremities which are present in all acute inflammations of the lining membrane of the stomach and bowels, however produced; but the same poison applied to the skin or inhaled by the lungs excites inflammation of the mucous membranes with which it does not come

into immediate contact. This is its specific action. Again, oxalic acid acts on the mucous membrane of the stomach and bowels as a corrosive, and excites inflammation around the parts of the membrane which it has destroyed. This destruction and consequent inflammation are attended with the same constitutional shock, which accompanies all severe local injuries; but besides this, it has a remote *specific* effect on the brain and spinal cord, producing apoplexy or tetanus.

This two-fold remote effect of poisons is distinctly displayed in the different ways in which death takes place in different cases of poisoning by the same substance. Thus, in rare cases of poisoning with arsenic, death is occasioned by a severe shock to the nervous system. In other and more numerous instances, the same substance excites in the mucous membrane of the intestinal canal an inflammation so severe as of itself to prove fatal. In others, again, the substance being absorbed, produces an inflammatory state of the entire system, and thus destroys life. There is also a fourth class of cases in which the nervous system is chiefly affected. The majority of cases is compounded of all these elements. The same remarks apply to oxalic acid, which sometimes proves fatal by inducing a mortal faintness, the result of a severe shock to the nervous system, at others by producing apoplexy, or tetanus. The purest example of a remote constitutional effect of a common kind is to be found in the mineral acids, which, by the local destruction they occasion, give rise to the common symptoms of collapse; extreme debility, faintings, imperceptible pulse, cold extremities, and death.

A knowledge of the *specific* remote action of poisons is of the first importance, as it often enables us to judge of the particular poison which has been taken. Tobacco, upas antiar, the active principle of hemlock, and digitalis, paralyse the *heart*; and this is among the effects of arsenic and oxalic acid. Tartar emetic excites inflammation of the *lungs;* and this is an occasional effect of other poisons. The narcotic and narcotico-acrid poisons affect the *brain ;* and so also may arsenic and oxalic acid. Nux vomica, and the several plants of which strychnia is the active principle, affect the spinal cord, producing violent attacks of tetanus; and oxalic acid sometimes has the same action. Arsenic causes inflammation of the mucous membranes, mercury attacks the salivary organs and mouth, cantharides the bladder, manganese the liver, (and this is an effect of copper,) chromate of potass the conjunctiva of the eyes, iodine the lymphatic glands, lead the muscular system generally (and this, too, is an occasional effect of arsenic), and spurred rye produces gangrene of the limbs.

In the case of some of these poisons, one part only is affected, but others attack almost every important organ of the economy. The most striking example of this kind is arsenic, which, besides producing inflammation in the parts with which it comes in contact, affects the mucous surfaces of all the viscera, as well as the organs of circulation, respiration, and innervation ; and all these effects may be exhibited

in the same case. Oxalic acid and mercury produce similar complications.

It is usual in works on Toxicology to discuss at some length the mode in which poisons act, and although this question is not of great practical utility, it may be well to examine it briefly in this place.

There is abundant proof of the absorption of poisons, and their consequent circulation through the system. Experiments on animals have shown that this takes place in whatever manner the poison is applied to the body; and the results of such experiments have been confirmed by the analysis of the blood and secretions, and even of the solid textures. The list of the poisons thus detected includes almost every substance which can be recognised by its odour or colour, or which, not being decomposed by the animal fluids or textures, can be submitted to chemical reagents.

The bare fact of the absorption of poisons is too generally known and admitted to require additional proof or illustration; but the question arises—Is it in consequence of absorption that poisons prove fatal? Is absorption necessary to the action of poisons?

As the greater number of experiments which have been made in illustration of this question have consisted in the introduction of poisons into wounds, it may be well to consider by themselves the arguments derived from this mode of introduction. In the first place, it has been satisfactorily shown, that poisons so introduced do not act on the nerves of sensation or volition, for their action is not impaired by the previous division of the nerves supplying the part into which the poison is introduced, and they continue to take effect even when, as in Majendie's well-known experiment, the poisoned limb is connected with the body only by quills introduced into its large vessels.* Again, a division of the spinal marrow does not prevent the action of those poisons which prove fatal by attacking that part,† and the direct contact of poisons with the substance of the brain itself has been found to be unattended with their usual effect.

We have, therefore, all the evidence which can be required to prove that it is not by any direct effect on the nerves of sensation or volition, that poisons prove fatal.

But the introduction of poisons into wounds is only one way in which they gain admission into the body. It is necessary, then, to inquire how poisons which have been swallowed produce their effects. Is absorption necessary to their fatal action? Two experiments performed by Mr. Blake prove this necessity as strongly as in the case of poison inserted into wounds. In the first experiment, prussic acid introduced into the stomach through an opening in its parietes pro-

* For proofs of these positions, and for exact references to authors, see Christison on Poisons, 3d edition, p. 9.

† See an experiment with prussic acid in an Essay on the operation of poisonous agents upon the human body, by Thomas Addison, M.D., and John Morgan, F.L.S., &c., p. 25.

duced no effect, so long as the vessels entering the liver were secured by a ligature, but began to act within one minute after its removal. In the second, the aorta having been secured by a ligature immediately above the origin of the arteries supplying the abdominal viscera, and the vena portæ having also been tied close to the liver, an opening was made into the latter vessel. On the removal of the ligature from the aorta, the blood would be distributed as usual to the viscera and to the nerves supplying their coats. Five grains of woorara dissolved in four drachms of water, were then injected into the cœliac axis and mesenteric arteries, and the ligature was removed from the aorta. Seven minutes, however, elapsed before the slightest symptom of the action of the poison manifested itself, and the animal did not die until fifteen minutes after its introduction. During all this time the blood which flowed from the vena portæ was escaping into the cavity of the abdomen, whence a portion of the poison must have been absorbed and carried into the circulation.*

It appears, then, that poisons, whether inserted into wounds or introduced into the stomach, produce their fatal effects in consequence of absorption, and that, where absorption is altogether prevented, these effects do not occur. The question now arises—In what manner do poisons, introduced into the blood and circulated through the system, produce their fatal effects? On what part and on what tissue do they act?

It is plain that all poisons do not destroy life in the same way. Some paralyse the heart, others produce fatal convulsions, and others, again, directly act upon the lungs, and give rise to asphyxia. These different modes of death can only be accounted for in one of two ways,—the poison must be conveyed with the blood to the organ affected, or some powerful influence must be transferred to that organ from the nerves distributed to the coats of the blood-vessels themselves. The latter supposition seems, in the highest degree, improbable; for in the second experiment of Mr. Blake, already referred to, the poisoned blood continued to traverse both the arteries and veins of the abdominal viscera for several minutes before any effect manifested itself, and in all the experiments in which the effects of poison have been suspended by ligatures applied to the arteries or veins of a poisoned limb, blood imbued with the poison must have been in contact with the coats of the vessels.

The experiments of Morgan and Addison, which seem, at first sight, to prove this mode of action of poisons, and which served to convince the authors of the soundness of this theory, are evidently quite inconclusive. The experiment on which they lay the greatest stress, is, that in which a poison having been introduced into the jugular vein between two ligatures, the upper ligature was removed, so that the poison could not directly enter the circulation, and yet

* See the experiments more at length in Mr. Blake's Essay in the Edin. Med. and Surg. Journal, vol. liii., p. 45.

its effects manifested themselves in so short a space of time as 108 seconds. Now it is clear that this is in all respects but one, the parallel of the well known experiment of Vernière, in which a ligature applied to the leg so as to stop the venous but not the arterial circulation, by preventing absorption prevented the action of the poison inserted in the foot, but blood drawn from the vein below the ligature, and introduced into the circulation of another animal proved fatal. In both experiments the direct passage of the poison into the circulation is prevented; but in the one case no effect is produced, in the other the animal dies. The difference between these two cases is this, that in the former there is a direct, while in the latter there is only a circuitous, access to the circulation. The poisoned blood contained in the vein above the ligature gradually contaminates the blood which is flowing through the first anastomosing vein, and thus the substance is carried into the circulation. Other objections to the conclusions drawn by Morgan and Addison from their experiments might be advanced, and have been urged by others, but those now mentioned seem decisive.

There remains, then, but one explanation of the action of poisons when once introduced into the blood-vessels, viz., that they are carried with the blood to the organs on which they act; some by the coronary arteries to the heart, which they paralyse, others to the brain and spinal marrow, exciting fatal tetanic spasms, and a third class to the lungs, causing an excessive secretion from the mucous membrane, and consequent asphyxia.

We owe the decision of the difficult question of the *modus operandi* of poisons to the ingeniously contrived and carefully performed experiments of Mr. Blake. Having provided a delicate measure of the condition of the circulating system by inserting into the femoral artery of the animal to be experimented on the hæmadynamometer of Poiseuille, he proceeded to ascertain the time required for the circulation of poisons from one part of the system to the other. This he effected chiefly by introducing various substances, previously known to paralyse the heart, directly into the vessels, and, by means of the instrument noting the instant of time at which the first effects of the poison manifested themselves, and at which the heart ceased to beat. Without entering into a minute account of the experiments themselves, it may suffice to state, that, in the dog, the time required for a poison to pass from the jugular vein to the lungs was four seconds, or from four to six seconds; from the jugular vein to the coronary arteries of the heart seven seconds; from the jugular vein to the carotid artery five to seven seconds, and from the aorta to the capillaries, four seconds. A poison introduced into the jugular vein was distributed through the whole body in nine seconds. In the horse, the time required for the completion of the circulation was from twelve to twenty seconds, or somewhat less than the time (twenty-five seconds) deduced by Hering of Stuttgardt, from his experiment.

Assuming that the time required for the complete circulation of a poison through the body of a dog is nine seconds, it follows that if it can be shown, that poisons applied to the tongue of the same animal do not act in so short a space of time, absorption may take place, and the blood may be distributed to the organ on which it produces its fatal effects. Now, in Mr. Blake's experiments, strong hydrocyanic acid applied to the tongue of a dog did not begin to act till eleven seconds, and did not prove fatal till thirty-three seconds ; and when a tube was previously introduced into the larynx, so as to prevent the vapour of the acid from entering the lungs, the first appearance of the symptoms was after sixteen seconds, and death took place in forty-five seconds. In like manner, nicotina, the essential principle of tobacco, applied to the tongue of the same animal, did not prove fatal till twenty seconds. It follows from these experiments, that the theory of the necessity of absorption to the fatal action of poisons is perfectly tenable, and, in all probability, must be regarded as the true one. Some authors have attributed to prussic acid a much more prompt action, and have related instances of marked effects induced instantaneously, with the rapidity of lightning, in three seconds, &c. ; and Christison states, that, in one of his experiments, an animal was killed outright in four seconds.* Though this is a shorter time than in the experiment of Mr. Blake, it is quite reconcilable with the supposition of the rapid absorption of the vapour by the lungs, and its equally rapid transit to the right side of the heart.

The theory, then, of the absorption of poisons, and their application by means of the blood to the organ on which they produce their fatal effect, is one firmly established by experiment, and, probably, admitting of universal application. In order to prove the possibility of an immediate effect upon the nerves, independent of absorption, it would be necessary to guard against the access of the poison to the lungs ; and if, after this precaution, the effects should be found to manifest themselves in less than three or four seconds, the possibility might be admitted. Till such an experiment has been performed, the theory of absorption must be held sufficient to explain the fatal effects of poisons, and the theory of the action of poisons by sympathy, or, in other words, through an influence directly communicated by the nerves, must be rejected. This theory of absorption finds a practical application in the use of ligatures and cupping-glasses in preventing the effects of poisons inserted into wounds.

CAUSES WHICH MODIFY THE ACTION OF POISONS.

There are three ways in which the action of poisons may be modified. 1. By the quantity and form in which they are administered. 2. By the part of the body to which they are applied; and 3. By the condition of the body itself.

* Treatise on Poisons, p. 7.

1. *Quantity and Form of the Poison.—Quantity.* Cæteris paribus, the larger the quantity of a poison the more severe its effects. But the effect of some poisons varies in kind as well as in degree with the quantity taken. This is especially the case with arsenic and oxalic acid. A small dose of arsenic will cause inflammation of the stomach, a large dose may merely affect the heart; oxalic acid in a large dose may corrode the stomach, in a smaller dose it may affect the heart, the spinal marrow, or the brain. *Form.*—Under this head will have to be considered,—*a. The State of Aggregation. b. The Chemical Combination*, and *c. The Effect of Mixture.*

a. The State of Aggregation.—Poisons act more energetically in a state of solution than in a solid form, because, in the former state, they are more readily absorbed. For the same reason soluble poisons are, *cæteris paribus*, much more active than those which are sparingly soluble. But solution not only renders poisons more active, it also contributes to modify their effects; of this oxalic acid is a remarkable example.

b. Chemical Combination.—As a general rule, substances which have a purely chemical action, as the mineral acids and the alkalis lose their active properties when in combination. The resulting substance obtains new properties, and is more or less active as it is more or less soluble. Poisons, whether acids or bases, which have a specific action, retain that action in their soluble combinations. Thus all the soluble salts of morphia have the same action, and all the soluble compounds of oxalic, hydrocyanic, and arsenious acid affect the system in the same way.

c. Effect of Mixture.—All admixtures which render a poison more soluble render it more active. All other admixtures have a contrary effect. Thus acids increase the activity of opium and the salts of copper, water of arsenic. Mucilaginous substances, on the other hand, partly by protecting the coats of the stomach, and partly by involving the poison, if in substance or in powder, retard or prevent its action. Food taken before or with poison has the same effect. Hence the frequent escape of those who have taken very large doses of arsenic. Poison mixed with food is similarly affected by the character of the food. Thus arsenic given in a solid dumpling would manifest its effects much more slowly than if taken in porridge, and in this latter case than if mixed with tea, beer, or water. We avail ourselves of the protecting effect of admixture with mucilaginous substances in the treatment of cases of poisoning.

2. *The Part to which the Poison is applied.*—The effect which the same poison has on different parts of the body is directly as the absorbing power of those parts. Thus poisons act more promptly when injected into a vein; next in degree when introduced into a wound; the serous surfaces hold the next place; then the stomach; and, last of all, the unbroken skin. Poisons introduced into the lungs, whether in a fluid or a gaseous form, act with nearly as great rapidity as when

introduced directly into the circulation. It is a remarkable fact, that even those poisons which most strikingly affect the nervous system do not act when applied directly to the brain, spinal marrow, or trunks of the nerves. Many animal poisons, which, as a class, are readily decomposed, have, as might be anticipated, no effect on the stomach, though the smallest quantity introduced into the skin proves certainly fatal. Thus the poison of the viper or mad dog may be swallowed with impunity.*

3. *The Condition of the Body itself.*—Under this head will have to be considered,—*a. Habit. b. Idiosyncrasy. c. Disease.*

a. Habit.—This has the effect of diminishing the influence of poisons derived from the vegetable kingdom, but of increasing that of mineral poisons. Thus, while opium, alcohol, and tobacco lose their effect by repetition, and may be taken at length in doses which would poison a man not accustomed to their use, arsenic and the preparations of mercury produce more effect the longer they are taken. To this general rule, however, there are marked exceptions; for, on the one hand, digitalis and strychnia, like arsenic and mercury, have a comulative effect; and, on the other hand, the less deadly mineral poisons, such as zinc and antimony, may be taken by healthy persons in continually increasing doses. It must be borne in mind, however, that even those substances to the action of which the system most readily adapts itself, produce permanently injurious effects on the system. Thus, alcohol causes disease of the lungs, liver, kidneys, and brain; tobacco, however frequently repeated, still excites the circulation, and opium raises the spirits, and gives increased activity to the mind.

b. Idiosyncrasy.—There are three ways in which individuals differ from each other, or from the majority of their fellows. 1. They are affected in a greater or less degree than is usual by a substance which produces the same effect in them as in other men. Thus, a few grains of mercury shall salivate one man, but as many drachms or ounces shall not affect another. The same remark applies to arsenic. A child, too, shall bear a larger quantity of mercury than an adult; probably because his functions being more active, the substance is sooner removed from the system by the secretions. 2. A substance which, in the majority of persons, produces one given effect, shall in an individual act in a very different manner. Thus, common Epsom salts have been known to act like opium, and opium to have a purgative effect. Lastly, a simple article of diet, which has no more action on most men than any other food that they take, shall act like a poison on the stomach of a few individuals. Thus, certain kinds of fish and vegetables, and even common butcher's meat, act like irritant poisons on some persons. Even mutton has been known to act invariably in this way.

* For more detailed information on this and other subjects of a general nature, see Christison on Poisons, Part I.

c. Disease.—This, like habit, generally renders the body less susceptible of poisons. Thus, persons reduced to extreme weakness are scarcely affected by stimulants which would overpower the strong, and this is seen even in healthy persons in the increased tolerance of spirits towards the after-part of the day, when the body is comparatively weak. In continued fever, there is increased tolerance of mercury; in severe dysentery, cholera, and hæmorrhage, of opium; in all the more severe affections of the nervous system, as tetanus, hydrophobia, delirium tremens, mania, &c., there is increased tolerance of almost every remedy, but especially of the narcotic poisons. The only exception to the general rule here laid down is in the case of poisons which tend to produce conditions of system similar to those actually existing. Thus, the irritants would increase gastritis, diarrhœa, or dysentery; and the narcotics exasperate a determination of blood to the brain.

Besides these three principal modifying causes, there is one condition of system which deserves mention as tending to diminish the operation of poisons, viz. sleep. This is too obvious to require any comment, as in this state all the functions are carried on more slowly, and all effects on the system must of necessity be less severe. On the same principle, substances which produce sleep being administered with or before other poisons, must weaken or counteract their effects; opium, for example, when given with arsenic not only masks the symptoms proper to that poison, but appears to retard its operation.

EVIDENCE OF POISONING.

Under this head it is proposed to examine very briefly the chief circumstances which would lead us to believe that an illness or death, accompanied or preceded by suspicious symptoms, was due to poison, using the term poison in a general sense. There are four such circumstances. 1. The symptoms. 2. The post-mortem appearances. 3. Experiments on animals. 4. Chemical analysis. 5. Circumstantial evidence.

1. *The Symptoms.*—The following circumstances are mentioned as characteristic. They make their first appearance suddenly, in a person in good health, and soon after some substance has been swallowed; and they increase rapidly and uniformly towards a fatal termination.

The *sudden appearance of the symptoms* affords a slight presumption in favour of poisoning, for, when administered, as poisons commonly are in criminal cases, in large doses, the symptoms soon show themselves. But, on the other hand, when given in small and repeated doses, the invasion of the symptoms is often gradual. It must also be recollected that many diseases occur suddenly. This may be the case with the plague, with the more severe forms of continued fever, in acute attacks of inflammation of the stomach and bowels, in perforation of the stomach or intestines, in organic diseases of the heart, in apoplexy,

&c. The objection from the sudden occurrence of epidemic diseases is of course readily overruled by the ascertained absence of such diseases in the neighbourhood in which the suspected case occurs; and by taking the character of the symptoms into account, the probability derived from the suddenness of their invasion may be strengthened.

The probability which attaches to the *occurrence of the symptoms in a person in good health*, is also extremely slight; for, on the one hand, this character is absent in all cases of slow poisoning, and where poison is given to an invalid; and, on the other, many acute diseases make their attack without any previous impairment of health.

The appearance of the symptoms soon after some substance, as food, drink, or medicine, has been swallowed, affords a somewhat stronger presumption. This happens in the case of all the more active poisons when given in large doses, especially if the poison be very soluble. The less soluble poisons, such as arsenic, even when given in large doses, may not act so speedily, especially if immediately followed by sleep naturally or artificially induced. On the other hand, it must be borne in mind, that vomiting and other symptoms of indisposition often manifest themselves after a meal containing no unwholesome substance, that apoplexy may follow a full meal, that rupture of the stomach, when its coats are softened by previous disease, would naturally take place while the organ was distended with food, that English cholera often follows unripe fruits, putrid meat, or other unwholesome ingesta, and that a large draught of cold water, swallowed while the body is heated, may produce instant death.

The probability derived from the symptoms occurring soon after a meal will be greatly strengthened by other persons who may have partaken of the same meal being similarly affected; but, at the same time, the absence of such effects must not be looked upon as satisfactory negative proof, inasmuch as the person in whom the symptoms have manifested themselves may have partaken of some dish or part of a dish, or of some wine or drink which the others may not have tasted.

A suspicion of poisoning is often raised on very slender grounds, and in such cases the fact, that no food or other substance has been taken for hours before the commencement of the symptoms may serve to prove the suspicion groundless. Thus the popular suspicion, that the Crown Prince of Sweden, who suddenly fell from his horse while reviewing a body of troops, 28th May, 1810, and died in half an hour, was poisoned, was rebutted by the fact, that the Prince had not taken food for four hours previous to his death—a fact quite incompatible with the action of any poison to which the death could be attributed. In another case examined by Dr. Christison and Mr. Newbigging, the suspicion of narcotic poisoning was shown to be groundless by the fact, that no food had been swallowed for five hours.* It must not, however, be

* Christison on Poison, p. 49.

too hastily assumed that, because no food or medicine has been swallowed for some hours before the appearance of symptoms which give rise to a suspicion of poisoning, therefore the person does not labour under the effects of poison, for poisons have been introduced into the body by the anus or vagina, or by the external meatus of the ear, and they have been poured down the throat during sleep. The possibility of such occurrences should be borne in mind.

Some stress has been laid upon the *rapid and uniform increase of the symptoms* as evidence of poisoning. This criterion is extremely fallacious, for in many cases of poisoning there are marked remissions and exacerbations, and in many acute diseases rapid and uniform progress towards a fatal termination. The effects of many of the poisons, again, are to the full as variable in degree and kind as the symptoms of a natural disease. Arsenic and oxalic acid are familiar examples of this kind.

Each of the characteristics now mentioned is, therefore, to be received with caution, and in actual practice will require to be accurately weighed. The joint occurrence of two or more of them will strengthen the probability; and the coincidence of all of them, though not decisive, would justify a strong suspicion. Thus, if a person in perfect health, soon after taking food or medicine is attacked with severe and continued disorder of the alimentary canal, a suspicion would naturally arise that the food or medicine had contained some poisonous substance, and this suspicion would be greatly strengthened if other persons, who had partaken of the same food, were similarly affected. The poison may have been added to the food, or the food may itself have had poisonous qualities; but the probability of poisoning in one of these two ways is very strong. If the case should terminate fatally, post-mortem appearances, corresponding with the symptoms during life, would greatly strengthen the presumption.

2. *The post-mortem appearances.* The evidence from post-mortem appearances is less decisive than that afforded by the symptoms. There are certain poisons which inflame the alimentary canal, and accordingly such inflammation forms a presumption of the administration of poison. There are others, again, which corrode the parts to which they are applied, and hence marks of corrosion would give a still stronger probability of poisoning; and in the case of the sulphuric and nitric acids, the colour superadded to the corrosion, not merely furnishes evidence that some corrosive substance has been introduced into the stomach, but points out at once what that substance is. The corrosive and irritant poisons, then, leave marked traces of their action, and raise a presumption to be rebutted or confirmed by the history of the case, and by a comparison with the effects of disease —the action of the corrosives with ulceration from natural causes, that of the irritants with common inflammation, however produced. The value of this presumption will have to be considered under the head of irritant poisons.

There is another class of poisons which combines the effect of the irritant with that of the narcotic poisons, and as some of these substances produce considerable inflammation in the alimentary canal, the general presumption of poisoning drawn from such appearances will include this class.

The post-mortem appearances due to the narcotic poisons and narcotic principles of the narcotico-acrids are not so strongly marked or so different from those present in many other forms of death as to give even a slight presumption.

The negative evidence from post-mortem appearances has the same force with the positive evidence. Thus the absence of corrosion in alleged cases of poisoning by corrosives would serve to disprove the charge; the absence of inflammation after the alleged administration of an irritant or narcotico-irritant poison to render the charge highly improbable; and the absence of congestion of the brain in a case of imputed narcotic poisoning would afford a lower presumption against the exhibition of such a poison.

Formerly much importance was attached to an unusual blackness or lividity of the skin, but there is no evidence that in cases of poisoning there is more lividity than in other cases of sudden or speedy death. The same remark applies to the speedy occurrence of putrefaction as evidence of poisoning. It is not probable that this process occurs more promptly after death from poisoning than after other forms of sudden death, and it is now well known that some of the mineral poisons, for instance arsenic and corrosive sublimate, preserve the parts with which they are in contact.

The discovery of post-mortem appearances similar to those produced by poison, even though confirmed by the discovery of the poison itself, does not prove that death has been caused by poison, for death may be produced by some other cause before the poison has had time to prove fatal. On the other hand, we may discover extensive morbid changes due to a natural cause, or severe external injuries, and yet death may really have been occasioned by poison. Thus Christison quotes, from Rust's Magazin, a case of poisoning by prussic acid, in which there was extensive consolidation of the left lung; a second, of poisoning by hemlock, in which the right lung formed one entire abscess; and a third, of death from excessive drinking, in which the whole left lung was similarly affected.* The same author quotes a case from Wildberg, in which death was attributed to a severe chastisement, but really due to arsenic; and a second, in which the cause of death was thought to be a penetrating wound of the chest, but was proved to be nitric acid.† These cases enforce the caution insisted on at page 280, under the head of post-mortem inspection, viz., to submit every part of the body to careful examination.

The post-mortem appearances might become important if poison

* Evidence of General Poisoning, p. 53. † Ibid. p. 55.

were introduced into the body after death, with a view to inculpate an innocent person. In such cases the absence of the characteristic appearances produced by the poison would enable us to frustrate the malicious purpose.

The post-mortem appearances, then, furnish independent evidence in the case only of one or two poisons; in other instances they are useful by confirming the presumption drawn from the symptoms or moral evidence, or in invalidating a charge prompted by malice, or springing out of an imperfect examination.

3. *Experiments on animals.*—There are many considerations which affect the value of the evidence derived from this source. Poisons are alleged not to produce the same effect upon animals as upon the human subject, and many examples of this difference have been put on record. They also require to be given in quantities altogether disproportionate to the difference of size. To this objection there is the obvious answer, that the animals to which poisons are likely to be given, intentionally or accidentally, are the domestic animals, especially the dog and cat, which, as has been abundantly proved, are similarly affected with man by all the poisons in common use. The above objection, then, even admitting it to go to the extent to which it is alleged to hold good, is not likely to find place, whether the poison has been swallowed accidentally, or administered intentionally.

In many cases of both kinds the objection has been obviated by the fact, that the poison has produced its characteristic effects upon more than one kind of animal. Thus in the case of Mary Bateman, accused of poisoning, a portion of the pudding and the honey, supposed to have been poisoned, caused violent vomiting in a cat, killed three fowls, and proved fatal to a dog in four days, with symptoms of irritation of the stomach, such as were observed in the people who died. On the other hand, in another case quoted by Christison, the absence of all the usual effects of poison in a dog, a cat, and a fowl, fed with the suspected substance, was held to furnish the strongest presumption against poisoning.*

Another objection to the evidence drawn from experiments on animals, applies to those cases in which the substance administered to the animal has been previously rejected from the human stomach, or collected from the stomach and intestines after death: viz., that the animal secretions may be so vitiated as to prove poisonous. This objection is supported by the well-known experiment of Morgagni, in which bile taken from the stomach of a child who died in convulsions from tertian ague, mixed with bread and given to a cock caused convulsions and death in a few minutes, and the same effect followed in two pigeons inoculated with this same substance.† It is obvious that this objection applies in strictness only to cases in which the contents of the stomach and intestines, when swallowed by animals have

* Christison, on Poisons, p. 68.
† De Sedibus et Causis Morborum.

proved fatal ; and such an event would probably be of rare occurrence. Evidence of this kind would derive strong confirmation from the similarity of the symptoms produced in the animals to those that had occurred in the case which had suggested the experiments.

Experiments with substances rejected from the stomach, or found there after death, are open to another obvious objection, namely, that the substances themselves may contain either no poison at all, or so small a quantity of it as not to produce any effect when given to an animal, the poison having either been decomposed, or previously rejected. This objection is too obvious to require illustration, and it is evidently a valid one. That the poison may not be thrown off the stomach of the animal itself by vomiting, it has been recommended to introduce it through an opening in the gullet, and to apply a ligature beneath the opening. The operation itself does not occasion any serious symptom till after the lapse of four or five days, so that the effect of the poison is not interfered with.

In the case of the greater number of poisons the necessity of experiments on animals is altogether superseded by the much higher certainty which attaches to chemical analysis ; but as the tests for some of the vegetable poisons are uncertain, such experiments, performed with care, are valuable, and have been admitted as evidence.

Experiments on animals have also been resorted to, in order to determine some physiological questions raised in cases of poisoning ; such as, the shortest time within which a dose of prussic acid may prove fatal. When used for this purpose, it should be borne in mind, that whatever animal we may select for experiment, we cannot obtain any precise information as to doses, or the time required to produce a fatal effect. Our reasonings upon such data are merely analogical.

4. *Chemical Analysis.*—This form of evidence, though not absolutely necessary, when the symptoms, post-mortem appearances, and moral evidence confirm each other, is of the very first importance. The evidence is most conclusive when the poison is found in the blood secretions or viscera of the body, for to this there is no objection. It is of somewhat less force when discovered in the contents of the stomach and intestines after death, inasmuch as there is a *possibility* of poison being introduced into those parts after death ; but the presence of characteristic symptoms or post-mortem appearances would render such an objection untenable. A somewhat less degree of importance, again, attaches to the detection of the poison in the substances rejected from the stomach or voided by the bowels, unless the possibility of the poison having been added to these substances out of the body has been carefully guarded against. The discovery of the poison in articles, whether of food or medicine, of which the sufferer has partaken, is open in a greater degree to the last objection, which also applies to substances found in the possession of the accused.

It may be well to state briefly the objections which may be urged against the evidence drawn from chemical analysis, on each of the

two suppositions, that poison has been detected, and that it has not been detected.

On the supposition that a poison *has been found* in any of the substances specified, there is the one objection, that it may have been accidentally mixed with it, or fraudulently, in order to inculpate an innocent party. In this case the evidence must be supported by proof that this could not have happened.

On the other hand, supposing poison *not to have been found* in any of the several substances submitted to analysis, it does not follow that a poison has not been taken. For in the case of food supposed to contain poison, and being part of a meal, followed by symptoms of poisoning, the articles submitted to analysis may not contain the poison, while some substance not supposed to contain it may have been adulterated with it. Again, the portion of a poisoned dish submitted to analysis may not contain any poison, though other parts of it do. Thus, the poison may be in the gravy, and not in the meat itself, or sprinkled only on the outside of the joint. On the supposition that the substance submitted to analysis consists of the contents of the stomach and intestines, we may fail to detect the poison for many reasons. It may have been rejected, or evacuated, absorbed, decomposed, or evaporated ; or it may belong to that large class of vegetable poisons which we have not yet found the means of discovering with certainty. The poison is most likely to be rejected or evacuated when it belongs to the class of irritants, absorbed when it is in a fluid state or soluble, decomposed when it belongs to the animal or vegetable kingdom. Insoluble substances, or those that are sparingly soluble, such as arsenic, may often be detected in the stomach and intestines after repeated vomiting and purging, for they adhere as powder to the mucous coat, and are enveloped by the tenacious secretion thrown out about them in consequence of the inflammation to which they give rise.

In cases of disinterment, poison, though it may have been the cause of death, and may have existed in the body at the time of death, may exude through the textures, or be evaporated, or so completely decomposed, that no trace of it is to be found. This observation does not apply to the mineral poisons, in a solid form, for though they may undergo change in consequence of the decay of the textures, they are merely transformed but not destroyed. Thus arsenious acid may combine with the nascent sulphuretted hydrogen given off during the decomposition of the stomach, and be converted into the yellow sesquisulphuret of arsenic, and corrosive sublimate may by the mere contact of the mucous membrane be converted into calomel, or pure mercury. Among the animal poisons, cantharides, and, among vegetable poisons, opium, may be mentioned as undergoing little change from the decay of the textures.

5. *Circumstantial Evidence.*—With the circumstantial or moral evidence of poisoning the medical man is only indirectly concerned ;

but, as many of the circumstances which raise or strengthen a suspicion of poisoning may derive much of their value from the evidence of the medical witness, the subject is deserving of a brief notice in this place. Of the points usually enumerated, the following are those concerning which the medical witness is most likely to be consulted:—*a.* Circumstances which tend to prove the administration of poison, either alone, or mixed with food, drink, or medicine. *b.* Circumstances which throw light on the intent with which the poison was given. *c.* The simultaneous illness of other persons who have partaken of the poisoned substance.

a. Circumstances which tend to prove the Administration of Poison, either alone, or mixed with food, drink, or medicine.—From the very nature of the case it is obvious that direct proof of the administration of poison is not to be expected; but chemical analysis may serve not only to prove that a poison has been given, but assist in fixing the charge of poisoning upon the guilty party. An interesting case of this kind is given by Christison on the authority of Dr. Alison. The poison (arsenic) was contained in a bowl of porridge. The chemical analysis showed that the poison was not mixed with the store of meal, but with the meal which had been used in making the porridge off which the deceased female had breakfasted. Other circumstances concurred to prove that the poison must have been mixed with the meal in the morning before any stranger entered the house. The husband was convicted of the murder. An instance of an opposite description is quoted by the same author from Barruel, where the arsenic was found mixed with a large mass of flour, of which a part only had been used in making bread. It was probable, therefore, that the admixture was accidental, inasmuch, as the poison was not likely to be mixed, with a criminal intent, with so large a portion of the flour. It appeared likely that the wheat had been intended for seed, and sent by mistake to the mill, the arsenic having been mixed with the seed to destroy insects.*

In the case of the corrosive poisons, the examination of the clothes of the suspected murderer has sometimes led to his conviction. A case of this kind, in which nitric acid was the poison administered, is related by M.M. Ollivier and Chevallier.†

In cases of alleged poisoning, the medical man may often clear the character of an accused party, and show that poison has not been administered, by comparing the symptoms which are stated to have been present with those of poisoning in general, or of any particular poison which is said to have been given. Chemical analysis may also serve the same purpose, by proving the absence of poison from any substance with which it is alleged to have been mixed. An interesting case of this kind is quoted by Dr. Christison, on the authority of Chevallier.‡

* Christison on Poisons, p. 75.
† Archives Générales de Médicine, xxi. 364.
‡ Journal de Chimie Médicale, vi. 149.

b. Circumstances which throw light on the intent with which the Poison was given.—A very important application of chemical analysis to the detection of crime consists in the accurate determination of the quantity of poison existing in the several substances submitted to analysis. Of this the two following cases are excellent examples :

Mr. Hodgson, a surgeon, was tried at the Durham assizes, in the autumn of 1824, for attempting to poison his wife. It was proved that the prisoner had substituted corrosive sublimate for calomel and opium in pills, prescribed by her physician. This he attributed to a mistake committed while he was intoxicated. It was also proved that a laudanum draught, also ordered by her physician, contained corrosive sublimate. This also the prisoner attributed to a mistake ; alleging that he had mistaken for the water-bottle an injection of corrosive sublimate which he had previously prepared for a sailor. This assertion was disproved by the chemical analysis of the draught and the injection, the former of which was found to contain fourteen grains to the ounce, while the latter contained only five grains to the ounce.*

The second case is that of Samuel Whalley, who was indicted at York Spring assizes, in 1821, for maliciously administering arsenic to Martha King, who was pregnant by him. In this case, in addition to other contradictory statements, it appeared that of the tarts in which the arsenic was alleged to have been administered, the portions eaten could not have contained more than ten grains, while the matters alleged to have been vomited, contained even after repeated attacks of vomiting, fifteen grains.†

c. The Simultaneous Illness of other Persons who have partaken of the poisoned substance.—Much importance attaches to this part of the circumstantial evidence, and the medical man is often in a position to throw much light upon it. The fact that several persons are similarly affected after partaking together of the same food is not readily accounted for on any other supposition but that of poisoning. But it must be borne in mind, that the poisonous substance may be in the food itself, and not necessarily mixed with it either by accident or design ; for several kinds of spoiled provisions act as poisons. It is only, therefore, when the symptoms of poisoning are highly characteristic, that they can be certainly attributed to some substance accidentally or intentionally mixed with the food. Thus in two remarkable cases of poisoning by arsenic (that of the Mitchells,‡ and the family poisoned by Eliza Fenning)§ though the simultaneous attack of the parties who had partaken of the poisoned meal, was strong evidence of poisoning, the peculiar symptoms which followed showed that that poison was arsenic.

* For a full report of this interesting case see the Edin. Med. and Surg. Journal, vol. xxii. p. 438.

† Ibid. vol. xxix. p. 19.

‡ Ibid. vol. xviii. p. 166.

§ Marshal's Remarks on Arsenic, &c.

As the simultaneous attack of several persons by any disease, altogether independent of some injurious substance in the food which they may have eaten, is a coincidence of the very rarest occurrence, this is justly accounted one of the most convincing points of the circumstantial evidence. Thus, the death in one night of four of the eight peers selected to represent the Scottish nation at the nuptials of Queen Mary with the Dauphin of France, in 1558 (Lord Fleming at Paris, Bishop Reid, the Earl of Rothes, and the Earl of Cassilis at Dieppe) very naturally gave rise to a suspicion of poisoning; especially as the refusal of the Scottish deputies to grant the crown matrimonial to the bridegroom had given great offence to the French court.*

None but epidemic diseases of the more severe kind are likely to attack several persons at the same time. It may be doubted even whether Asiatic Cholera, in any one instance, seized two or more members of a family so nearly at the same time as to give rise to a suspicion of poisoning. The only other diseases which are known to occur simultaneously, or at about the same time in several persons, are convulsive disorders, and these are generally confined to females.

The attack of several persons by severe symptoms at or about the same time, and soon after a meal of which all have partaken, may, therefore, be considered as the strongest possible presumption of poisoning either by the food itself, or by some accidental or intentional admixture. If the symptoms are those of simple irritant poison, it will not be possible to determine by the symptoms alone which alternative is the true one; but they may happen, as in the cases referred to, to be so characteristic as at once to point to the very poison which has been administered. On the other hand, it does not follow that a poison has not been mixed with food of which several persons have partaken, because one only of those persons is affected; for the poison, as has been already stated, may be in one dish, or part of a dish, or in some liquid of which the poisoned person alone has partaken.†

The other items of circumstantial evidence.—The suspicious conduct of the accused, before, during, and after the illness or death of the deceased; his knowledge or experience of poisons and their properties; the possession of poison, and the fact of his having purchased it under false pretences; the existence of a motive or inducement to such a crime; the previous state of mind of the deceased, and the degree of probability that he would commit suicide;—these and many other considerations belonging to the circumstantial evidence, do not demand any detailed examination in this place, as the medical man does not enjoy any advantage over other men in the discussion of them.

* Sharpe's Peerage, Marquis of Ailsa.

† See several examples of this kind in Christison on Poisons, p. 84, et seq.

RULES FOR MEDICO-LEGAL EXAMINATION IN CASES OF POISONING.

The chief points to be attended to in cases of suspected poisoning are the following:

The state of the patient before the commencement of the symptoms, whether in good health or suffering from illness—the time at which the symptoms began, and at what interval after a meal, or after taking food or medicine—the nature of the symptoms, their order and time of occurrence, and the period of the commencement of any new symptom or train of symptoms—whether the symptoms increased steadily in severity, or alternated with intervals of ease, and whether the exacerbations corresponded with a repetition of the food or medicine, or followed the use of any new article of food or medicine—the character of any substances which may have been rejected from the stomach, or have passed from the bowels. If the case have terminated fatally, the exact time of the death should be noted down. If the person is found dead, the time at which he was last seen alive should be ascertained.

2. Minute inquiries should be made as to the manner in which the several dishes used at the meal have been prepared, the vessels used in the preparation of the food should be inspected, and their contents, if necessary, be preserved; suspicious powders or liquids found in the house should also be sealed and kept. If several persons have partaken of the same meal we must ascertain what articles have been taken by those who have suffered, and by those who have escaped, and in what quantities, and whether the same articles of food had been previously taken without any bad effect by the parties attacked.

3. The vomited matters must be carefully collected, and removed from clothing, furniture, &c., on which they may have been rejected. Portions of the dress, furniture, or boards, may, if necessary, be reserved for examination.

4. In performing a post-mortem inspection, a note should be kept of the time at which the inspection is made, and all the precautions already insisted on (p. 274, et seq.) should be carefully observed. The state of all the internal viscera must be noted, and especially of the fauces, and larynx, the œsophagus, stomach and intestines—in removing the viscera care should be taken to place them on a *clean* surface, and to preserve them in *clean* vessels, and the same caution applies to the contents of the stomach and intestines.

5. In performing a chemical analysis take measures to preserve the identity of the substances submitted to examination; while the analysis is going forward they must not be let out of the sight and custody of the operator, and during his absence they should be preserved under lock and key. If the medical man has occasion to transmit the suspected substance to a chemist for analysis it must be carefully sealed,

so as to prevent the possibility of the substance being tampered with during its transit. For want of such simple precautions as these, the ends of justice have more than once been defeated.

GENERAL OBSERVATIONS IN EXPLANATION OF THE PLAN OF THE SUCCEEDING CHAPTERS.

In treating a succession of subjects comprising a great number of similar details, it is extremely useful to adopt some general method or order. This facilitates not only the comparison of one subject with another, but that condensation which, provided it be not carried too far, both assists the memory, and the understanding. It also renders unnecessary many repetitions which tend only to perplex the student. It is proposed to adopt the following arrangement.

After a statement of the scientific and common name of the poison under consideration, such of its properties will be described as are of importance in the actual analysis of it for medico-legal purposes. Starting with the supposition that we are ignorant of the nature of the substance submitted to analysis, the tests and reasoning by which we obtain a clue to the nature of the substance in question will be briefly described, and to make this more easy of comprehension reference will be made to tables constructed on a different principle from existing chemical tables, and which, for the sake of distinction, may be termed tables of elimination. These will be given in an appendix. Assuming, on the other hand, that we have been made acquainted with the nature of the poison, or can infer it from the symptoms or post-mortem appearances, the characteristic test or tests of the poison will be described, and the fallacies which attach to them will be pointed out and guarded against. As it rarely happens that we are altogether ignorant of the substance which is submitted to analysis, it may be necessary to state that the first process of elimination is adopted not to meet a difficulty which so rarely arises, but to make the whole subject of the tests for poisons more easy of comprehension. The process for the detection of the poison in organic mixtures will then be described, that one being selected which seems to the author most simple and effectual. The means of ascertaining the quantity of the poison contained in the substance submitted for examination will then be stated. It will be sufficient for this purpose to state the particular resultant of the analysis which must be made use of with this view, and the proportion of the poison contained in 100 parts. The general formula, with an example of its application, will be given in the appendix together with the tables, and will be referred to as a guide in each case. The space devoted to the several subjects will be mainly determined by their importance, and the frequency of their administration whether as medicine or as poisons.

A short description of the symptoms will follow that of the chemical tests, and the time at which the symptoms commence, and at which,

in fatal cases, death happens, will also be stated; the shortest, longest, and average periods will be deduced from cases carefully analysed for the purpose, and will include those contained in the most approved works on Toxicology. In the case of the more important poisons, a list will be given of some of the symptoms of more rare occurrence, and the relative frequency of some of the more prominent will be noticed. The post-mortem appearances will be described with similar care and minuteness, and will be followed by the treatment proper to be adopted. Each class of poisons will be prefaced by a brief account of the symptoms and appearances by which it is characterised.

CLASSIFICATION OF THE POISONS.

The most useful classification of poisons is that which is founded upon their mode of action, and this is the arrangement now generally adopted. There are three principal classes—the *irritants*, *narcotics*, and *narcotico-acrids*, or *narcotico-irritants*. The first class excite inflammation in the parts with which they come in contact, and give rise to the constitutional disturbance which attends on high inflammatory action; the second class affect the nervous centres, producing delirium, coma, convulsions, and other allied symptoms; and the third class, the narcotico-acrids, combine, in varying proportions and degrees, the symptoms proper to the first two classes. Some of the irritants, as arsenic and oxalic acid, act on the nervous centres, but as this mode of action is an exception to the general rule, these substances are not separated from the class of irritants. The points in which the several substances included in each class differ from each other will be stated when describing those substances themselves.

CHAPTER XII.

IRRITANT POISONS.

Symptoms and Morbid Appearances.—Distinction between the Symptoms and Morbid Appearances from Irritant Poisons, and those due to common Causes and Diseases.—SYMPTOMS.—*Simple Cholera.—Asiatic Cholera.—Acute Inflammation of the Stomach.—Of the Intestines.—Simple Distention of the Stomach.—Sudden Death from drinking Cold Water.—Rupture of the Stomach or Intestines.—Of other Viscera of the Abdomen.*—POST-MORTEM APPEARANCES,—*Redness of the Mucous Membrane.—Gangrene and Lividity.—Softening.—Ulceration.—Perforation.—Different kinds of Perforation.—From Corrosion.—From Ulceration.—From softening during Life.—From Solution of the Coats of the Stomach after Death.—Classification of the Irritants.*

THE *symptoms* of irritant poisoning are a burning pain and sense of constriction in the throat and gullet; acute pain, increased by pressure in the pit of the stomach; intense thirst; nausea and vomiting, followed by pain, tension and tenderness of the entire abdomen; purging attended with tenesmus, and frequently with dysuria. The constitutional symptoms vary with the intensity of the irritation, and the interval which has elapsed from the administration of the poison, being at one time those of collapse, at another of inflammatory fever. The mode of death also varies. The patient does not rally from the first shock on the nervous system, or he dies in strong convulsions, or worn out by protracted suffering.

These symptoms vary in severity according as the poison is corrosive, or simply irritant; they also vary with the solubility and state of solution of the poison. When the poison is sparingly soluble, as in the case of arsenic, the pain in the several parts specified is not felt immediately on swallowing the poison, but after an interval more or less considerable, and, occasionally, the pain and sense of constriction in the throat and gullet are absent; but when the poison is corrosive, and very soluble, as is the case with the mineral acids, oxalic acid, the pure alkalis, and corrosive sublimate, the pain is felt as soon as the poison comes in contact with the part affected, and the pain occurs almost simultaneously in the throat, fauces, gullet, and stomach, extends rapidly to the entire abdomen, and is soon followed by vomiting and purging. The action of the corrosives and more soluble

irritant poisons is also followed by vomiting and purging of blood, which does not take place at all, or more rarely, and to a more limited extent, in the case of the simple irritants. The upper part of the windpipe is also more frequently affected with inflammation, which gives rise to hoarseness and wheezing respiration.

The corrosive poisons, then, are distinguished from the simple irritants by the greater promptitude of their action, and the greater severity of their symptoms. The constitutional symptoms and mode of death vary in both classes of poisons, with the dose, the interval, and the constitution of the patient.

The Morbid Appearances caused by the irritants are those of corrosion, followed by inflammation and its consequences, when the poison is a corrosive, and those of inflammation and its consequences when the poison is a simple irritant. The corrosions are sometimes confined to small spots, at others extended over a large surface. In cases of poisoning by oxalic acid, the mucous membrane of the gullet is often found stripped off in small patches so as to give to that part the appearance of a fragment of worm-eaten wood ; in cases of poisoning by the mineral acids, the entire mucous membrane of the stomach has been found peeled off, and the other coats destroyed in large patches, or perforated by smaller holes.

The effect of the simple irritants and of the corrosives, beyond the corroded part, is inflammation with its various consequences ; sometimes in the form of increased vascularity, at others of deep redness ; the surface is covered with a tenacious secretion, and the cavity filled with a glairy mucus. The coats are found thickened with the intensity of the inflammation; dark, as if gangrenous, from the extravasation of blood into the mucous membrane and beneath the submucous tissue; softened ; but occasionally hard and shrivelled. Vessels filled with dark blood are sometimes found ramifying minutely over the surface, which in other instances is studded with black points. Sometimes the mucous membrane is found ulcerated, and more rarely it is gangrenous. These appearances are not confined to the stomach, but are found in the fauces, œsophagus, and in the duodenum. The appearances in the remainder of the small intestines, are those of acute inflammation, with ulceration and softening of the mucous membrane ; ulcers are also found in the large intestines, and excoriation of the anus. In some cases there are traces of inflammation in the mucous membrane of the larynx and air passages.

The symptoms and post-mortem appearances now detailed are not peculiar to poisoning, but may be produced by natural causes, and form a part of common diseases. Those most frequently enumerated are the following :—*a.* Simple cholera. *b.* Asiatic cholera. *c.* Acute inflammation of the stomach. *d.* Acute inflammation of the intestines. *e.* Simple distention of the stomach. *f.* Sudden death from drinking cold water. *g.* Rupture of the stomach, or intestines. *h.* Rupture of

other viscera of the abdomen. These will now be briefly considered, and their chief symptoms contrasted with those of irritant poisoning.

a. Simple Cholera.—There is a very close resemblance between the symptoms of a severe attack of inflammation of the mucous membrane of the stomach and intestines, and those of irritant poisoning. The chief differences are these—In poisoning with the irritants the evacuations often contain blood; in cases of English cholera rarely, if ever. Cholera occurs mostly in summer and autumn, poisoning alike at all seasons. In cholera, there is rarely any sense of burning in the throat, but if present, it follows vomiting, whereas in most cases of poisoning it precedes it. Cholera rarely proves fatal in less than three or four days, while few cases of irritant poisoning survive two days.* English cholera, moreover, may often be traced to an adequate cause, such as a large meal of unripe fruit or unsound meat. If a doubtful case continue for more than twenty-four hours, the absence of symptoms characteristic of the individual irritants will tend strongly to rebut the supposition of poisoning. Post-mortem inspection and the result of a chemical analysis will generally serve to decide the case.

b. Asiatic Cholera.—There are many points of resemblance between this disease and the symptoms of irritant poisoning; but the absence of blood from the evacuations, the copious discharge from the bowels of a matter resembling rice-water with flakes of lymph, the blue colour of the skin, and the peculiar expression of collapse in the countenance, the absence of the burning sensation in the throat, (or, if that exist, the fact of its following instead of preceding the vomiting,) with the absence of symptoms characteristic of the more violent irritants, and the negative result of chemical analysis, will serve to distinguish the malignant cholera from irritant poisoning.

In both forms of cholera, the purging follows the vomiting much more rapidly than in the case of most of the irritant poisons.

c. Acute Inflammation of the Stomach.—Chronic inflammation of the mucous membrane of the stomach is as common as the acute form is rare. Indeed, it admits of doubt whether acute gastritis is ever due to any other cause but poison, if we except hot water, which when swallowed, gives rise to violent inflammation of the fauces, œsophagus, and stomach. If such a disease as acute gastritis ever does occur, except as the consequence of poison or drinking hot water, it is unaccompanied by diarrhœa, and the sensation of burning in the throat, if present, exists only as the consequence of continued vomiting.

d. Acute Inflammation of the Bowels —The seat of this disease is the peritoneal covering of the intestines. The mucous coat is rarely

* To both these rules there are several exceptions—to the first, cases of death in 12, 15, 26, and 48 hours, quoted from various authorities by Christison (on Poisons, p. 111); and to the second, exceptions, under the head of almost all the more active poisons.

involved, so that it is almost never attended with diarrhœa. The same remark applies to inflammation of other portions of the peritoneum. The obstinate constipation, and in many cases, the absence of vomiting, render it difficult to confound this disease with the effects of irritant poisons. The history of the case, too, will materially assist the diagnosis.

e. Distention of the Stomach.—This has been mentioned among the causes of sudden death requiring to be distinguished from poisoning by the irritants. It is sufficient to observe that, if in any case, the stomach should be found greatly distended with food, that very circumstance would go far to negative the supposition of poisoning by the *irritants*, for it is very rarely that an irritant destroys life without previously causing vomiting. Such distention, however, is not incompatible with the supposition of narcotic poisoning. It is scarcely necessary to state that, in cases of sudden death from distention of the stomach, marks of severe inflammation of the mucous membrane would be absent.

f. Drinking Cold Liquids.—This is a well-known cause of sudden death. The symptoms which it produces vary in different cases. Sometimes they are those of a sudden shock to the nervous system, sometimes those of acute gastritis, in other instances those of cholera, and in another class of cases they resemble those produced by the narcotico-acrids. A knowledge of the fact that a large draught of cold liquid has been taken by a person heated by exercise will often help us in our diagnosis. It some cases it may be necessary to call the post-mortem appearances, and the negative result of an analysis, to our aid. When the death follows immediately on the draught of cold water, the supposition of irritant poisoning finds no place.

g. Rupture of the Stomach or Intestines.—Sudden and violent pain, generally occurring after a meal, and during an effort to vomit, followed by collapse, and death instantly, or in from four or five to less than twenty-four hours, are the characteristic consequences of a rupture of the stomach. The post-mortem appearances are so well-marked as to render a minute distinction of symptoms unnecessary. The same observation applies to a rupture of the inner coat alone—a case of very rare occurrence—and to rupture of the intestines.

h. Rupture of the other Viscera of the Abdomen.—This accident is followed by vomiting, and occasionally by purging, excruciating pain and extreme tenderness of the abdomen, cold skin, feeble pulse, and symptoms of collapse, with death within twenty-four hours. The post-mortem examination will reveal the nature of the case.

Besides the foregoing diseases, others may be mentioned as more or less resembling the effects of irritant poisons in one or more symptoms. Thus *hæmatemesis* and *melæna* resemble some of the irritants in the one symptom of the discharge of blood by vomiting or purging, and, in rare instances, the two are combined. But in these diseases there is little or no pain, or tenderness, and no other symptom of a very marked kind. *Colic* resembles the effect of irritants inasmuch as

there is violent pain in the abdomen; and it is also a consequence of one class of irritants—the preparations of lead. But in colic from common causes there is no other symptom of a marked kind except pain and flatulence, with nausea and occasional vomiting, but diarrhœa is absent. *Strangulated hernia* may also be mentioned, but the character of the matters vomited, the obstinate constipation and the presence of the abdominal tumour, will render the diagnosis easy. Even in cases of internal strangulation, the symptoms are not such as to be readily confounded with the effect of the irritants.

In cases of sudden death, a suspicion of poison is often raised, of which the justice can be determined only by an examination of the body. This examination may lead to the discovery of some internal disease, or of the rupture of some viscus, which, coupled with the absence of the characteristic appearances produced by the irritant poisons, will at once remove all ground of suspicion ; or it may issue in the discovery of appearances in the alimentary canal which, though such as would be occasioned by poisoning, might be due to disease. Hence it will be necessary to examine those post-mortem appearances which are common to poisoning and to disease. These are, *a*. Redness of the mucous membrane. *b*. Gangrene and Lividity. *c*. Softening. *d*. Ulceration. *e*. Perforation.

a. *Redness of the Mucous Membrane.*—This is not always due to inflammation, for it may occur after death, or it may be a mere stain produced by some colouring matter taken into the stomach.* On the supposition that it is not a mere stain, but the consequence of an accumulation of blood in the vessels, have we any certain means of distinguishing the redness which occurs during life from that which may take place after death ? Redness of the mucous membrane of the alimentary canal is by no means a rare post-mortem appearance. It occurs in the depending parts of the stomach and intestines whenever the vessels of those parts are charged with blood, and it occurs in its most marked form in cases of sudden death. In these latter cases the redness may be as bright as if it were due to acute inflammation. Thus, in a case of death by hanging, mentioned by M. Billard, the mucous membrane of the commencement of the large intestine presented "a large, amaranth-red patch, six finger-breadths wide, covered with bloody exudation, and not removable by washing."† The redness which occurs after death has its seat in the veins of the part, and the redness is more intense as the death is more sudden and the circulation more active. The fact of the redness being due to the accumulation of the blood in the veins of the depending part of the viscera has been proved by actual experiment. Redness, then, occurring in these situations is not to be regarded as a vital appearance. But, on

* See a case of this kind in which the colouring matter was the corn-poppy. Foderé, Traité de Médicine Légale, tom. iv. 282.

† De la Membrane Muqueuse Gastro-intestinale, p. 220.

the supposition that the redness is not found in a depending part of the stomach and intestines, but on all parts equally, or on the higher parts exclusively, is such redness necessarily due to causes existing during life? The answer to this question must be in the negative, for no one who has been in the habit of inspecting the bodies of the dead can fail to have observed extensive redness of the stomach and of large tracts of the intestines, without a single symptom of inflammation of those parts having occurred during life. These pseudo-morbid appearances are attributed by Dr. Yelloly to the contraction which takes place in the arteries after death, and by which the blood is forced into the veins. "The branched or stellated form of vessels, under which the vascularity usually appears is capable of being imitated, either by injecting the veins with fine injection, or by forcing back with the finger, or the back of a scalpel, the blood from the larger branches of veins into the smaller." "This vascularity soon becomes diffused redness, by transudation of the blood through the coats of the containing vessels, just as happens with the bile in the gall-bladder"* A redness of the stomach and intestines also occurs from the determination of blood to the mucous coat during the process of digestion, and after death it may arise from transudation of the blood through the peritoneal covering of the liver or spleen. Hence, mere redness of the mucous coat, even when it does not occur on the most depending part of the stomach or intestines, is not to be regarded as a proof of inflammation.

When, however, the redness of the mucous membrane is combined with a softened state of that structure, putrefaction not having set in, when the membrane itself is covered with a thick and tenacious mucus, when it is opaque, so that dissected off and stretched over the finger, the finger is not visible, the redness may be certainly attributed to inflammation; and this conclusion will be strengthened if the redness occurs in the least depending parts of the membrane, or is not limited to such parts, and the larger veins are not distended with blood,†

b. Gangrene and Lividity.—Gangrene of the mucous membrane is of very rare occurrence, except as the consequence of long-continued pressure in cases of hernia. Gangrene of the mucous membrane from acute inflammation has been described by authors of reputation, and perhaps with justice, but there is no doubt that a dark appearance of the mucous membrane due to infiltration of blood into its texture has been often confounded with it. This lividity of the mucous membrane presents itself in as many shapes as the redness just described; in points, striæ, ramifications, and patches of greater or less extent. In some instances the vessels, to their smallest branches, are filled with black blood; in others, the mucous membrane is thickly studded,

* Trans. of the Med. Chir. Society, Nov. 1835.
† Billard, op. cit.

as if with petechiæ, and in others, again, the membrane itself is thickened with black coagulated blood. These appearances, but especially the latter, are most commonly seen in cases of poisoning by the mineral acids, and by oxalic acid, and more rarely in poisoning by the more powerful metallic irritants, as arsenic and corrosive sublimate. There is strong reason for believing that these appearances are never found in the stomach in a marked form, as the result of disease, but that they are always due to the action of violent irritants. They are sometimes met with in the intestines, in severe cases of dysentery, and in acute enteritis.* This livid colour of the mucous membrane is distinguished from melanosis by the latter being arranged in regular well-defined spots, without thickening of the mucous membrane, or surrounding inflammation, as also by the absence, in melanosis, of previous symptoms of disease.

c. Softening.—The mucous membrane is sometimes softened and sometimes hardened by the action of poisons. The corrosive poisons are those which most commonly produce softening of the membrane. It is more rarely the effect of inflammation without corrosion. Softening also occurs from other causes, both before and after death. The distinction is easy. The softening from corrosion is combined with those changes of colour, and appearances of violent inflammation in the softened parts, which attend the action of the corrosives ; and when the softening is due to the non-corrosive irritants it is accompanied by marks of acute inflammation. The history of the symptoms, will also often serve to distinguish the one from the other ; for the softening from disease is not preceded by any characteristic symptoms.

d. Ulceration.—Ulcers of the stomach may arise either from the action of poison, or from disease. When due to poison it is the result of a more intense degree of inflammation than that which attends the more chronic ulceration of disease. We are often assisted in our diagnosis, too, by finding the ulcer discoloured, as in the case of nitric acid and iodine, or covered with a white powder, as in the case of arsenic, or with a substance resulting from the decomposition of the poison, such as the black powder, (minutely divided mercury,) formed by the decomposition of corrosive sublimate during life, or the yellow sesquisulphuret of arsenic formed during the process of putrefaction after death. These occasional appearances, added to the intensity of the inflammation, and the symptoms during life, will render the distinction between idiopathic ulceration and that due to poisoning easy.

e. Perforation.—Perforation of the stomach may arise, 1, from corrosion ; 2, from inflammation, and consequent ulceration ; 3, from softening during life ; and 4, from the action of the gastric juice after death.

1. *Perforation from Corrosion.*—It is impossible to confound a per-

* Christison is strongly of the opinion expressed in the text. See his Treatise on Poisons, p. 125.

foration due to the direct *corrosive* action of an irritant poison with any perforation arising from natural causes, acting either during life or after death. The state of the mouth, throat, and gullet, and oftentimes of the skin and clothes of the deceased will render the distinction easy. In many cases, too, the corrosive poison escaping into the cavity of the abdomen will leave traces of its action on the other viscera.

2. *Perforation from Ulceration.*—This is of extremely rare occurrence. That from idiopathic inflammation will be generally distinguished from the effect of the irritants by the state of the surrounding mucous membrane, which is less highly inflamed, and neither stained nor covered with deposit. The condition of the remainder of the alimentary canal, and the previous symptoms will often serve to throw light on the nature of the case.

3. *Perforation from Softening* of the coats of the stomach during life is not of rare occurrence. It most frequently attacks young females, from eighteen to twenty-three years of age, after slight symptoms of indisposition. The rupture generally takes place soon after a meal, and is immediately followed by acute pain of the abdomen, and inflammation of the peritoneum. There is little vomiting, and no purging, but the patient dies in a state of collapse in from eighteen to thirty-six hours. The aperture is commonly, if oval or rounded, about half an inch in diameter, with smooth edges, and situated in or near the lesser curvature of the stomach. "The margin of the aperture is often blackened, and the aperture itself is funnel-shaped, from within outwards, *i.e.*, the mucous coat is the most removed, and the outer, or peritoneal coat, the least. The coats of the stomach, round the edge of the aperture, are usually thickened for some distance, and when cut, they have almost a cartilaginous hardness." *

The absence of marks of acute inflammation, and, in many cases, of the discolourations characteristic of some of the irritant poisons; the non-detection of poison in the stomach itself, or in the contents of the abdomen; the sudden occurrence of pain; the slight subsequent vomiting; the absence of diarrhœa; and the early occurrence of death, as compared with the period at which perforation following poison generally proves fatal, will make the distinction between this form of perforation and that due to poison easy.

4. *Perforation from the action of the gastric juice after death* has been the subject of much controversy; but the fact of its sometimes taking place has been placed beyond a doubt, by observations and experiments made both on men and animals. The seat of the opening is generally the posterior surface of the stomach, but it depends on the position of the body. The aperture may be of any size, from that of a shilling to that of the palm of the hand; and, in some instances, it has been found to occupy one half of the stomach. It may assume any shape, and its

* See an excellent Essay on this subject by Mr. Alfred Taylor, in the Guy's Hospital Reports, No. 8.

edges are fringed, softened, and smeared with a dark pulpy mass. The viscera, in contact with the opening, sometimes undergo a similar change. Occasionally there is more than one aperture. There is no appearance of inflammation around the opening. It is, therefore, impossible to confound such an appearance with the effect of an irritant poison.

With regard, then, to perforation of the stomach discovered after death, we may decide, irrespective of symptoms during life, that it is not due to irritant poisoning when it is unaccompanied by marks of acute inflammation in the mucous coat. On the other hand, if the mucous coat presents merely a diffused redness, and there is no sign of corrosion or inflammation of the stomach, we should hesitate to ascribe the opening to the effects of an irritant poison; for ulceration is not likely to occur, except as the effect of the most acute inflammation. A redness generally diffused over the mucous coat would agree much better with the supposition of subacute gastritis, due to common causes, or of that change of colour, which, as has been stated, may occur after death. The absence of marked symptoms of disease in the stomach, may be expected to accompany the post-mortem destruction of its coats; a sudden and acute pain, followed by peritoneal inflammation and collapse, characterises spontaneous perforation from softening during life; while a pain gradually increasing, with severe and continued vomiting and purging, together with a sense of heat and constriction in the throat, are the marked symptoms of poisoning by the irritants.

Perforation of the *Intestines* is of very rare occurrence in cases of poisoning; it never follows corrosion, but when it occurs it is the result of inflammation, and, as such, would not be distinguishable from the consequence of inflammation arising from common causes. It is possible that a corrosive poison escaping from an opening in the stomach may corrode the intestines by acting upon them from without.

Perforation of the *gullet*. Christison has met with only one instance of perforation of the gullet from poisoning, and this took place in a case of poisoning by sulphuric acid.* Perforation, from other causes, whether during life or after death, is of occasional occurrence; but it can give rise to no difficulty, as in cases of corrosion the surrounding mucous membrane will bear marks of the action of the poison, which will be absent in all other cases.

Classification of the Irritant Poisons.

There are four obvious subdivisions of this class of poisons—those derived from the mineral kingdom, those belonging to the vegetable and animal kingdoms respectively, and the irritant gases.

* On Poisons, p. 135.

The following classification comprises the principal poisons contained in these four divisions.

1. Irritant Poisons derived from the mineral kingdom, comprising:

a. Corrosive acid Poisons; containing the sulphuric, nitric, muriatic, and oxalic acids. This last acid, though not derived from the mineral kingdom, is placed with the mineral acids, in consequence of its highly corrosive properties. Mixtures of the mineral acids—the nitro-muriatic and the nitro-sulphuric—the sulphate of indigo, and the binoxalate of potash, will be briefly alluded to under the same division.

b. Alkalis and Earths, with their Salts; containing potash and carbonate of potash, soda and carbonate of soda, ammonia and carbonate of ammonia; nitrate, sulphate, and bitartrate of potash; chloride of sodium, iodide of potassium, baryta and its salts.

c. Metallic Irritants; containing arsenic and its preparations, mercury and its preparations, and the salts of copper, lead, antimony, zinc, tin, silver, iron, bismuth, and chrome.

2. Irritants derived from the vegetable kingdom; comprising aloes, colocynth, gamboge, jalap, scammony, castor-oil seeds, croton oil, savin, and yew-berries.

3. Irritants derived from the animal kingdom; comprising cantharides, poisonous fish, and diseased and decayed animal and vegetable matter.

4. Irritant gases; comprising nitrous acid gas, sulphurous acid gas, muriatic acid gas, chlorine, and ammonia.

The individual poisons will be discussed, according to their importance, either in separate chapters, or several of them thrown into one. The three mineral acids will be treated in the same chapter; oxalic acid, on account of its peculiar properties, in a chapter by itself. The contents of the second division of irritants derived from the mineral kingdom will form a separate chapter. Of the metallic irritants, arsenic, mercury, copper, and lead will be the subjects of distinct chapters. The remaining metals, as less important, will be thrown into one. The vegetable, animal, and gaseous irritants, will also be treated in separate chapters.

CHAPTER XIII.

MINERAL ACIDS.

Frequency of Poisoning with the Mineral Acids.—Proportion of cases of Accident, Suicide, and Homicide.—Properties of the Mineral Acids.—Symptoms common to the Mineral Acids.—Period at which Death takes place.—Post-mortem Appearances.—Treatment.—SULPHURIC ACID.—*Tests.—Process for detecting the Acid in Stains on Cloth, and in Organic Mixtures.—Symptoms.—Post-mortem Appearances.—Smallest Quantity which has proved fatal.—Duration of Fatal Cases.—Chances of Recovery.*—NITRIC ACID.—*Tests for the concentrated and diluted Acids.—Nitric Acid in Stains.—In Organic Mixtures.—Symptoms.—Post-mortem Appearances.—Smallest Quantity which has proved fatal.—Shortest Duration of Fatal Cases.—Treatment.*—MURIATIC ACID.—*Tests, &c.—Mixed Acids.—Nitro-sulphuric.—Nitro-muriatic.*

The importance of the poisons included in this class will be understood when it is stated, that out of 543 cases in which a verdict of death by poisoning was returned by the coroner's court in the years 1837 and 1838, thirty-six, or one fifteenth, were due to the mineral acids whether pure or in a state of admixture, and of these, thirty-two, or one seventeenth, were from sulphuric acid.* Of these thirty-two cases, 21 were accidental, the acid being swallowed by mistake, 7 suicidal, and 4 unknown.

These numbers will probably represent the comparative frequency of these two modes of death. For obvious reasons poisoning by the mineral acids is not likely to be a homicidal act; but Christison has collected as many as eight cases, in four of which the poison was given to adults, and in the remaining four to young children. In the case of the adults it was either given as medicine, or poured down the throat while they were asleep or intoxicated.†

The probabiiity of poisoning being accidental, suicidal, or homicidal, will vary with the age. In the infant, it is most probably homicidal, in the child either homicidal or accidental, in the adult generally suicidal.

Of late years a new crime has sprung up,—that of throwing the

* Of the remaining four cases two were from aqua-fortis, one from a mixture of aqua-fortis and laudanum, and the fourth from nitric acid and aloes. See Brit. and For. Med. Rev. XVII. p. 278.

† Treatise on Poisons, p. 137.

mineral acids, especially oil of vitriol, on the person. A recent act has provided for the punishment of this class of offenders.

The Mineral Acids possess the following familiar properties :—they redden vegetable blues, and coloured articles of dress. In both these respects they resemble the vegetable acids. The two classes of acids differ, however, inasmuch as the mineral corrode the substances to which they are applied, while the vegetable acids do not.

The *symptoms* common to the mineral acids are the following :—a burning pain in the mouth, throat, and gullet, occurring *immediately* after swallowing the acid; followed by excruciating pain in the stomach, eructations, constant retching, and vomiting of a brownish or blackish matter containing blood, coagulated mucus, or portions of the mucous membrane of the stomach itself. The patient swallows with difficulty, and deglutition is sometimes altogether prevented. There is intense thirst, the bowels are usually confined, the urine is scanty or suppressed, and there are constant tenesmus and dysuria. The pulse is generally small and frequent, the respiration catching, and sometimes laborious, and the countenance expressive of intense anxiety. The larynx is occasionally injured, and then there are croupy respiration, hoarseness of voice, and constant threatening of suffocation from the accumulation of tenacious mucus. On examining the mouth, the lips are found shrivelled and changed in colour; in the case of sulphuric acid, at first white, but afterwards brown, and yellow in that of nitric acid. Sometimes there are small blisters, or excoriations, and the spots occasionally present a centre of the characteristic colour of the acid, with an intensely red margin. The inside of the mouth is white, shrivelled, and corroded, and the teeth loose and discoloured. The tongue is sometimes white and polished, at others changed in colour like the other parts. There are generally distinct marks of the action of the acid on the cheeks, neck, or fingers, as well as on the clothes, and the vomited matters, if rejected on a limestone pavement, cause effervescence. When death takes place it is commonly with symptoms of collapse; the intellectual faculties remaining clear to the last. Occasionally life is terminated in convulsions. In rare cases, severe nervous symptoms have occurred. In a case of poisoning by sulphuric acid, which will be presently cited, trismus, tetanus, epilepsy, and delirium occurred in succession.

The *period at which death happens* is very variable ; it may take place as early as two hours, or at the end of days, weeks, or even months. When the patient survives for some days, the symptoms are somewhat modified. The patient is feverish, with a dry skin and frequent pulse ; there is occasional vomiting of food and drink, mixed with flakes of tenacious mucus ; there are salivation and fœtor of the breath ; the belly is tense, the breathing short and difficult ; there are pains and spasms of the limbs ; and flakes of lymph are sometimes discharged from the bowels. Digestion is impaired, all the functions of the body languish, the patient becomes extremely emaciated, and in

this state dies, in a period varying from a fortnight to some months. This is the second variety of M. Tartra.

In other cases, again, the patient recovers imperfectly, but becomes a dyspeptic and valetudinarian for life. Rather less than half the number of cases recover completely.

In some instances the poison does not reach the stomach, but affects the fauces and gullet, the larynx being, in some cases, involved at the same time. In other instances, again, the effect is confined to the larynx, and death may take place from suffocation.

The mineral acids may also prove fatal when introduced into the body otherwise than by the mouth. Cases of this kind will be mentioned under the individual acids.

The *post-mortem appearances*, common to the mineral acids, are the following:—The body externally has a healthy appearance; the lips, neck, and fingers are marked with brownish or yellowish-brown spots, resembling old parchment or a burn, or with small vesications. The mucous membrane of the mouth is white, yellowish, or brownish, and shrivelled; and the same appearances extend into the pharynx. The epiglottis is sometimes contracted, sometimes swollen, the rima glottidis contracted, and the larynx inflamed. The gullet sometimes presents the same appearance as the mouth and fauces, at others it is highly inflamed, lined with a coat of tenacious mucus, or its mucous coat is partially or wholly stripped off. Occasionally the gullet entirely escapes. In rare cases it becomes the seat of ulceration and is perforated. The stomach is usually distended with gas, and filled with a yellowish, brownish, or blackish glutinous secretion, which also extends into the œsophagus and commencement of the small intestines. The mucous membrane is highly inflamed, its vessels are minutely injected with black blood, or the membrane is thickened with black blood extravasated into its substance, so as to resemble gangrene; there are also softening of the rugæ or separation of the mucous coat, ulceration, and frequently perforation. Similar appearances are generally found in the duodenum. The pylorus is commonly contracted. When perforation takes place, the apertures are generally circular, situated at the posterior part of the organ, and surrounded by inflammation and black extravasation. The peritoneal surface of the viscera, even when there is no perforation of the stomach, is highly inflamed and coated with coagulable lymph. When the contents of the stomach escape into the cavity of the abdomen they act upon the surface of the viscera, and impart to it a peculiar unctuous feel. The inflammation sometimes extends into the chest, so that the thoracic surface of the diaphragm has been found coated with lymph. The blood in the large vessels is often found firmly coagulated. The urinary bladder is generally empty and contracted.*

* The appearances of inflammation, even when the action of the poison is very violent, are not always strongly marked. Thus, Dr. Bateman related a case of a child, two and a half years old, who had swallowed about a tea-spoonful

From the foregoing description of the symptoms and post-mortem appearances present in cases of poisoning by the mineral acids, it will be evident that the effects of this class of poisons are unusually well marked. The fact that the symptoms begin *immediately* after swallowing the poison, distinguishes this class from all others except oxalic acid, corrosive sublimate, and one or two other of the more soluble and active irritant poisons. The same may be said of the extensive disorganization which they produce in all the parts with which they come in contact. The absence of diarrhœa is also another point almost peculiar to this class of poisons. If we add to the characteristic symptoms and post-mortem appearances the accompanying stains on the skin of different parts of the body and clothes, which are so rarely absent, we shall have little or no difficulty in deciding on the cause of death. The symptoms and post-mortem appearances taken separately would be decisive in the great majority of cases, but when combined they place the case beyond the reach of doubt. In almost every instance we shall have the additional evidence derived from the chemical analysis.

Treatment.—Calcined magnesia is the best antidote. It should be finely powdered and mixed with water. If this cannot be immediately procured carbonate of magnesia, chalk, or whiting may be substituted ; and, if these should not happen to be at hand, soap and water. The plaster from the wall of an apartment, beaten into a thin paste with water may be advantageously substituted. The pure alkalis and their carbonates, being themselves corrosive poisons, should not be given. Previous to the preparation of the antidote, and subsequently to it, milk, and mucilaginous and oily drinks should be given frequently and in large quantity, and should be continued for many days. Sometimes the patient is unable to swallow ; in which case the stomach-pump has been recommended. It is scarcely necessary to observe that the use of the stomach-pump is attended with danger, in the corroded and softened state of the membrane, and that it ought not to be resorted to ; indeed, it has often been found quite impossible to introduce it. If the patient is unable to swallow, a cautious attempt may be made to introduce the tube into the œsophagus beyond the obstruction, by which means there will be less risk of injury than if it were introduced into the stomach itself. The subsequent treatment is that of inflammation, and must be proportioned to the severity of the symptoms. Leeches to the pit of the stomach will generally be necessary, and sometimes blood must be taken from the arm. The bowels must be kept open by mucilaginous injections.

of strong sulphuric acid. The stomach was perforated, and the aperture was bordered by thickened edges of a dark brown cinder-like appearance, "an appearance of inflammation extended towards the cardiac extremity of the stomach; but the œsophagus, with the exception of a little purplish blush on some parts, showed nothing which could indicate violent action. The inflammation did not seem to extend towards the pylorus, and the intestines were free from any inflammatory action." Quarterly Report of the Carey Street Dispensary.—Ed. Med. and Surg. Journal, vol. x. p. 257.

SULPHURIC ACID. (*Oil of Vitriol.*)

Tests.—We may have to examine sulphuric acid in its concentrated state, diluted with water, in stains on cloth, and in organic mixtures.

Concentrated Sulphuric Acid is an oily-looking liquid, colourless when pure, but, as found in commerce, often of a brownish colour, without odour, and heavier than water. It chars vegetable, and corrodes animal, matter. A fragment of wood dipped into the acid is immediately blackened. When mixed with water heat is given out. These characters alone are sufficient to distinguish it from all other acids.

Dilute Sulphuric Acid.—The liquid is known to be an acid by its action on litmus paper. It is immediately known to contain sulphuric acid by the addition, first, of a few drops of nitric acid, and then of a solution of nitrate of baryta. A heavy white precipitate—sulphate of baryta—falls down. Several other acids yield a white precipitate with nitrate of baryta, but as they are all soluble in a few drops of nitric acid, the previous addition of this acid prevents the precipitate from being formed. (See Table II. of Appendix, in which the chloride of barium and muriatic acid take the place of the nitrate of baryta and nitric acid.) This test is so delicate that it will detect one part by weight of sulphuric acid in 40,000 of water. It gives all the assurance required by the chemist; but for legal purposes it may be necessary to give still further proof that the acid is sulphuric. For this purpose, the precipitate is to be collected, washed, and dried. It is then to be mixed with five or six times its weight of charcoal. The mixture is to be heated to redness in a crucible, or covered spoon of platinum. The sulphate of baryta is thus converted into a sulphuret of barium. To prove this, introduce the powder into a test-tube, and add to it a little dilute muriatic acid. On placing a strip of filtering paper, moistened with a solution of acetate of lead in the mouth of the tube, the paper will be blackened by the sulphuretted hydrogen evolved from the mixture. This test is so delicate that less than a grain of the sulphate of baryta will give all the evidence required. If so small a quantity be used the mixture may be introduced into a fold of platinum foil, and heated under the blow-pipe in the flame of a spirit-lamp.

Precautions.—In the application of these tests some precautions are necessary. The nitric acid must be free from sulphuric acid, and the charcoal from saline sulphates. The nitric acid also must be added sparingly, as the nitrate of baryta is insoluble in strong nitric acid. This fallacy may also be guarded against by diluting with distilled water the liquid containing the precipitate. The precipitated sulphate of baryta will not be dissolved, while any nitrate that may have been thrown down will be taken up.

Objections to the Tests.—To the *succession* of tests just described, there are the following objections: 1. A supersulphate, such as alum will give the same precipitate, and may therefore be confounded with the free acid. 2. In addition to the free acid there may be a neutral sulphate, such as Epsom salts, which will give the same precipitate, and thus

lead to error in estimating the quantity of free acid. 3. A neutral sulphate with a free acid in excess will give the same precipitate as the free sulphuric acid.

The presence of the supersulphate, in the first objection, and of the neutral sulphate in the second and third objections, may be proved by evaporating to dryness a portion of the liquid in a platinum capsule, when there will be a saline residue in the case of the supersulphate and sulphate, while the free sulphuric acid will be entirely dissipated in dense fumes. The free sulphuric acid may be separated from the neutral sulphate by boiling pure carbonate of baryta in the solution until effervescence ceases. The precipitate must be well washed, digested in hydrochloric acid to remove any free carbonate, and the remaining sulphate will represent the quantity of free sulphuric acid. When the acid liquid contains a neutral sulphate with a free acid in excess, the free acid, if volatile, as nitric, hydrochloric, or acetic acid, may be separated by a careful process of distillation, and its nature ascertained by appropriate tests.

Analysis of Stains on Cloth.—Stains produced by the strong sulphuric acid are red or brown ; the cloth is corroded, continues moist, and has an unctuous feel. The process of analysis is very simple. The stained fragment of cloth must be cut out, and digested in distilled water at a gentle heat. The liquid, on being filtered, must be slightly acidulated with nitric acid, and tested with the nitrate of baryta. The nature of the precipitate must be further ascertained by the process already described. The acid may be thus detected after long intervals of time.* For medico-legal purposes it will be well to use the precaution of analysing at the same time an unstained portion of the same cloth. A very delicate test for sulphuric acid is founded upon its ready decomposition by organic matter when submitted to heat, sulphurous acid gas being formed, and indicated by its action on starch paper, moistened with a few drops of iodic acid. A fragment of cloth may be introduced into a small test-tube and heated, while a strip of starch paper, moistened with a drop of iodic acid, is introduced into the mouth of the tube. The blue iodide of starch is formed as soon as the gas comes in contact with the paper. This is a simple modification, proposed by Mr. A. Taylor, of a process recommended by Dévergie for the stomach itself, which process is not quite free from objection.

Analysis of Sulphuric Acid in Organic Mixtures.—It may be necessary to examine liquids with which sulphuric acid may have been mixed, such as gin, tea, &c. If the liquid is thick or turbid, it must be boiled with distilled water and filtered ; if clear, it may be filtered at once. The nitric acid and nitrate of baryta test may then be applied, the precipitate may be collected and boiled in strong nitric acid, and dried, and the subsequent steps of the process may be applied as already described. If the sulphuric acid has been mixed with any spirituous liquor, that may be first separated by evaporation.

* In one instance after more than twelve years.—Taylor's Manual of Medical Jurisprudence, p. 96.

The process for detecting sulphuric acid in the contents of the stomach, or in the matters rejected by vomiting, will vary with the condition of the matters themselves. They may have a strong acid reaction, or they may be neutral or even alkaline.

1. If the matters have an acid reaction, it is probable that they contain a free acid. This acid may be sulphuric acid, or one of the two acids usually found in the stomach—the acetic and muriatic. To guard against this probable fallacy, boil and filter, then distil the filtered liquid with a heat applied by the chloride of calcium bath, described when speaking of muriatic acid, till it attains the consistence of a thin syrup. Test the result of the distillation for muriatic and acetic acid. If neither of these acids is present, then the liquid in the retort must be diluted and tested by nitric acid and nitrate of baryta. If the fluid resulting from the distillation contain either the acetic or muriatic acid, dilute the liquid in the retort, and continue the distillation, adding distilled water as often as necessary, till all trace of these acids disappears. Then test the fluid remaining in the retort for sulphuric acid.

2. If the matters have an alkaline reaction or are neutral, they must be boiled in distilled water and filtered. The tests may then be applied to the filtered liquid.

If carbonate of lime has been given as an antidote, the resulting sulphate of lime must be dissolved by first boiling the mixture with a little nitric acid.

If the quantity of acid discovered by any of these processes is very small, there is no proof that it has been swallowed ; for the secretions of the stomach always contain a small quantity of neutral sulphates.

The discovery of a neutral salt also does not prove the administration of free sulphuric acid, for a solution of the salt itself may have been swallowed. The discovery of sulphate of lime, however, would be conclusive as to the administration of sulphuric acid, and the subsequent use of chalk as an antidote, for it is out of the question that sulphate of lime should have been swallowed. The discovery of a large quantity of free acid or of the sulphate of lime would be conclusive as to the administration of free acid. Other neutral sulphates may have been swallowed, and unless it can be shown that they have not been taken into the stomach, the discovery of them will not in itself be a proof of poisoning.

It must be borne in mind, however, that in almost every case in which we are called upon to examine the contents of the stomach with a view to discover sulphuric acid in them, we shall have the benefit of the appearances produced by the corrosive action of the acid on the tissues. If the characteristic appearances of poisoning with sulphuric acid are present, all refinement will be unnecessary, and the chemical analysis itself will be superfluous. The only case in which it can be required is where the acid is taken in so dilute a form that its more marked effects are absent—such cases are extremely rare.

Quantitative Analysis.—Use for this purpose the precipitated sulphate of baryta, previously boiled in pure nitric acid, and then care-

fully washed and dried. One hundred grains of the pure sulphate correspond to about 41½ grains of the strong acid. (For the method of proceeding, see appendix.)*

Symptoms.—Those already described (p. 426). The dark brown appearance of the stain forms the chief distinction between the action of this and of the other mineral acids.†

Post-mortem Appearances.—Those already described (p. 427). The degree of disorganisation, cæteris paribus, greater, and perforation more frequent, than in cases of poisoning with nitric acid. The colour of the mucous membrane dark brown or black, as if charred; while in cases of poisoning with nitric acid, it is more commonly yellow or green. Sulphuric acid has sometimes been detected in parts of the body to which it must have been carried by the circulation. In the case of a pregnant female poisoned by the acid, it was detected in the fœtus, in the liquor amnii, and in the peritoneum, pleura, heart, and bladder of the poisoned female.‡ In several cases the milk of nurses who were taking the acid medicinally has been found to produce disordered bowels and convulsions in the children whom they were suckling. In one case,§ the matters voided from the bowels of the child were found to corrode the linen.

The *smallest* quantity of sulphuric acid which has been known to destroy life in the adult is one drachm.‖ This proved fatal in seven days. As much as two ounces has been taken in more than one instance without fatal consequences. A smaller quantity than one drachm has proved fatal to an infant. In one case, half a teaspoonful of the dilute acid given by mistake proved fatal to an infant five weeks old.¶

The *shortest* period within which the poison has proved fatal is two hours.** The period is very variable. If the larynx is much affected suffocation may ensue very rapidly. When the poison proves fatal by its action on the stomach, the period at which death takes place will depend upon the presence or absence of perforation; the poison proving fatal much sooner when attended by perforation. It is

* For a minute description of methods of analysis, and a more detailed statement of fallacies, the reader is referred to Christison on Poisons, pp. 140—8.

† Nervous symptoms of a severe character were present in an interesting case of poisoning with this acid, reported in Horn's Archiv. for 1825, p. 454, and translated in the Edin. Med. and Surg. Jour., vol. xxvi. p. 221. A female servant, æt. 19, swallowed a quantity of the strong acid in a fit of passion. She recovered perfectly in fourteen days, after suffering from trismus from the first day, with tetanic spasms of the upper extremities; an attack of epilepsy, followed by delirium on the seventh; on the third day she vomited several lumbrici which were dead and partly corroded by the acid. The inside of the mouth and fauces was covered with yellow spots, which were black in the middle and vivid red on their margin.

‡ Gemeins, Deutsche Zeitschrift, and Med. Gaz. vol. i. p. 710.

§ Med. Gaz. vol. i. p. 756.

‖ Case quoted by Christison from the Journal der Prakt. Heilkunde, vii. ii. 18.

¶ Med. Gaz. vol. xxii. p. 389.

** Case by Professor Remer, of Breslaw, ib. xlix. iii. 60.

difficult to strike any useful average, as the fatal period may extend from a few hours to as many days, weeks, or even months.*

Treatment.—That already described (p. 428).

Sulphuric acid has been introduced into the body in other ways than by the mouth. It has been injected into the vagina to procure abortion,† and into the rectum by mistake for a glyster.‡ Of late it has been often thrown on the skin in order to produce disfigurement.

As it is possible that sulphuric acid might be introduced into the body after death with a view of inculpating an innocent party, it may be necessary to state that sulphuric acid thus introduced renders the mucous membrane yellowish and brittle, bleaches the muscular and peritoneal coat, and chars the blood in the vessels. These changes are confined to the spot with which the acid is in contact; there is a distinct line of demarcation around it, and no inflammatory redness.§

* The following are the general results of several cases reported in the English and Foreign Journals:—

Of 36 cases—26 were fatal (all the children and 18 adults), and 10 recovered (all adults).

Of 31 cases—20 were suicidal, 3 homicidal (all young children), and 8 accidental (2 of them children).

Among adults, the recoveries were to the deaths, both in accidental and suicidal poisoning, as 1 to 2.

Of the 26 fatal cases, 10 lasted a day or less; 6 more than a day and less than a week; 3 less than a fortnight; 1 from a fortnight to three weeks; 1 more than three weeks; and 5 extended from five to forty-five weeks. The rough estimate, usually stated, viz. from 18 to 24 hours, is, therefore, very far from correct.

The majority occurred in females.

The following were the precise periods of death—In 5 children, 1 in 3½ hours, 2 in 4½ hours, 1 in 12 hours, and 1 in 3 days. In 20 adults—1 in 3½ hours, 1 in about 4 hours, 1 in 8 hours, and 1 in 12 hours; 2 in 1 day, 1 in 1½ day, 2 in 2 days, 1 in 4 days, 1 in 5 days, 1 in 8 days, 1 in 11, 15, 22, and 33 days respectively, and 2 in 60 days; 1 in 26 weeks, and 1 in 45 weeks.

The average duration of all who survived a day or less was 10 hours—of all surviving a week or less 32 hours.

The recoveries are stated to have taken place in 6, 7, 10, 11, 14, 18, and 23 days respectively.

Perforation of the stomach took place in 8 cases out of 21 in which the post-mortem appearances are described. In general terms it may be said to be present in about one-third of the cases.

The reader is referred to the following cases reported in English Journals, or extracted from foreign publications:

Ed. Med. and Surg. Journal—Vol. x. p. 527. Vol. xxii. Vol. xxvi. Vol. xxxvi. p. 99. Vol. liii. p. 406 et seq. (an interesting case by Dr. Craigie with many valuable cases from foreign sources), and Vol. lvi. p. 537.—Lancet, 1834—5, i. p. 266 1836—7, i. p. 195. 1837—8, ii. p. 782.—Medical Gazette, Vol. i. p. 127. Vol. vii. p. 27. Vol. xxii. p. 76. Vol. xxv. p. 944. Vol. xxix. p. 147. Vol. xxx. p. 352.—Medical and Physical Journal, Vol. i. p. 500.—Medical Repository, Vol. xiv. p. 160.—Guy's Hospital Reports, Vol. iv. p. 297.—See also Dr. Roupell's Illustrations of the effects of poisons.

† See a case brought before the Académie Nationale of Paris, and detailed in a letter addressed to M. Guérin. Violent inflammation, followed by obliteration of the vagina ensued, and the child was extracted dead by the Cæsarian section, the mother expiring soon after.

‡ In this case, which is reported in the Medical Gazette, Vol. xvii. p. 623, death took place in a few hours.

§ Orfila, Toxicologie, ii. 689.

NITRIC ACID. (*Aqua Fortis, Red Spirit of Nitre.*)

Tests.—This poison may present itself for analysis in the form of the strong acid, diluted, in stains on cloth, and in organic mixtures.

The *strong acid*, as it is met with in commerce, varies in colour from a deep orange to a light yellow, gives out acid fumes, and stains organic matter yellow or brown, the stains becoming brighter when touched with an alkali. The action of the acid on copper, tin, lead, or mercury, at once distinguishes it. On placing a few fragments of copper in the strong acid, effervescence takes place, ruddy fumes of nitrous acid gas are given off, and a greenish liquid remains. No other test for the strong acid is required. The beautiful orange red colour produced in the salts of morphia by the contact of the acid, must be mentioned on account of its frequent application as a test.

Dilute Nitric Acid.—Having ascertained by the effect on litmus paper that the liquid contains an acid, we add to a portion of it a few drops of pure nitric acid and nitrate of baryta. The absence of precipitate proves that the acid is not sulphuric acid. To another portion of the liquid we add a few drops of nitrate of silver; and the absence of a precipitate shows that it is not muriatic acid. If a mineral acid, therefore, it is nitric acid; and as most of the vegetable acids give a precipitate with nitrate of silver, there is a strong presumption in favour of the liquid containing nitric acid. This presumption is converted into certainty by the following tests:—*a.* When boiled with copper filings, provided the acid be not very dilute, the characteristic orange-red fumes are given off. *b.* Having added carbonate of potash to the liquid till effervescence ceases, dip a piece of filtering paper into the liquid and dry it. It will burn like touch-paper.* *c.* On slowly evaporating the neutralized liquid, we obtain crystals of nitrate of potash.

The properties of the crystals of nitrate of potash obtained in this manner from the solution, form further corroborative proofs of the nature of the acid. These are as follows:—*a.* The crystals are lengthened, fluted prisms, permanent in the air. *b.* When rubbed to a fine powder, and mixed with an equal bulk of powdered charcoal, they burn with deflagration. *c.* On the addition of strong sulphuric acid, a colourless vapour with the peculiar odour of nitric acid is given off. *d.* Place a few grains of the salt in a test-tube, add a small quantity of distilled water, and then a few drops of strong sulphuric acid; drop into the resulting liquid a grain of morphia. This will be immediately changed to an orange red, and the liquid will assume a deep yellow colour. *e.* Substitute for the morphia some

* This taken alone is not characteristic, for the salts of all acids containing five proportions of oxygen, as the chlorates, bromates, iodates, &c., also deflagrate, but they almost never occur in medico-legal inquiries.

copper filings, the characteristic nitrous acid fumes will be given off. *f.* Place on a slip of glass a crystal of the salt, moisten it with a drop of distilled water, add a drop of concentrated sulphuric acid, apply the heat of a spirit lamp, and, as effervescence takes place, introduce into the liquid a crystal of the green sulphate of iron; a dark green ring will form around the crystal. *g.* Introduce the crystal of nitre, as before, into a test-tube, moisten with distilled water, add a drop of strong sulphuric acid, and one or two drops of strong muriatic acid: the resulting liquid dissolves gold leaf.

Objections to the Tests.—To some of the tests now specified there are objections, but the copper test is characteristic, as are also the last four tests. The morphia test only is open to objection, where the change of colour happens to be very slight. The sudden change to a deep orange on contact with nitric acid is quite characteristic.

Nitric Acid in Stains on Cloth.—These stains are yellow, orange, yellowish or brown, according to the length of time which has elapsed. The texture of the cloth is destroyed, and the stain (unlike that of sulphuric acid) is dry. The process of analysis is very simple. The fragment of cloth must be boiled in a small quantity of distilled water. The presence of an acid will be indicated by test paper. The appearance of the stain will leave no doubt as to the nature of the acid. Neutralize with caustic potash, and filter the solution. Dry the filter, and burn it. If nitric acid was present it will burn like touch-paper. Evaporate the liquid and crystallize. Collect the crystals with care, and apply the morphia test on a fragment of white porcelain. If the crystals are in sufficient quantity, apply the other tests in succession. As the nitric acid is less permanent than the sulphuric acid, evidence of its existence in stains on cloth cannot be obtained after so long a period. Satisfactory evidence, however, was obtained by Dr. O'Shaughnessy after an interval of some months.*

Yellow stains may exist on the skin, or in the internal organs, which it may be necessary to distinguish from each other. Such stains may be produced by nitric acid, by iodine, or by bile. M. Barruel points out the following simple distinction:—Stains from nitric acid when touched with a weak solution of caustic potash become orange yellow, and the stain is indelible. Those caused by iodine immediately disappear when touched with the alkali. The bile stain undergoes no change.†

Nitric Acid in Organic Liquids.—If the liquid is viscid, or contains solid matters, dilute with distilled water, boil, and filter. If the liquid is acid, neutralize with carbonate of potash, evaporate, and obtain crystals, to which apply the tests already described. This process may be adopted even though the liquid be strongly coloured.

If the antidotes, as chalk or magnesia, have been given, the liquid,

* Lancet, August 1830. The fragment of cloth submitted to analysis was part of a coat which had been folded up "during the previous summer months."

† Annales d'Hygiène, vol. i. p. 278.

instead of having an acid reaction, may be neutral or feebly alkaline. In this case, also, we must add carbonate of potash to the filtered liquid: nitrate of potash will be formed, and the insoluble carbonate of lime or magnesia will be thrown down, and must be separated by fresh filtration. The remaining steps of the analysis are those just described.

Portions of the mucous membrane which have been acted upon by the acid may be treated in the same manner as fragments of cloth.

The discovery of a very minute portion of nitric acid in the contents of the stomach does not afford sufficient evidence of poisoning; but, in the case of nitric as of sulphuric acid, the post-mortem appearances are so characteristic as to render chemical analysis unnecessary.

When the quantity of acid in the organic liquid is very small, it has been recommended to filter the liquid from the vessel containing it by means of a rough syphon formed of filtering paper.*

Quantitative analysis.—Convert the nitrate of potash into sulphate, dissolve the sulphate and calcine it, wash the residue with alcohol to remove any free sulphuric acid. For one hundred grains of the dry sulphate allow about eighty-two grains of liquid nitric acid.

Symptoms.—Those already described (p. 426), distinguished from sulphuric acid by the orange or brownish-yellow colour of the stains.†

Post-mortem appearances.—Those already described (p. 427). The colour of the mucous membrane yellow in parts, or green from the action of the acid on the bile. The degree of corrosion less than in cases of poisoning with sulphuric acid, and perforation of rarer occurrence.

The *smallest quantity* of nitric acid which has destroyed life is two drachms.‡ Recovery has taken place after considerable quantities had been swallowed.

The *shortest* period within which the poison has been known to prove fatal in the adult is one hour and three quarters: in the infant a few minutes.§

Treatment.—That already described for the mineral acids generally (p. 428).

Nitric acid, like sulphuric, has been introduced into the body in other ways than by the mouth. In one case it was poured into the ear, and was followed in succession by sloughing, abundant hæmorrhage, paralysis jactitans, extreme debility, and death in about thirteen weeks.‖

* For a description of this process, and of some of the objections to which the several methods are exposed, see Christison on Poisons, p. 152.

† Among the occasional symptoms of poisoning by this acid may be mentioned a miliary eruption on the skin, attended with intolerable itching, which occurred on the sixth day, in a case related by M. Desgranges, Recueil Périodique, No. XXXI., and Med. and Phys. Journal, vol. i. p. 500.

‡ Case of a boy thirteen years of age, mentioned by Mr. Taylor (Manual p. 100). The reference is not given.

§ See these cases quoted, Taylor's Manual, p. 101.

‖ Med. Gazette, March, 1836.

Several cases of poisoning by nitrous acid gas are on record. One of the most fully reported is to be found translated at length from Corvisart's Journal, vol. viii. p. 487, in the Edin. Med. and Surg. Journal, vol. iii. p. 16. The case was that of a chemical manufacturer, who incautiously exposed himself to the fumes from some bottles of nitrous acid which had burst. The first symptom was a sense of impending suffocation, which obliged him to hasten from the room. He, however, again exposed himself to the fumes, without immediate inconvenience ; but in about four hours began to suffer from great debility, dry and burning heat in the throat, irritation in the stomach and chest, tightness in the epigastrum, spontaneous purging of a matter of the colour of citrine ointment, urine scanty, dysuria. At the end of twelve hours, cough, expectoration of a yellow matter, nausea, and slight vomiting. After seventeen hours the body had a bluish colour, the oppression of the chest had increased, accompanied with rattling in the throat and hiccup, and acute pain in the abdomen and across the lower part of the chest. Convulsions, transient delirium, and inexpressible anxiety preceded his death, which took place twenty-seven hours after the accident. Other cases are referred to by Christison.*

MURIATIC ACID. (*Spirit of Salt.*)

Poisoning by muriatic acid is extremely rare, not more than four or five cases being recorded, and of these only three occurred in this country.

Tests—The Strong Acid.—The acid of commerce is of a yellow colour, fuming when highly concentrated, stains organic substances and corrodes them, and reddens vegetable blues. It is distinguished from sulphuric acid by its colour, and from nitric acid by the absence of decomposition and orange fumes on boiling it with metals. It is identified by boiling it with black oxide of manganese, when chlorine is given off, which is known by its colour, smell, and bleaching properties.

The Dilute Acid.—On the supposition that an acid liquid contains one of the mineral acids, we first add to a small portion of it a few drops of nitric acid, and the nitrate of baryta ; if there is no precipitate the acid must be either the nitric or the muriatic. Add to another portion a few drops of nitrate of silver. If muriatic acid is present we obtain a dense white precipitate of chloride of silver. In the case of the nitric acid there is, of course, no precipitate. The precipitate thus obtained has the following properties:—It is darkened by exposure to light, like other salts of silver ; it is insoluble in nitric acid, and in caustic potash, but very soluble in ammonia ; and the precipitate when dried and heated fuses into a horny mass, which may be cut with a knife.

* On Poisons, p. 734 et seq.

Objections to the Nitrate of Silver Test.—Almost all the vegetable acids give white precipitates with nitrate of silver. Hence a mere white precipitate must not be looked upon as sufficient evidence of muriatic acid ; but the nature of the precipitate must be ascertained. The characters in which the chloride of silver differs from the white precipitates formed with the several vegetable acids will be seen at once by a reference to Table II. in the Appendix. Another objection to the chloride of silver test is, that any of the vegetable acids with common salt will give the same precipitate as the free muriatic acid. This admixture will be suspected when, on evaporating a portion of the liquid, there is a crystalline residue, and it may be guarded against by first slowly distilling over the free acids, and testing the residue for the chloride of sodium.

Muriatic Acid in Stains on Cloth.—The portion of stained cloth must be digested in warm distilled water, and the resulting liquid must be filtered. Nitrate of silver will give the characteristic precipitate, which may be identified by the means already described. In this case, as in that of the other mineral acids, an unstained portion of cloth should be examined at the same time, and in the same manner.

Muriatic Acid in Organic Liquids.—Most organic liquids contain muriatic acid free or in combination, and most organic matters themselves are precipitated by nitrate of silver. Hence some preparation is necessary before this test can be employed. In the case of the contents of the stomach, the acid may exist either in the free state, in which case the liquid will have a strong acid reaction, or in combination with lime or magnesia, chalk or magnesia having been given as antidotes, and here the liquid may be neutral.

On the supposition that the liquid has a strong *acid* reaction, we must first submit the mixture to distillation, for which purpose the retort must be immersed in a boiling solution of chloride of calcium in the proportion of two parts of the crystallised salt to one of water. The distillation must be repeated by adding distilled water to the dry residue. The liquid distilled over may be treated as pure diluted acid.

To this process there are the following objections: 1. Free sulphuric acid with a chloride will give the same result. 2. The process will succeed only when the quantity of acid is not very small. The presence of free sulphuric acid may be detected by the nitrate of baryta ; and the second objection, though not obviated, is rendered unimportant by the consideration, that the discovery of minute quantities of muriatic acid in an organic liquid is no proof that the acid has been swallowed.

On the supposition then that free muriatic acid has been discovered in the contents of the stomach, this will not furnish any proof of poisoning by that acid, if the quantity is extremely small, for the gastric juice itself contains a minute proportion (one part in 1500) of free muriatic acid. The symptoms during life and the discovery in the stomach itself of the corrosive action of a mineral acid will gene-

rally be the best proof of the administration of this as well as of the other acids, and this proof scarcely requires confirmation from the chemical analysis. The general evidence, and the examination of the clothes will enable us to determine which acid has been taken.

If the organic liquid do not give an acid reaction, it may either be altogether free from the acid, or the acid may have combined with the antidotes administered—magnesia, lime, soda, or potash.—In this case we evaporate to dryness and calcine, dissolve the residue, and test the solution with nitrate of silver.

In this case, too, there is a fallacy. If carbonate of soda have been administered as an antidote, the discovery of a muriate is no proof of the administration of the free acid, for almost every article of food contains common salt. If, then, this salt should be discovered in the residue it will afford no proof of poisoning. Here again we must trust to the symptoms and post-mortem appearances, and the stains which we may discover on the clothes.

Quantitative Analysis.—Use for this purpose the precipitated chloride of silver. Every 100 parts of the dried chloride are equivalent to 69 grains of liquid muriatic acid.

Symptoms.—Those already described (p. 426).

Post-mortem Appearances.—Those already described (p. 427). The colour of the mucous membrane like that in poisoning by nitric acid, is yellow or green, from the action of the acid on the bile. There was no perforation in either of the four reported cases. Stains on black cloth were observed, in a case reported by Mr. Quekett, to be first red and afterwards green.*

The *smallest* quantity which has destroyed life was *one ounce.* The shortest period within which it has proved fatal was *five hours and a half.*†

Treatment.—That of the other mineral acids.

The nitric acid mixed with the sulphuric, under the name of *aqua reginæ*, and with muriatic acid, under the title of *aqua regia*, are used in the arts, the one to separate silver from plated articles, the other to dissolve gold and platinum. As neither of these poisons has been taken in this country, it is unnecessary to do more than to state the fact of their being in use, that the medical man may be prepared for the possible occurrence of cases of poisoning with them.

The mineral acids have also been taken in a state of mixture with other substances. Nitric acid with laudanum, aloes, &c., and muriatic acid in combination with tincture of iron and corrosive sublimate;—the mixture used for browning gun-barrels.‡

* Lancet, 1839—40, vol. i.

† In four other cases the intervals were 15 hours, 18 hours, 33 hours, and 8 days. The dose in the first and last two cases being two ounces, and in the third one ounce and a half.

‡ Med. Gaz., Nov. 1839.

CHAPTER XIV.

OXALIC ACID—(*Acid of Sugar.*)

Tests.—In the form of Crystals.—In Solution.—In Organic Mixtures.—Symptoms.—Post-mortem Appearances.—Treatment.—Binoxalate of Potash.

THIS substance is in common use in England, and is frequently employed as a poison. Of the 543 cases of poisoning occurring in England and Wales, in 1837 and 1838, nineteen, or 1 in 28, were from oxalic acid, of which thirteen were suicidal, and one accidental. When taken accidentally, it is generally by mistake for Epsom salts, which it closely resembles. It is very rarely used by the murderer; unless in a state of mixture with some liquor which is so strongly flavoured as to disguise its taste, such as gin, tea, or coffee.

Tests.—Oxalic acid may have to be examined in the form of crystals, in solution, and in organic liquids.

Oxalic Acid in the form of Crystals—The crystals are six-sided prisms, transparent, colourless, permanent in the air, very acid to the taste, soluble in from twelve to fourteen times their weight of water, and in alcohol. The crystals closely resemble sulphate of magnesia, and sulphate of zinc; with the former of which they are frequently confounded. The distinction is easy. Oxalic acid has an intensely sour taste; the other salts are bitter: the solution of oxalic acid has a strong acid reaction; that of the sulphate of magnesia is neutral, and of the sulphate of zinc only slightly acid: oxalic acid is entirely dissipated by heat; the sulphate of magnesia and zinc are fixed; liquor potassæ added to a solution of oxalic acid produces no change: it precipitates the white oxides of the sulphates of magnesia and zinc: oxalic acid discharges the colour of ink; the other crystals produce no change in it.

Oxalic Acid in Solution.—The liquid is known to contain a strong acid by its action on litmus. On the supposition that we are ignorant of the nature of the acid, we add to a small portion of the liquid a few drops of nitric acid and nitrate of baryta. The absence of precipitate shows that it is not sulphuric acid. We then add to another portion of the liquid a few drops of a solution of nitrate of silver; a white precipitate is thrown down, which will be identified as oxalate of silver by the tests presently to be described.

If we have reason to believe that the acid liquor contains oxalic acid, we may obtain more complete evidence by evaporating and obtaining crystals, or by the addition of ammonia, which, if the solution contain a large proportion of the acid, will produce a characteristic

radiated crystallization of oxalate of ammonia. The characteristic tests by which the oxalic acid may be fully identified, are the following: Nitrate of silver, sulphate of lime, and sulphate of copper.

1. *Nitrate of Silver.*—It throws down an abundant white precipitate, which is dissolved by nitric acid; and, when dried and heated on platinum foil, detonates, and is dispersed as a white vapour. (See table II. in the appendix.)

2. *Sulphate of Lime.*—The salts of lime give with oxalic acid a white precipitate, soluble in nitric acid, insoluble in a few drops of muriatic acid, and in tartaric acid; and reduced, when heated, to carbonate of lime. The precipitate, therefore, is characterised by effervescing with acids *after* exposure to heat.

3. *Sulphate of Copper.*—This throws down a greenish white precipitate, which is not soluble in a few drops of muriatic acid.

The most characteristic of these tests is nitrate of silver. It is also one of great delicacy.

Objection to the Tests.—If the solution contain nitric acid in excess, these tests will not act; it may, therefore, be necessary to evaporate the liquid, to crystallize, and to re-dissolve the crystals. The objections to the nitrate of silver test will be understood on referring to table II. They are obviated by the application of heat to the dried precipitate.

Oxalic Acid in Organic Liquids.—Oxalic acid is not altered by contact with the animal textures or with food. Hence the process is comparatively simple. It may exist free, or combined with some antidote, as lime or magnesia.

If the liquid has an acid reaction, add distilled water if necessary, and macerate for a few hours; then filter, and concentrate by evaporation. To the resulting liquid add acetate of lead till a precipitate ceases to be formed. The oxalic acid, if there is any in the liquid, will be converted into oxalate of lead. Diffuse this through distilled water, and transmit sulphuretted hydrogen gas for two hours through the mixture. Sulphuret of lead is formed, and oxalic acid remains in solution. The sulphuret having been separated by filtration, the characteristic tests may be applied to the liquid, as in the case of oxalic acid in solution. The acetate of lead is here used not as a test, but as a means of separating the oxalic acid; hence it is unnecessary to mention as an objection to this process the fact, that acetate of lead is precipitated by many other substances.

If carbonate of lime or magnesia has been employed as an antidote, and the acid is in combination with either of those bases, we may have to analyse it in this state. For this purpose the fragments of solid matter must be rubbed down, and the mixture must be brought to the consistence of a thin syrup by the addition, if necessary, of distilled water. Add to this mixture about a twentieth part of carbonate of potash, and boil for two hours. The resulting liquid, which will contain oxalate of potash, must now be filtered, and neutralized with pure nitric acid. To this add the solution of acetate of

lead as long as any precipitate falls. Collect, as before, the oxalate of lead, suspend it in distilled water, and separate the oxalic acid by transmitting sulphuretted hydrogen through the mixture. Identify the oxalic acid by the tests already described.

If the antidotes which have been administered have only partially neutralized the oxalic acid, and the separated liquid has an acid reaction, the two processes now described must be adopted for each portion separately.

It may be objected that the discovery of oxalate of lime in very minute quantity is no proof that oxalic acid has been taken, because rhubarb contains a minute proportion of that salt. The discovery of a mere trace of oxalate of lime, then, unless at the same time it can be shown that no rhubarb has been taken, will not establish the fact of poisoning. In most cases, however, the previous symptoms and post-mortem appearances will at once destroy this objection.

Oxalic acid stains cloth without corroding it, and reddens the vegetable blues. The acid may be detected by macerating the fragment of cloth in distilled water, filtering, and applying the tests. In consequence of its removing the colour of ink, it has been used to discharge writing.

Quantitative Analysis.—Use for this purpose the oxalate of lead. Every hundred grains correspond to forty-two of the crystallized acid.

Symptoms.—These vary with the dose and the degree of concentration. When the dose is large, and the solution concentrated, the symptoms follow immediately on the swallowing of the poison. They are, an intensely sour taste, a burning sensation in the stomach, and sometimes in the throat; the pain in the stomach increased by pressure. The pain is soon succeeded by vomiting, the matter rejected being sometimes bloody, but generally consisting of a greenish-brown or black grumous matter; if the patient survive several hours, there is purging of a similar matter, sometimes tinged with blood. The remaining symptoms are those of collapse,—pale and anxious countenance, small and frequent pulse, cold and clammy skin, and hurried respiration. Convulsions are sometimes superadded. If the patient survive for some hours, soreness of the mouth, inflammation and swelling of the tongue, constriction of the throat, painful deglutition, intense thirst, restlessness, difficulty of breathing, cough, extreme debility, cramps and numbness of the legs and arms, acute pain in the head and back, delirium and convulsions supervene; the group of symptoms varying with each case.

There are many anomalies and exceptions to the general rule. Even pain and vomiting have been altogether absent. An eruption has in one case appeared on the skin. The blood is said to be altered in character, though the poison has not been detected in it by chemical means. The altered quality of the blood is inferred from the speedy death of leeches applied to the epigastrium in a case of poisoning by oxalic acid.

Post-mortem Appearances.—The external appearance of the body is natural, and the countenance pale and composed. The mucous mem-

brane of the mouth and fauces is generally white, shrivelled, and easily detached, and a similar appearance extends into the œsophagus. The lining membrane of the œsophagus is often more or less extensively detached.* The stomach contains a dark brown, or greenish-brown, grumous matter, in appearance nearly resembling *meconium*, which also lines the œsophagus, and extends into the duodenum. The mucous membrane is sometimes quite pale, and free from rugæ; at others, the membrane is highly inflamed, and the rugæ strongly marked. The vessels of the stomach are minutely injected with black blood. It is easily stripped off, and in some instances has been extensively detached. Perforation is of rare occurrence. In cases of some continuance, the small intestines have presented the same appearances as the stomach. The peritoneum has been found inflamed, and in one case the right pleura. The lungs are sometimes greatly congested, and in one instance there were some traces of inflammation in the brain.

In rare instances, the most characteristic post-mortem appearances, like the symptoms during life, are absent.

First Appearance of the Symptoms.—Where the quantity of the poison is considerable, and the solution concentrated, the symptoms begin almost immediately. If the quantity is small, and the solution weak, they may be delayed for some hours.

The *smallest quantity* of the poison which has destroyed life is *half an ounce*; but a less quantity has produced severe symptoms, and on the other hand recovery has taken place after the administration of two or three times as much. Where active treatment is immediately adopted the patient often recovers.

The *shortest period* within which death has taken place is *ten minutes*, the dose being one ounce. Death has taken place in one case at the end of twenty-three days, the dose having been half an ounce.

Treatment.—The proper antidotes are chalk, and magnesia, or its carbonate, mixed with water: in the absence of these the plaster of the apartment. Lime water and oil have been used with advantage. The alkalis must not be used. Warm water may be given in large quantity after the use of the antidotes. If vomiting is not present, emetics of sulphate of zinc may be employed. The stomach-pump should not be used till all other means of evacuating the stomach have failed.

There are few poisons which by the promptitude of their action, and the marked symptoms they produce, are more characteristic. Christison justly observes, "If a person, immediately after swallowing a solution of a crystalline salt, which tasted purely and strongly acid, is attacked with burning in the throat, then with burning in the stomach, vomiting, particularly of bloody matter, imperceptible

* In a case which I had an opportunity of inspecting some years back with Mr. Alfred Taylor, the œsophagus was contracted into folds both longitudinally and transversely, and the mucous membrane detached in minute portions, leaving a dark brown surface, the whole tube resembling exactly a piece of worm-eaten wood.

tible pulse, and excessive languor, and dies in half an hour, or, still more, in twenty, fifteen, or ten minutes, I do not know any fallacy which can interfere with the conclusion, that oxalic acid was the cause of death. No parallel disease begins so abruptly, and terminates so soon; and no other crystalline poison has the same effects."* It may be added, that the post-mortem appearances, though not equally characteristic, afford a strong probability. The pale, shrivelled, and partially detached mucous membrane, the dark veins ramifying on the surface of the stomach, and the dark brown grumous matter which fills its cavity, point strongly to the action of a poison allied to the more powerful corrosives, while the absence of the spots on the skin, so rarely absent in poisoning by the mineral acids, would preclude the supposition of the effect being due to either of the mineral acids.†

BINOXALATE OF POTASH. (*Salt of Sorrel—Essential Salt of Lemons.*)

Tests.—The salt is found in the form of feathery crystals, which are less soluble in water than oxalic acid; but the solution has a strong acid reaction; is precipitated by nitrate of silver, sulphate of lime, and sulphate of copper; and in these respects resembles oxalic acid.

The salt differs from oxalic acid in the form of its crystals, and is at once distinguished by heating the crystals on a piece of platinum foil. The oxalic acid is completely dissipated, while the binoxalate of potash leaves an ash of carbonate of potash which effervesces with nitric acid, forming nitrate of potash. This may be identified as such by the appropriate tests. The binoxalate of potash has been mistaken for the bitartrate of potash or cream of tartar. The latter is not precipitated by sulphate or muriate of lime; lime water, however, throws down a white precipitate with both; but the binoxalate is not re-dissolved on the addition of a small quantity of a solution of tartaric acid, while the precipitate with cream of tartar is dissolved.

Mr. Taylor has collected three cases of poisoning by this salt.‡ In one of the three cases, half an ounce of the salt was taken by a lady recently delivered instead of cream of tartar, and death followed in eight minutes. Of the two other cases, one was fatal, the other recovered. The symptoms differ little from those of poisoning by oxalic acid.

* Treatise on Poisons, p. 208.

† Of 11 cases of poisoning by oxalic acid reported in the Journals, 5 were accidental, and 6 suicidal. Of the accidental cases, 3 were by mistake for Epsom salts. Of 13 cases, 5 recovered, and 7 died. 3 occurred in males, and 10 in females. The duration of the fatal cases was as follows—2 of a quarter of an hour, 1 of twenty minutes, 1 of less than half an hour, and 1 of eight days. The average duration of the first 4 cases was about twenty minutes.

The reader is referred to the following cases:—Med. Gazette, i. 757: v. 704: xxvii. 870: xxxi. 491. London Medical Repository, vi. 474: xi. 20; xii. 18. Lancet, Dec. 15, 1827: vol. ix.: x. 512: xxxii. 748, xxxiii. 29. Guy's Hospital Reports, vii. 353. Edin. Med. and Surg. Journal, xxiv. 67.

‡ Manual of Medical Jurisprudence, p. 124.

CHAPTER XV.

ALKALIS AND THEIR SALTS.

Potash and its Carbonate, Soda and its Carbonate, Ammonia and its Carbonate. — Tests. — Symptoms. — Post-mortem Appearances. — Treatment.—Nitrate, Sulphate, and Bitartrate of Potash.—Chloride of Sodium.—Iodide of Potassium.—Baryta and its Salts.

Poisoning by the alkalis and their salts is of rare occurrence. Of the 543 cases already referred to, one only was from a substance included in this class, viz. potash.

Caustic Potash, and Carbonate of Potass.—*Caustic Potash*, as found in commerce, is in the form of greyish cylinders or cakes, presenting, when broken, a radiated crystalline texture, soapy to the feel, acrid to the taste, highly deliquescent, rapidly absorbing carbonic acid from the air, fusible by heat, and very soluble in water. The solution has a strong alkaline reaction, and is distinguished from the alkaline earths by not being precipitated by carbonic or sulphuric acid, and by the yellow colour which it yields with bichloride of platinum. The *carbonate of potash* (subcarbonate, salt of tartar, potashes, pearl ash) is found in the form of small grains, which are white when pure, but are greyish, yellowish, or bluish, in their impure state. It is highly deliquescent, and a strong caustic, and gives out carbonic acid on the addition of a mineral or vegetable acid.

Soda and its carbonate resemble potash and its carbonate in their general properties. The *carbonate of soda* easily crystallizes, and is efflorescent, in both which properties it differs from potash and its carbonate. The following are additional means of distinction. Potash and its salts are precipitated yellow by the bichloride of platinum; soda and its salts are unaffected by it; perchloric acid throws down a crystalline precipitate from moderately strong solutions of potash, but not from those of soda; converted into an acetate, potash is extremely deliquescent, soda permanent; when converted into a nitrate by dilute nitric acid, potash crystallizes in prisms, soda in rhombic plates; a strong solution of tartaric acid precipitates potash in the form of white crystals, but does not affect a solution of soda; in the flame of a spirit lamp, the salts of potash burn with a violet colour, those of soda with a yellow.

Symptoms.—An acrid burning taste in the mouth accompanies the act of swallowing, and extends rapidly to the throat and gullet. This

is soon followed by acute pain in the pit of the stomach, and great tenderness on pressure; frequent and violent vomiting of tenacious mucus, often containing blood, and tinging vegetable blues green, violent colic pains, and purging of stringy mucus mixed with blood. There is constriction of the throat, with difficult deglutition, and sometimes hoarseness of the voice and cough. In the more acute cases death takes place with symptoms of collapse,—excessive weakness, cold sweats, hiccup, tremors, and convulsions. In the chronic cases, there is constant vomiting of food, difficulty in swallowing, bloody stools, tenesmus, rapid emaciation, and death from starvation. In still more chronic cases, death is due to long continued stricture of the œsophagus.

Post-mortem Appearances.—The mucous membrane of the throat and gullet is softened and corroded, with inflammation in different degrees of intensity in the œsophagus, stomach, and intestines, patches of ulceration, and dark spots caused by the extravasation of blood beneath the membrane. Sometimes the inflammation extends to the larynx. In chronic cases, large portions of mucous membrane are found removed, with contraction of the gullet and stomach. Perforation has not taken place in any of the recorded cases.

The *smallest* quantity of the alkalis or their carbonates which has proved fatal in the adult is *half an ounce* of the carbonate of potash.

The *shortest period* within which death has taken place is twelve hours. This occurred in a boy who had swallowed three ounces of a strong solution of the carbonate of potash. In other instances, as in the case of the mineral acids, the fatal event may be postponed for days, weeks, months, or even years. In a case related by Sir C. Bell death took place after twenty years from stricture of the gullet.*

Treatment.—Vinegar mixed with water in large quantities to neutralise the alkali, or almond or olive oil, also in large quantity, to convert it into a soap, and to shield the coats of the stomach. Acidulated demulcent drinks, and the juice of oranges or lemons may be used with advantage. The inflammatory symptoms must be combated with antiphlogistics, and collapse, if present, must be met by the usual stimulants.

Ammonia and Sesquicarbonate of Ammonia.—Ammonia in the form of gas, or dissolved in water, as the liquor ammoniæ, is distinguished from the other alkalis by its pungent odour, and by the change produced in vegetable colours being dissipated by heat. The *sesquicarbonate* (vulgarly known as hartshorn, volatile salt, or smelling salts) is at once distinguished from other substances by its pungent odour, and from liquid ammonia by yielding a precipitate with the salts of lime.

Symptoms.—These as far as they are due to actual contact, are the same as those produced by potash and soda, and their carbonates,

* Surgical Observations, part i. p. 82.

but from its extreme volatility it gains access to the air-passages, and has thus proved fatal in so short a time as *four minutes*. The incautious use of the vapour of ammonia with a view to rouse patients from syncope, or asphyxia, or as an antidote to prussic acid, has led to fatal bronchitis.

Post-mortem Appearances.—Signs of violent inflammation in the alimentary canal and air-passages.

The nitrate, sulphate, and bitartrate of potash, and the chloride of sodium resemble each other in being weak poisons, that is to say, in only acting as such in doses larger than most other poisons. Such salts are not generally considered poisons, and are consequently sometimes taken to procure abortion. They have also been taken by mistake.

NITRATE OF POTASH (Nitre, Salt-petre, Sal-prunelle).—Poisoning with this substance is commonly accidental, it being mistaken for sulphate of soda.

Tests.—For these, see nitric acid (p. 434).

Symptoms.—It is only when given in large doses that nitre is injurious. I have repeatedly given it medicinally in doses of a scruple, and it has been administered in doses of two and three scruples, and even to the extent of half an ounce in a dose without injurious effects. It has also been taken in doses of one or two ounces without producing any more severe effect than a strong emetic or purgative. One ounce is the smallest dose which has proved fatal, and in one case death took place in *three* hours. The symptoms are those of violent irritation of the alimentary canal, accompanied, in many cases, by convulsions, chorea, tetanus, or paralysis.

Post-mortem Appearances.—Marks of violent inflammation with patches of black, resembling gangrene. In one case there was a small aperture in the stomach.

Treatment.—The copious exhibition of demulcents, and, if vomiting be absent, of emetics. Antiphlogistic remedies if required.

SULPHATE OF POTASH.—Some cases which have recently occurred have attached an interest to this salt. It has more than once proved fatal when administered in large doses. In a case which occurred not long since in France, ten drachms of the salt, in divided doses, given to a lady within a week of her confinement, proved fatal in two hours. The symptoms and post-mortem appearances were those of irritant poisoning.

Tests.—The salt is readily identified by the nitrate of baryta as a test for the acid, and the bichloride of platinum as a test for the base.

BITARTRATE OF POTASH (*Cream of Tartar*, *Argol*).—This salt, too, has proved fatal in a large dose, the symptoms and post-mortem appearances being those of an irritant poison. This substance is generally found as a white powder, sparingly soluble in water, and the solution has a feeble acid reaction. The powder when heated is converted into carbon and carbonate of potash, which latter effervesces with acids. The base may be identified by bichloride of platinum. It

may be obtained as a sediment from organic liquids. The *treatment* is by copious demulcents, and by other remedies appropriate to the condition of the system.

Chloride of Sodium.—This salt in a large quantity has also destroyed life with symptoms of irritant poisoning. It possesses the following characters: it is soluble in water, and the solution, when slowly evaporated, gives cubic crystals. It is insoluble in alcohol. The solution gives with nitrate of silver a dense white precipitate which has all the properties of chloride of silver. When strong sulphuric acid is added to it, it yields vapours of muriatic acid, which become visible by holding over them a rod dipped in ammonia. On adding peroxide of manganese, sulphuric acid, and a small quantity of distilled water, chlorine is given off. The base may be detected by the means already pointed out (p. 445). It is scarcely necessary to state, that the discovery of common salt in the contents of the stomach is no proof of poisoning by that substance.

Iodide of Potassium.—This salt is important, inasmuch as it is extensively used in medicine, and even in small doses has produced serious effects.

Tests.—It is in the form of cubic Crystals, which, when pure, are white, permanent in the air, and very soluble in water and alcohol; but when impure, of a yellowish colour, and deliquescent. The salt is known by the effect of strong sulphuric acid, which turns it brown, causing effervescence and the disengagement of violet fumes of iodine.

In Solution the salt is recognized by the following tests:—corrosive sublimate yields a fine carmine-red precipitate, the biniodide of mercury; acetate of lead, the yellow iodide of lead; protonitrate of mercury, the yellow protiodide of mercury, which gradually changes to a dirty brown; sulphuric acid changes the solution to a brown; and, on the addition of starch, to a characteristic blue. This blue colour, in weak solutions, disappears on boiling, reappears on cooling, and is permanently removed by a stream of sulphuretted hydrogen gas. The base may be detected by the bichloride of platinum.

In Organic Mixtures.—Transmit sulphuretted hydrogen through the mixture to convert any free iodine into hydriodic acid. Drive off the excess of gas by a gentle heat, add potash in excess, filter, and evaporate to dryness. Place the residue in a covered crucible and char it at a low red heat; reduce the charred mass to powder, treat it with distilled water, and filter. Concentrate the liquid by evaporation, and apply the test of starch and sulphuric acid. By this means very minute quantities of the poison may be detected. As a trial test we may dip a strip of starch paper in the organic mixture, and expose it to the fumes of strong nitric acid. The resulting blue colour will indicate the presence of the hydriodate. If the mixture contain free iodine the reaction will take place without the use of the acid.

Hitherto it is only when given as a medicine in comparatively small doses that the hydriodate of potash has acted injuriously, and then

probably in consequence of peculiarity of constitution. Cases are recorded in which alarming symptoms have been produced by two or three doses of two or three grains, or a single dose of five grains; but the author has given this medicine in five grain doses three times a-day to large numbers of patients, but only in one or two instances with any constitutional effects, and those very slight and unimportant.

The symptoms are vomiting and purging, severe griping pains in the abdomen, watering at the nose and eyes, swelling of the face, headache, dryness of the throat, intense thirst, difficulty of breathing, frequent pulse, and great prostration of strength. In less marked cases the symptoms resemble those of a severe cold.

Treatment.—The poison should be promptly removed by the use of emetics, or by the stomach pump. The after treatment is by diluents, with antiphlogistic remedies if necessary.

BARYTA AND ITS SALTS.—There are several salts of baryta in use,—the soluble nitrate, chloride, and acetate, and the insoluble carbonate and sulphate. The chloride and the carbonate have proved fatal. The pure earth is met with only in the laboratory.

The *chloride* is found in commerce irregularly crystallized in tables. It has an acrid taste, is permanent in the air, and soluble in water. The *carbonate* is commonly found in the shops as a fine white powder, insoluble in water, and soluble with effervescence in dilute nitric or muriatic acid.

Tests.—Baryta, in common with strontia, lime, and magnesia, is precipitated white by carbonate of potash. It is also immediately precipitated white from a dilute solution by sulphuric acid, or any alkaline sulphate; while strontia is precipitated slowly from a weak solution, magnesia is not precipitated, and lime falls after a time in the form of crystals. Oxalic acid does not precipitate baryta from a dilute solution, but throws down strontia in the form of a feathery crystal, and lime and magnesia white. The salts of baryta colour the flame of a spirit lamp yellow, those of strontia and lime red. The acids in combination are easily distinguished; the carbonic acid by effervescing on the addition of dilute acid, the muriatic by the nitrate of silver, the nitric by precipitating with sulphate of potash, when sulphate of baryta will be thrown down, and nitrate of potash remain in solution, and acetic acid by the odour of the vapour disengaged on adding dilute sulphuric acid.

In organic Liquids.—As a trial test, add to a small portion of the filtered solution the dilute sulphuric acid, when, if baryta be present, a dense white precipitate will be thrown down. A similar precipitate is thrown down by the same test from salts of lead. The distinction is easy. Baryta is not affected by the addition of hydro-sulphuret of ammonia, while lead is thrown down as a black sulphuret. Having ascertained that the organic mixture contains baryta, add a little nitric acid to dissolve any carbonate which may be present, filter, and add sulphate of soda so long as there is any precipitate. Collect the

precipitate, mix it with charcoal in a platinum spoon or crucible, and heat the mixture. The sulphate thus changed to a sulphuret, is to be dissolved in boiling water and filtered. The clear liquid must be washed with dilute muriatic acid, when we obtain chloride of barium in solution. To this apply the appropriate tests for the base.

The *symptoms* produced by the salts of baryta are those of irritant poisoning, with the addition of an unusual degree of nervous affection.

Dr. Christison mentions the case of a woman and her child poisoned by a drachm of the carbonate. In another case, quoted by the same authority from the Journal of Science, an ounce of the chloride, taken by mistake for Glauber's salts, proved fatal within an hour; the symptoms being burning pain in the stomach, vomiting, convulsions, headache, and deafness. A fatal case, in which death took place in two hours, and the stomach was found perforated, is given by Wildberg.* The treatment consists in the free administration of sulphate of soda or magnesia as an antidote, with the use of emetics or the stomach-pump. The after treatment is that common to the whole class of irritants.

* See an abstract of this case in Mr. Taylor's Manual of Medical Jurisprudence, p. 74. For a case of recovery after a very large dose of the carbonate, see Med. Gaz. xiv. p. 437.

METALLIC IRRITANTS.

CHAPTER XVI.

ARSENIC.

Preparations of Arsenic.—Properties of Metallic Arsenic.—Of Arsenious Acid.—Tests for Arsenious Acid.—In Powder.—In Solution.—Liquid Tests.—Sulphuretted Hydrogen.—Reduction.—Characters of the Crust.—Marsh's Test.—Characters of the Crust.—Reinsch's Test.—In Organic Liquids.—In Animal Fluids and Solids.—Quantitative Analysis.—Arsenic detected in the Body long after death.—Not a natural Constituent of the Body.—Arsenic Acid.—Arsenite of Copper.—Sesquisulphuret of Arsenic.—Symptoms.—Post-mortem Appearances.—Treatment.—Arsenious Acid externally applied.—Arseniuretted Hydrogen.—Arsenic contained in Sulphuric Acid.—In Muriatic Acid.—Arsenical Candles.—Arsenite of Copper in Sweetmeats.—Poisoning by Arsenite of Copper.—By Sesquisulphuret of Arsenic.—Cases of Compound Poisoning.

THERE are several preparations of arsenic employed in medicine or in the arts. Besides the metal itself, there are three oxides; the greyish-black protoxide, which is unknown in this country, the white oxide, or arsenious acid, and arsenic acid: two pure sulphurets, the orange red realgar, containing one part of the metal and one of sulphur, and the yellow orpiment consisting of two equivalents of metal and three of sulphur, besides king's yellow which consists of an admixture of orpiment and arsenious acid: a white arsenite of potash, contained in Fowler's solution, a green arsenite of copper (mineral green), and a white arseniate of potash.

Metallic arsenic sublimes at 356° Fahr. In close vessels it sublimes unchanged, but when heated in contact with air, it is gradually converted into arsenious acid. The metal in the form of vapour has the odour of garlic. These properties require to be borne in mind.

The most important of all the preparations of arsenic is the arsenious acid.

ARSENIOUS ACID (*White Oxide of Arsenic, White Arsenic, Arsenic*).

This substance may be mixed, without suspicion, with many articles used as food, has scarcely any taste, is very cheap, may be bought under a plausible pretext, is allowed to be sold without restriction, and is, moreover, a deadly poison. These properties have brought it

into such general use, that in the two years 1837 and 1838, it destroyed no less than 185 lives, being as many as those sacrificed by all the preparations of opium taken together, and considerably more than the victims of all other poisons. Of these 185 deaths, 21 were accidental, 12 homicidal, and 112 suicidal.

Arsenious acid is found in commerce in the form of a solid cake, and of a white powder. The *solid* arsenious acid, when first sublimed, is nearly transparent, but becomes opaque by keeping, and resembles white enamel, intersected with thin transparent striæ. The powder alone is used as a poison. Arsenious acid in either of these forms has the following properties:—1. It is sparingly soluble in hot or cold water. 2. The solution has a very slight acid reaction. 3. It has a very faint sweetish taste. 4. The solution of the acid in boiling water, when slowly evaporated, deposits well-formed octahedral crystals. 5. It combines with alkalis, forming soluble arsenites.

There are two properties of arsenious acid which require a closer examination—the *solubility* and the *taste*.

Solubility.—This has been variously stated, and the results of different experiments vary more than might have been expected. Thus, according to Klaproth, 1000 parts of temperate water take up about $2\frac{1}{2}$ parts, being about $1\frac{1}{4}$ grains to the fluid ounce; according to Mr. A. Taylor, from one to two parts, being from half a grain to a grain to the ounce; and according to Guibourt, as much as 9·6 parts of the transparent, and 12·5 of the opaque variety, being 4·8 and 6·2 respectively to the fluid ounce: 1000 parts of boiling water dissolve, according to Klaproth, $77\frac{3}{4}$ parts, or $38\frac{3}{4}$ grains to the ounce, and retain on cooling 30 parts, or 15 grains to the ounce; according to Guibourt, 97 parts of the transparent, and 115 of the opaque variety, being $48\frac{1}{2}$ and $57\frac{1}{2}$ grains to the ounce respectively. According to Mr. Taylor, on the other hand, boiling water retains on cooling only $1\frac{1}{4}$ grain to the fluid ounce, but water boiled for an hour on the powder takes up 20 grains to the ounce, and retains 12 on cooling.* The most important of these experiments is that which determines the solubility of the poison in cold water; and it may be well to include in the estimate the experiments of Klaproth and Mr. A. Taylor, which give from half a grain to $1\frac{1}{4}$ grains as the quantity taken up. The presence of organic matter in a liquid renders the poison less soluble. This fact has a practical bearing.

Taste.—Arsenious acid was formerly described as having an acrid taste; but Dr. Christison has shown that this statement is incorrect. In the form of powder it has scarcely any taste, or, if any, a faint sweetish taste; but in the form of vapour this sweetness seems to be much more perceptible.†

Both the solubility and taste of arsenic have been subjects of inquiry in our courts of law.

* Guy's Hospital Reports, No. iv. p. 102.

† Otto Tachenius, in his *Hippocrates Chemicus*, says, "that after many sub-

Tests.—We may have to examine arsenious acid in the solid form; in solution; in organic liquids; and in the fluids and solids of the human body.

Arsenious Acid in the Solid State.—On the supposition that we are ignorant of the nature of a white powder submitted for analysis, the first step is to place a small quantity in a narrow test tube on a strip of platinum foil, and apply the heat of a spirit lamp. Arsenious acid is volatilized unchanged; and if there is any residue it is from plaster of Paris or some other impurity. This effect of heat does not prove the powder in question to be arsenious acid, for bichloride of mercury and calomel also sublime unchanged. To another portion of the powder add liquor potassæ. If the powder be arsenious acid no change takes place. Corrosive sublimate is changed to a yellow, and calomel to a black colour. Arsenious acid further differs from corrosive sublimate, in that the former is sparingly soluble in water, while the latter is very soluble.

Having by these two tests, or by previous information, ascertained that the powder is arsenious acid, we obtain further assurance by the following tests:—1. To a small quantity of the powder in a watch-glass add hydro-sulphuret of ammonia. No immediate effect is produced; but, after the lapse of some hours, the excess of ammonia being dispelled, the watch-glass is found covered with the deep yellow sesquisulphuret of arsenic. This decomposition may be hastened by driving off the excess of ammonia by heat, or by neutralizing it with a few drops of dilute acid. A deep orange-coloured precipitate is obtained if arsenic is present. Sulphur is thrown down on the addition of an acid of a pale yellow colour. A pale yellow precipitate, therefore, would furnish no proof of the presence of arsenic. 2. Introduce a small quantity of the powder into a small glass tube, and apply the heat of a spirit-lamp. It will be sublimed and deposited on the sides of the tube in the form of small brilliant octohedral crystals. This test, is quite characteristic. 3. Mix a small portion of the powder with about four times its bulk of freshly ignited charcoal finely powdered; introduce the mixture into a small glass tube, and apply the flame of a spirit-lamp. A ring of metallic arsenic is deposited on the cool part of the tube, and the characteristic garlic odour is given out. Any one of these tests gives sufficient evidence of the presence of arsenic, but the reduction-test has this advantage, that when we have the metallic ring we may, by driving the metal up and down the tube by the aid of the spirit-lamp, obtain the characteristic octohedral crystals, and, having dissolved them in distilled water, apply the liquid tests presently to be described.

The tests just enumerated are intended to be applied to a powder submitted for analysis, and in such quantity that we can divide it

limations of arsenic, on opening the vessel, he sucked in so grateful and sweet a vapour, that he greatly admired it, having never experienced the like before.'' This rash experiment, however, was followed by dangerous symptoms.—See Baker's "Employment for the Microscope," p. 133.

into several successive portions. But the arsenious acid sometimes presents itself in such a form and quantity that we must limit ourselves to the use of one test; that is, when we scrape it in small quantity from the surface of the stomach, or collect it as a deposit from the fluids contained in, or rejected from, that organ. In this case we resort at once to the process of reduction. As this process, then, may have to be applied for medico-legal purposes, it will be necessary to describe it more minutely, and to state the objections to which it is exposed.

The tube employed for the purpose of reduction should be of German glass, about one eighth of an inch in diameter and about three inches long. If the quantity of arsenious acid is large it should be well mixed with the charcoal, and introduced into the tube by means of a glass funnel of smaller bore, or along a triangular gutter of stiff paper. When the quantity of the powder is very small it is recommended to introduce it first into the tube, and then to cover it with the charcoal powder. The flame of the spirit-lamp should be applied in the first instance to the part of the tube above the mixture, so as to drive off any moisture which the tube may contain, which moisture may be absorbed by a roll of filtering-paper introduced into the mouth of the tube. The part of the tube containing the mixture must then be held steadily over the point of the flame of the spirit-lamp, when the arsenic will be sublimed and deposited, in the form of a ring, on the cool part of the tube. This ring consists of two parts, of which the lower has a more distinct metallic lustre than the upper. The former consists of the metal, the latter of the metal with variable proportions of arsenious acid. By applying the flame of the spirit-lamp below the crust the arsenious acid is driven higher up the tube, and the metallic appearance becomes more distinct. This test is extremely delicate. The three-hundreth part of a grain will yield a distinct crust.

Objections.—It is asserted that the crust thus obtained may be confounded with other crusts, or even with changes in the appearance of the glass itself. The crusts with which it is said to admit of being confounded are,—1. Charcoal driven up the tube, or deposited on its sides during the careless introduction of the mixture. The answer to this objection is easy,—the charcoal has no metallic lustre, but consists of black particles scattered over the inside of the tube. The objection would be guarded against by proper care. 2. Mercury may be sublimed by a similar process. This sublimate is in the form of distinct globules, which may be detected by the naked eye, or by the lens. 3. The oxide of Cadmium may be reduced so as to form a crust. In answer to this objection, it is sufficient to state that the oxide of Cadmium is extremely rare, and of a brown colour, that the crust is bordered by this brown oxide, that it gives out no garlic odour, that it is not readily volatilized like arsenic, and that the ring of metal when heated is converted to the brown oxide, instead of being sublimed as a white powder or a ring of octohedral crystals. The objections founded on

changes in the appearance of the glass are two in number,—1. A loss of transparency in the part of the glass to which the heat is applied, if the glass contain lead. This fallacy may be avoided by the use of glass which does not contain lead. But if such glass is used, it is sufficient to state, that the change is obviously in the glass itself, that it is confined to the part to which the spirit-lamp has been applied, and that, while the arsenic crust is driven off by heat, this appearance remains fixed. 2. Glass is said to contain arsenic. This is not the case, for it has been shown that the arsenic used in the manufacture of glass is volatilized during the process.

If, then, from a *white* powder, treated in the manner described, we obtain a distinct metallic crust, which crust is readily volatilized by heat, with the odour of garlic, and the formation of octohedral crystals, we have irrefragable evidence of arsenious acid. No additional test is really necessary, though it is usual to apply the liquid tests presently to be described.

Arsenious Acid in Solution.—On the supposition that we are ignorant of the substance held in solution in a clear liquid, and that we have ascertained that it does not possess any decided acid or alkaline reaction, we test for a base, by transmitting sulphuretted hydrogen through the liquid slightly acidulated with acetic acid. If the liquid contains arsenious acid its colour is changed to a rich golden yellow. If the quantity of the arsenious acid is considerable, a precipitate of the same colour is formed, but if it is in small quantity, the precipitate is not formed until the excess of gas has been expelled by heat. We ought, in no case, to pronounce upon the absence of arsenic until the liquid has been left at rest twenty-four hours after the excess of sulphuretted hydrogen has been expelled. The only other substances which yield with sulphuretted hydrogen a yellow precipitate are the peroxide of tin and cadmium, the one of rare, the other of extremely rare occurrence. There is the strongest presumption, therefore, in favour of arsenic. This presumption is converted into a certainty by the other liquid tests. These are—1. The ammonio-nitrate of silver.* This throws down a rich yellow arsenite of silver, which on exposure to light changes to a dingy brown. The test detects the 10,000th of a grain or less. 2. The ammonio-sulphate of copper,† which causes a precipitate of the bright green arsenite of copper. This test will detect the 8000th of a grain. 3. To these two may be added, when the sulphuretted hydrogen cannot be conveniently applied, the hydro-sulphuret of ammonia, which produces no immediate effect, but after a long interval, or on the addition of a few drops of acetic acid, the golden yellow sesquisulphuret, or orpiment, is thrown down, which is

* The ammonio-nitrate of silver is formed by adding liquor ammoniæ to a strong solution of nitrate of silver, till the brown oxide of silver at first thrown down is nearly redissolved.

† The ammonio-sulphate of copper is formed in the same way by adding liquor ammoniæ to a solution of the sulphate of copper, till the bluish-white hydrated oxide of copper is nearly redissolved.

readily distinguished by its solubility in caustic alkalis. It is necessary to distinguish the orange yellow precipitate thus formed from the sulphur thrown down on the addition of an acid.

The three liquid tests, then, are the ammonio-nitrate of silver, the ammonio-sulphate of copper, and the hydro-sulphuret of ammonia. Other liquid tests formerly in use are now by general consent abandoned. The sulphuretted hydrogen may also be termed a liquid test, inasmuch as it is applied to arsenious acid in solution ; but it will be more convenient to characterise it as the *gaseous test.*

Objections to the Liquid Tests.—1. To the yellow precipitate (arsenite of silver) obtained by means of the ammonio-nitrate of silver, it has been objected, that an alkaline phosphate or a solution of phosphoric acid will also yield a yellow precipitate. The answer to the first part of the objection is, that an alkaline phosphate will yield such a precipitate with nitrate of silver, but not with the ammonio-nitrate when properly prepared. The last part of the objection is valid, inasmuch as phosphoric acid yields a yellow precipitate with the ammonio-nitrate of silver. The distinction is easily made. Phosphoric acid does not give a green precipitate with the ammonio-sulphate of copper, nor the yellow sesquisulphuret with the hydro-sulphuret of ammonia. 2. To the green precipitate (arsenite of copper) obtained by adding to a solution of arsenious acid the ammonio-sulphate of copper, there are the objections, that any intensely yellow solution, as carbazotic acid or bichromate of potash will change to green on the addition of the blue ammonio-sulphate ; and that with a decoction of onions a distinct green precipitate is formed. These objections are obviated by the simultaneous employment of the silver test, and the sulphuretted hydrogen or hydro-sulphuret of ammonia. We may also procure a ring of metal by applying heat to the dry arsenite of copper, introduced into a small reduction-tube. 3. Any objections which may lie against the hydro-sulphuret of ammonia are removed by collecting the precipitate and reducing the metal in the manner presently to be described.

To the three liquid tests, when simultaneously employed, and yielding well marked precipitates, there is, then, no objection, as no substance but arsenic yields with all of them the precipitates just described. The characteristic precipitates are prevented, or interfered with, by several substances existing in the solution, or by the admixture of organic matter. The liquid tests, therefore, must only be applied to simple solutions of arsenious acid. As they are now never employed except as trial tests, and for medico-legal purposes in order to prove that a white powder or crystals obtained from the oxidation of a ring of metal really consists of arsenious acid, this last objection finds no place.

The Gaseous Test—Sulphuretted Hydrogen Gas.—The mode of applying this test has already been described in speaking of the means of discovering arsenious acid when we are ignorant of the nature of the substance submitted to analysis. To the clear solution, we add a few drops of acetic acid, transmit the gas through the liquid, boil to expel

the excess of gas, collect, wash, and dry the precipitate. It has the following properties:—it is soluble in caustic ammonia, soda or potash; but insoluble in water and alcohol, and in mineral and vegetable acids, with the exception of strong nitric and nitro-muriatic acids, which decompose it. But the most characteristic property is that of yielding, when heated with black flux, a ring of metallic arsenic.

The reduction of sesquisulphuret of arsenic is not effected, like the arsenious acid, by charcoal, but requires the use of a flux containing an alkali. That commonly employed is the black flux, which is formed by mixing one part of nitrate with two of bitartrate of potash, and projecting the mixture by degrees into a crucible heated to redness. The result is a mixture of carbonate of potash with minutely divided charcoal. As this mixture is highly deliquescent it must be carefully dried for use.* About three parts of the flux must be mixed with one of the sesquisulphuret of arsenic, and heat must be applied in the manner already described.

Objections to the Gaseous Test.—To the assertion that a liquid from which, on transmitting sulphuretted hydrogen through it, we obtain a yellow precipitate, contains arsenic, there are three objections. 1. Cadmium also yields a yellow precipitate. The answer to this objection is, that sulphuret of cadmium is thrown down directly by the hydro-sulphuret of ammonia, while the sulphuret of arsenic is not thrown down till after a very long interval, or on the addition of an acid. Sulphuret of cadmium is insoluble in ammonia, but soluble in strong muriatic acid; arsenic is soluble in the former and insoluble in the latter. The crusts obtained from the two sulphurets present the differences already described. 2. A persalt of tin also yields a yellow sulphuret with sulphuretted hydrogen. It differs in that the hydro-sulphuret of ammonia occasions an instantaneous precipitate, in the solution of a persalt of tin, which precipitate is insoluble in ammonia. It also gives no metallic sublimate. 3. Antimony gives a brick-red precipitate, not easily confounded with the orange-yellow sulphuret of arsenic. The solution is also immediately precipitated by hydro-sulphuret of ammonia, and the precipitate gives no metallic sublimate.

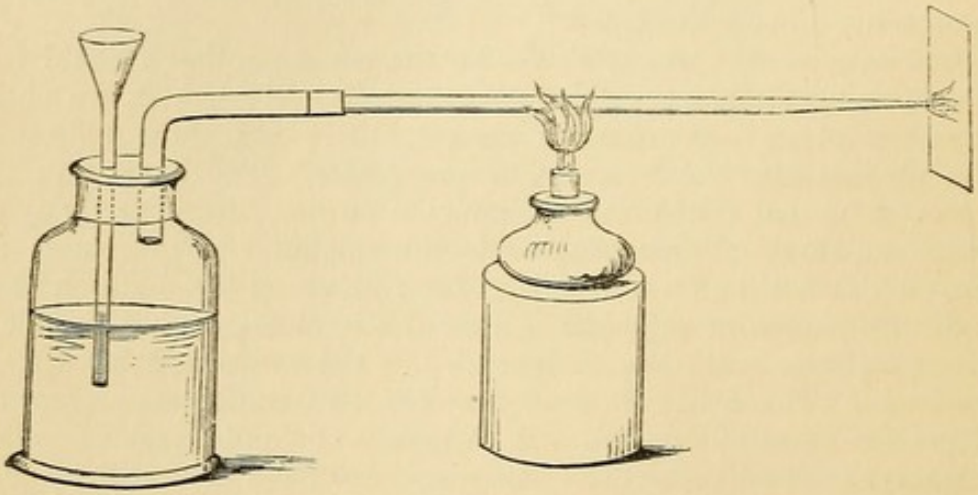
The distinction, therefore, between the precipitated sesquisulphuret of arsenic and the sulphurets of cadmium, tin, and antimony, is easily made. The reduction test serves as a further means of distinction, for neither antimony nor tin, when mixed with black flux and heated in the manner described yields any metallic sublimate; while that of cadmium is readily distinguished by the colour of the oxide which is always blended with the crust.

The gaseous test, then, applied with simple precautions, and followed by the reduction test gives certain evidence of arsenic. It is quite unnecessary, though for medico-legal purposes desirable, to convert the sublimed metal into arsenious acid and to apply the liquid tests.

* Mr. Taylor recommends, as more free from objection, incinerated acetate of soda.

There are two other tests for arsenious acid in solution—Marsh's test, and Reinsch's test.

Marsh's Test.—The original form of the apparatus employed by Mr. Marsh was that of a tube bent in the shape of the letter J, the long leg being twice the length of the shorter one, and open, and the latter furnished with a stop-cock terminated by a nozzle with a minute bore. Hydrogen was generated in this apparatus by pure zinc and dilute sulphuric acid, to which a portion of the liquid containing arsenic was added. When the arseniuretted hydrogen had filled the smaller leg of the tube the stop-cock was opened, and the jet of gas inflamed. On holding over the flame a piece of glass or porcelain, a distinct metallic ring was deposited upon it. Many alterations and modifications of this apparatus have been suggested, which it is unnecessary to describe. The subjoined engraving represents the most



convenient form. The apparatus consists of a wide-mouthed bottle with a closely fitting cork, pierced for two tubes, of which the one, furnished with a funnel, dips beneath the liquid, and the other bent nearly at right angles, but sloping slightly towards the bottle descends but a short distance into the vessel. This tube is furnished with a cork for the reception of a detached horizontal tube of glass free from lead, and drawn out at its extremity into a point with a small aperture.

In this apparatus hydrogen is generated by pure zinc and dilute sulphuric acid, and the action is continued till the atmospheric air is completely expelled, and all risk of an explosion is thereby avoided. We then heat the horizontal tube by the flame of a spirit-lamp, in order to ascertain that the materials we have used occasion no deposit on the sides of the tube. This is an essential preliminary, for, if this precaution were not used, it might be objected that the zinc or dilute sulphuric acid itself contain arsenic. Having convinced ourselves of the purity of these substances, we pour into the funnelled tube a portion of the liquid supposed to contain arsenious acid, and immediately reapply the spirit-lamp to the horizontal tube. If the liquid contain

arsenious acid a metallic deposit will take place on the tube at the distance of half an inch or more from the part to which the flame is applied. The horizontal tube should be at least five or six inches in length, so that we may obtain two such crusts at least. Having procured these, we may inflame the hydrogen as it issues from the end of the horizontal tube, and obtain one or two deposits on small fragments of glass. A very minute quantity of arsenic will suffice for both these purposes. We may then continue to apply the flame of the spirit-lamp to the horizontal tube, until the absence of stain from a fragment of glass held before the jet proves that the metal is exhausted.

The metallic rings on the tube and the spots on the fragments of glass are either arsenic or antimony. To determine which metal it is, we first procure on small fragments of glass a similar crust of antimony. The next step is to melt a small quantity of tin in a shallow Wedgewood evaporating dish placed over a spirit-lamp, keeping the tin at the melting point by placing in it a fragment of the unmelted metal, we float on the melting metal the fragments of glass with the metallic stains uppermost, and continue to apply the flame of the lamp. When the temperature of the metal has risen somewhat above the melting point, the crusts of arsenic will be found to contract by degrees and ultimately entirely to disappear, while the stains of antimony undergo no change till the temperature has been raised to a much higher point. Then, but not till then, they, too, contract in the same way, and very slowly disappear.*

The disappearance of the arsenic stains is accompanied by the characteristic garlic odour.

The stains of antimony and arsenic in the tube present some remarkable differences. The antimony is deposited close to the point of the tube to which the heat is applied, the arsenic at some distance from it; the antimony volatilizes very slowly, the arsenic rapidly, on the application of heat; the arsenic has often a nut-brown colour nearly resembling that of copper, the antimony more nearly resembles tin;

* This simple means of distinguishing the crusts of the two metals was suggested to the author by an ingenious paper published in the Medical Gazette, vol. xxx. p. 456, by Mr. H. W. Watson. He employed for the purpose a fixed oil, of which the boiling point 600°, is above the volatilizing point of arsenic (356°), and much below that of antimony (810°); but he suggested the use of some salt of which the boiling point is about that of arsenic. A melting metal is here recommended as more convenient. Though arsenic is asserted to volatilize at 356° Fahrenheit, the crust is not dissipated at the melting point of tin which is 442°. The plan here recommended has the advantage of simplicity, and with the most ordinary care is open to no objection. The comparison of the crust obtained from the liquid submitted to analysis, with similar crusts of arsenic and antimony guards against every possible objection. It is obvious that if the additional test of heat is to be used at all, it must be in some such way; for the direct application of the flame of the spirit-lamp to the crusts would be objectionable, inasmuch as the temperature might be sufficient to volatilize both metals, and the intervention of a surface of metal such as a knife, or platinum foil, would not remove the difficulty.

the antimony crust often resembles smoke, the arsenic never has such an appearance; the fumes of arsenic have the odour of garlic, those of antimony are inodorous. Of these characters the first, second, and last, are highly characteristic, but the appearance is more deceptive; for though the antimony rarely presents the distinct copper colour of arsenic, nor arsenic the tin-like lustre and smoky appearance which belong to many crusts of antimony, it is possible to obtain, both in the tube, and on fragments of glass, crusts of antimony and arsenic so nearly resembling each other as to defy the most practised eye to distinguish them.*

We must not, therefore, trust to the appearances of the crust, but apply other means of discrimination. The effect of heat, applied in the manner recommended, is quite decisive. As it is well, however, for medico-legal purposes to obtain the most complete conviction, the crust contained in the tube may be driven up and down, until it is converted into arsenious acid, which may be distinguished by the shape of its crystals. We may also dissolve it, and apply the liquid tests.

Some precautions are necessary in the use of this test. In the first place, the generation of hydrogen should not go on too briskly at the time of adding the suspected liquid; for the smallest addition of another metal occasions a violent extrication of gas. To avoid the risk of explosion it is well to generate the gas freely at first, but to wait till the action has become less violent before adding the suspected liquid. Having next ascertained by the continued application of the flame of the spirit-lamp to the horizontal tube, not only that there is no risk of explosion, but that no deposit is formed on the tube itself, in other words, that the materials are pure, the suspected liquid must be added drop by drop, the flame being kept constantly applied. If there is much froth, a small quantity of spirits of wine may be poured into the funnelled tube. By this mode of proceeding all risk is avoided, and all objections are obviated. Though several other substances may combine with nascent hydrogen, or be mechanically carried over, and deposited on the tube, there is none which can be mistaken for the arsenic crust, except antimony; and this is distinguished by the methods just pointed out. The objection that the zinc and sulphuric acid may themselves contain arsenic is obviated by the preliminary application of heat to the horizontal tube.†

* The appearance of the crusts varies remarkably with the quantity of the metal, and occasionally from causes difficult to understand. In one instance I obtained from the blood of a patient poisoned with arsenic, a crust consisting of three distinct parts — a thin iridescent film of metal, a distinct coating of sesquisulphuret, and a third of arsenious acid, forming an extremely beautiful variegated crust. On applying heat to another part of the tube, I obtained a crust possessing the usual characters.

† In this place one or two plans for distinguishing arsenical and antimonial crusts may be mentioned. Fresenius converts the metallic ring into sulphuret by transmitting a stream of dry sulphuretted hydrogen through the tube, and chasing the metal, by the heat of a spirit-lamp, in a direction opposed to the stream of gas. Dry hydrochloric acid is then transmitted through the

Reinsch's Test.—This test consists in adding to the liquid containing arsenious acid a few drops of pure muriatic acid, and introducing a slip of bright metallic copper. On heating the liquid to the boiling point, the copper will be coated with an iron-grey deposit of arsenic. The copper, being removed from the liquid, must be washed in distilled water, dried, and introduced into a reduction tube. On applying heat, arsenious acid will be sublimed and deposited on the sides of the tube in the form of minute octohedral crystals. The portion of the tube containing these crystals may be filed off, the arsenious acid dissolved in distilled water, and the liquid tests applied.

Objections.—Muriatic acid may contain arsenic. To obviate this objection ascertain the purity of the acid by diluting it, and boiling in it a strip of clean copper. If no deposit takes place the acid contains no appreciable quantity of arsenic. Another objection arises from the fact, that from liquids containing antimony and bismuth, when similarly treated, a similar metallic deposit is obtained. Mercury and silver give a deposit without boiling, solutions of tin and lead, and alkaline sulphurets tarnish the metal. To furnish an answer to all such objections, arsenious acid must be obtained in the manner described, and the liquid tests must be applied. If these tests act characteristically the proof of the presence of arsenic is complete. In the absence of such confirmation a metallic film on the copper will not demonstrate the presence of arsenic.

Arsenious Acid in Organic Liquids.—As arsenious acid is very insoluble in water, and still more so in liquids containing organic matter,

tube without the application of heat, when if the sulphuret of antimony is present it is carried off, while the arsenic is unaffected.—Elementary Instruction in Chemical Analysis. By Dr. C. R. Fresenius. Translated by J. L. Bullock, p. 125. I have more than once carefully performed this experiment on both sulphurets, and with the effect of driving both of them off. Another means of discrimination consists in transmitting the gas through a spirituous solution of ammonia, when the antimony is arrested, and produces a flocculent black precipitate while the arseniuretted hydrogen passes unaltered. I have found this plan successful in arresting part of the antimony, which discolours the liquid and produces the dark flocculent precipitate; but when the quantity is considerable a crust is formed. The apparatus and method recommended in the text have the peculiar advantage of simplicity, and offer, unless the quantity is very inconsiderable, every facility for confirming the evidence derived from the crust alone. Another mode of distinguishing the arsenical from the antimonial crust has been proposed by Mr. A. Taylor. It consists in receiving the deposits "on a sheet of bright copper or brass, that from arsenic has an iron-grey lustre and clear metallic polish; that from antimony presents the same rings of black hydruret of antimony, alternating with rings of oxide, which are observed on glass. I have not found any metallic lustre from antimony under these circumstances, and the antimonial deposit is removed by the slightest friction, while that from arsenic is persistent." The distinction here pointed out has not appeared to me so marked as in this description. Occasionally a crust of antimony and arsenic will closely resemble each other, both before and after the metal has been strongly rubbed. The appearance, moreover, varies in both cases with the size and heat of the flame.

we may sometimes procure the arsenious acid in a solid shape by diluting with distilled water, and allowing the powder to subside. In cases of poisoning with arsenious acid also, the powder may be found adhering to the mucous coat of the stomach. By carefully collecting the powder in the one case, and by scraping it off from the mucous membrane in the other, we may at once reduce it to the metallic state. For this purpose we must proceed in the manner described at p. 454.

If there is no solid arsenious acid in the organic liquid, it may still be dissolved or diffused through the liquid. In this case the organic liquid must be rendered slightly alkaline by liquor potassæ, and then carefully evaporated to dryness. By this means a large portion of the organic matter is coagulated, so that by boiling the residue in distilled water, a liquid may be obtained which will pass the filter. The solid matters which remain on the filter must still be preserved. The clear filtered liquid may now be tested by sulphuretted hydrogen, or by Marsh's or Reinsch's test. One test or the other may be preferred, according to the experience of the operator. They are all decisive, provided we identify the metallic crust by the methods described under the head of the several tests. Marsh's test is by far the most delicate, Reinsch's the most simple, and the gaseous test, which until recently was most in use, perhaps, on the whole, the most satisfactory. If on applying some trial test to a small portion of the liquid we discover decided traces of arsenic, we may divide the liquid into three parts and apply the several tests in turn. When there is reason to believe that the quantity is small, Marsh's or Reinsch's test alone should be employed. If we fail to procure evidence of arsenic from the filtered liquid, the solid residue may be boiled with nitric acid or deflagrated with nitrate of potass, in the manner presently to be described. By this means evidence may be obtained after the above process has failed. Sometimes when no arsenic is to be found in the contents of the stomach, it may be procured from the stomach itself by boiling it, filtering the resulting liquid, and applying any of the tests.

Arsenious Acid in the Solids or Fluids of the Body. — As there are cases of poisoning by arsenic, in which the poison is entirely expelled during life, so that no trace of it can be discovered in the stomach after death, it is most important to be able to detect the poison in the fluids or solids to which it has been conveyed by absorption. Orfila has the merit of having first directed attention to this proof of poisoning, and of having devised methods of analysis. These methods have been since modified, and others adopted in their place.

As this part of the subject of poisoning with arsenic has recently attracted great attention, and given rise to much controversy, the several methods which have been recommended will be briefly described.

They all consist of three essential parts: The destruction of the animal matter, and the concentration of the poison ; the reduction of

the poison by means of Marsh's apparatus ; and the complete identification of the result of the reduction.

Three principal methods have been proposed for the destruction of the animal matter, two by Orfila, and a third by M. M. Flandin and Danger. In the first, nitrate of potash is employed ; in the second, nitric acid ; and, in the third, sulphuric acid.

1. *Reduction by Nitrate of Potash.*—If the substance supposed to contain arsenic is in the form of a liquid, such as urine, the nitrate of potash is dissolved in the liquid, which is then evaporated to dryness. If it is in the shape of a solid, as portions of the liver, spleen, or heart, it is cut into fragments, and well mixed, in a mortar of glass or porcelain, with double its weight of nitre, and the mixture is then dried. This mixture of animal matter and nitre is then introduced in small fragments into a Hessian crucible, heated to a dull red heat. If the first fragments introduced, instead of being reduced to a white or grey substance, are black, as if charred, the quantity of nitre is insufficient, and an additional quantity must be added. The whole substance having been deflagrated, the residue will be found at the bottom of the crucible in a state of fusion. This is removed, and boiled in a small quantity of distilled water. This saline solution is now decomposed by sulphuric acid, added cautiously, and in slight excess. The resulting liquid is evaporated to dryness, the saline residue dissolved in a small quantity of distilled water, and introduced into Marsh's apparatus.

2. *Reduction by Nitric Acid.*—A decoction of the animal substance supposed to contain arsenic is treated with pure nitric acid, and evaporated to dryness in order to carbonize the animal matters. The ash is then boiled in distilled water, and the solution is filtered and evaporated to a quantity convenient for introduction into Marsh's apparatus. M. Orfila, however, prefers the following plan :—dry the animal matters, and cut them into small fragments. Warm some pure nitric acid in a large porcelain vessel, and add these fragments, one by one, until they are completely dissolved. Evaporate the resulting liquid till, in place of common fumes of nitrous acid, it gives off, all at once, a thick smoke. The vessel must then be removed from the fire, when the mixture swells into a bulky ash ; this ash must be powdered, and boiled in distilled water. The solution being filtered, and evaporated to a suitable quantity, must be introduced into Marsh's apparatus.

3. *Reduction by Sulphuric Acid.*—Cut the substance to be analysed into fragments, place them in a large vessel of porcelain, and add, from a sixth to a fourth of their weight of pure sulphuric acid ; place this vessel on the fire, stir the contents with a glass rod, and evaporate slowly. If the ash, instead of being friable, is soft and greasy, it will be necessary to add a fresh quantity of sulphuric acid, and proceed as before till we obtain a crisp ash. Reduce the charcoal to powder, and moisten it with nitro-muriatic acid, in the proportion of

three parts of nitric acid to one of muriatic. The arsenious acid is thus converted into the more soluble arsenic acid ; this mixture is again evaporated to dryness, boiled in distilled water, filtered, and introduced into Marsh's apparatus.

Of these three processes the first is to be preferred, and is the one recommended by the Commission appointed by the Parisian Academy of Sciences. It has the advantage of obtaining the arsenic in the form of an arseniate of potash, which is not apt to be volatilized by the heat employed. The other processes, however, though more likely to occasion a loss of arsenic by volatilization, yield, when carefully conducted, very satisfactory results. By the second process, with nitric acid, I obtained from less than a pound of blood, collected from the heart and large vessels of a patient who had been poisoned by arsenic, a distinct metallic ring, and the peculiar crust described in the note at p. 460. In the same case I collected arsenious acid in substance from the mucous coat of the stomach, and detected it in considerable quantity in the contents of that organ.

Quantitative Analysis.—For this purpose we use the sesquisulphuret of arsenic obtained from a measured portion of the liquid purified by being dissolved in ammonia, and then washed in distilled water and dried. 100 grains of sesquisulphuret correspond to about 8 grains of arsenious acid.

Arsenic is one of those poisons which may be detected in the dead body after long intervals of time. In one instance after so long an interval as seven years. In such cases it is usually found attached to the coats of the stomach in the form of sesquisulphuret of arsenic, formed by the union of the arsenious acid with the sulphuretted-hydrogen generated in the process of putrefaction. It may be collected, dried, and reduced with black flux.

The same authority to whom we owe the suggestion of examining the fluids and solids of the body, in cases of poisoning by arsenic, has thrown a doubt over the value of evidence derived from this source, by the supposed discovery of arsenic as the natural constituent of the body itself. He imagined that he had discovered it in the bones, and probably in the muscles. Subsequent researches of himself and others have shown, that there was in his first experiments some source of fallacy. To render the evidence from this mode of analysis satisfactory, it would be advisable to compare a portion of the same fluid or solid from the body of a person who had died a natural death, and treat it precisely in the same way.

Arsenic Acid.—This acid, though not used as a poison, is of some importance, inasmuch as it is formed in the course of the processes just described. It is a white deliquescent solid. It resembles arsenious acid in yielding a yellow precipitate with sulphuretted hydrogen, a metallic sublimate when reduced with charcoal, and a metallic crust when treated by Marsh's or Reinsch's method. It differs from arsenious acid in being very soluble in water, in having a strong acid re-

action, and in not being volatilized by the heat of a spirit-lamp. It is also precipitated red by nitrate of silver, and by the ammonio-nitrate, while arsenious acid gives with the latter a yellow precipitate.

The combinations of arsenic acid are called arseniates, and have the same properties.

The Sulphurets of Arsenic.—The sesquisulphuret of arsenic is the yellow precipitate thrown down from liquids, containing arsenious or arsenic acid, and their compounds. It is also occasionally administered as a poison, and is sometimes found adhering to the coats of the stomach after death, having been formed, as already stated, by the union of arsenious acid with nascent sulphuretted hydrogen, formed during the process of decomposition. Its properties have already been described. In organic mixtures it will be detected by its intense yellow colour, may be dissolved by ammonia, and thrown down in a state of sufficient purity by muriatic acid.

Arsenite of Potass.—This is the active principle of Fowler's solution, in which it is contained in the proportion of four grains to the ounce. It may be analysed by any of the methods recommended in the case of arsenious acid.

Arsenite of Copper.—This substance may be mixed with charcoal and reduced in the same manner as arsenious acid. It yields a metallic sublimate, and leaves a residue of pure copper.

SYMPTOMS, POST-MORTEM APPEARANCES, AND TREATMENT.

Symptoms.—The symptoms of poisoning with arsenious acid are those of the class of irritant poisons added to some which are peculiar to the poison itself. In the majority of cases they set in at variable periods of from ten minutes to half an hour after swallowing the poison, with nausea, burning pain in the pit of the stomach increased by pressure, faintness, and vomiting. After a variable interval purging comes on, accompanied by a more diffused pain, swelling and tenderness of the belly, a sense of constriction in the throat, intense thirst, headache, frequent pulse, quick catching respiration, great restlessness, increased debility, cramps in the legs, and convulsive twitchings of the extremities. If death takes place it is either from collapse or from irritative fever, or after a long train of nervous symptoms, In cases of recovery the restoration to health may be complete, or the patient may be harassed by severe dyspeptic symptoms, or by symptoms due to the strong impression made upon the nervous system.

The symptoms vary greatly in different cases. In some they are merely those of collapse ; there is little or no pain, slight vomiting, no diarrhœa, a cold and clammy skin, extreme prostration of strength, the pulse either so low as 30 or 40 beats, or very frequent and almost imperceptible. The mind is unimpaired, there is some approach to coma, slight cramps or convulsions, and death ensues before any reaction has taken place. Sometimes these symptoms of collapse

are accompanied with constant vomiting and profuse purging. In this class of cases death often takes place in four or five hours, and is rarely delayed beyond twenty hours.

In another class of cases the symptoms from the first are those of violent excitement, or they follow a stage of collapse. The vomiting is more incessant, the pain in the pit of the stomach more intense and increased by the slightest pressure; there is a sensation of burning heat and constriction in the throat, the tongue and throat are red, the eyes blood-shot, the countenance flushed and swollen, the thirst excessive; the diarrhœa profuse, accompanied by intense pain and great swelling of the abdomen, with tenesmus and dysuria; the skin is hot and dry; the pulse full, quick, and frequent; the respiration laborious; there is a sensation of oppression at the heart, with violent palpitation; intense headache, giddiness, incessant restlessness, and severe cramps in the legs and arms, followed, if life is prolonged, by convulsions, tetanic spasms, epileptic fits, coma, delirium, insensibility, —a group of nervous symptoms varying with each case, and terminating in various ways and at various intervals in recovery or death.*

* The great importance which attaches to the subject of poisoning by arsenic, and the very variable character and grouping of the symptoms in different cases, renders a more detailed account of symptoms both desirable and necessary. The following is a brief statement of the results of the analysis of 25 cases.

Vomiting, stated to be present in 23 cases, but in one case not till it was artificially induced. In one or two instances, in common with every other marked symptom, it has been absent. The *vomited matters* consisted, in 3 cases, of blood; in 2, of mucus tinged with blood; in 1, of mucus only; in 1, of water containing arsenic; in 1, of bile, and in 1, of bile and fæces. In the other cases the character of the vomited matter was not mentioned. *Diarrhœa.* Of 15 cases in which this symptom is mentioned, it was present in 11 cases, and stated to be absent in 4; in 7 cases it was excessive. The *matters passed by stool* consisted, in 3 cases of blood, and in 2 they are described as closely resembling green paint. *Pain.* Of 20 cases in which this symptom is mentioned, it was present in 19, and stated to be altogether absent in 1; in 2 instances it subsided after a short time. The pain is stated not to have been increased by pressure in 2 out of 5 cases, in which the circumstance is alluded to. The *tongue and throat* are described as sore, constricted, hot, painful, and tense, in 9 cases. *Thirst.* Of 17 cases in which this symptom is mentioned, it was present in 15, and absent in 2; in 13 it is described as intense. *Countenance* flushed and swollen, in 7 cases; pale and anxious in 5: the facies hippocratica present in one. *Eyes* inflamed, swollen, or smarting in 7 cases. *Skin* hot and dry in 6 cases; covered with cold perspiration in 4; profuse perspiration with petechiæ in 3; universal desquamation in 1; covered with an eczematous eruption in 1. *Headache* in 9 cases, absent in 1; described as intense in 4. Violent *palpitation* in 2 cases. *Pulse* generally very frequent, but of variable character, ranging from 90 to 140, or more; in one case 30 to 49. *Nervous symptoms.* Extreme *restlessness* in 5 cases; extreme *debility* in 10 cases; *coma* in 3 cases; *delirium* in 3. *Mind* stated to be unimpaired in 6 cases; *cramp* in legs, in 9 cases, in 4 extending to the arms; *convulsions* in 6 cases; *paralysis* of tongue and gullet in 3 cases; *tetanus* in 2 cases; *chorea* in 1; *hysteria* in 1; *epilepsy* in 2 cases. Tetanus, coma, and delirium successively in 2 cases. *Death* took place in 3 cases in the midst of convulsions, and in one after a horrible fit of convulsive laughter followed by rigid spasm of the whole body.

The nervous symptoms were in many cases of very long continuance. Thus, Mr. Gadsden, one of the victims of Eliza Fenning, was seized with epilepsy on the first day ; had four attacks on the second day, then a fit every evening at the same hour, for fourteen successive evenings ; then an interval of seven or eight days, followed by another relapse, and that by another interval of three weeks ; at the end of three months the fit still recurred every twelve hours, or three or four times in two days ; and he continued, even after the lapse of two years, to be subject to frequent attacks.

In the case of Helen Mitchell, there was extreme debility of the limbs for three months.

One of the most remarkable exceptions to the general rule of the symptoms of poisoning by arsenic is recorded by Mr. Thomas Wright, of Dublin,* Death took place in four hours, and followed upon sound sleep ; and after death there was no trace of inflammation of the mucous membrane even in the spots covered with arsenic.

It is important, then, to understand, that the symptoms of poisoning by arsenic may vary in different cases to a very remarkable extent, so as to occasion very wide departures from any general description which can be given of them.

Post-mortem Appearances.—These are chiefly confined to the stomach and intestines, and either do not exist at all, or only in a slight degree, in the mouth, throat, and gullet, and still less frequently in the windpipe. The appearances in the stomach are those of acute inflammation, sometimes spreading over the entire surface, sometimes confined to the prominent folds of the membrane, and at others existing in well defined patches. The most common appearance is that of one or more patches of variable size, consisting of a tough white or yellowish paste of arsenious acid, mixed with coagulable lymph, and firmly adhering to the inflamed mucous membrane. These spots form so many centres of intense inflammation ; arsenious acid in powder is also often found between the rugæ. Ulceration is comparatively rare, but gangrene is described as present in more than one case. The dark appearance produced by the extravasation of blood beneath the mucous membrane has perhaps been confounded with gangrene, and described as such. This extravasation is often met with. The stomach generally contains a brown grumous matter, which is occasionally tinged with blood. The inflammation generally extends to the duodenum and commencement of the other small intestines, and occasionally affects the whole length of the intestinal canal. The œsophagus, also is sometimes the seat of inflammation, and in rare instances the fauces and windpipe have been involved in the inflammatory action. The peritoneal covering of the stomach or of the entire abdomen is sometimes found in a state of inflammation.†

* Lancet, vol. xii. p. 194.

† Among the occasional post-mortem appearances noticed in the cases already referred to, may be mentioned inflammation of the bladder in 1 case :

The mucous membrane of the stomach is sometimes found free from all traces of inflammation. In a case already referred to, (*Lancet*, vol. xii. p. 612,) there was an absence of all the characteristic post-mortem appearances ; and this is not a solitary case.

It appears that inflammation may commence within a short period after the swallowing of the poison. Thus, in the case of a child who died in two hours, the mucous membrane had a vermilion hue.* Ulceration, too, may occur within a comparatively short period after the poison has been taken. In one case which came under Mr. Taylor's notice in so short a time as ten hours ;† and in a second in the remarkably short space of four hours.‡

Smallest Fatal Dose.—Four and a half grains taken in solution by a child four years old, is the smallest recorded dose.§ In a case recorded by Dr. Murray,‖ a young man of 22 died in four days and a half, from taking fifteen grains. Alberti relates a fatal case from six grains ;¶ and Mr. Taylor from four grains, and probably as little as three grains.** The smallest dose may, therefore, be probably stated at three or four grains. Much smaller quantities have given rise to very alarming symptoms. On the other hand, as much as one ounce has been taken, and the patient has recovered under the use of sulphate of zinc and magnesia.†† Very large doses of the poison are generally either promptly carried off by vomiting and purging, or they prove fatal in a comparatively short space of time.

The shortest period within which death has taken place is *two hours*. Two cases of this kind are recorded: the case of a child already referred to, on the authority of Mr. Foster, of Huntingdon, and a second given by Dr. Christison, on the authority of Mr. Macaulay, of Leicester.‡‡ Dr. Dymock relates the case of a girl of 20, who died after taking two ounces of the powder, in less than two hours and a half.§§ Pyl has recorded a case fatal in three hours, and several cases are on record of four hours, and a few of three hours and a half.‖‖

livid spots on the skin in 3 cases: great congestion of the brain, with serum in the ventricles, and at the base in 1 case: in another case the contents of the stomach from the large quantity of sesquisulphuret found after death are described as resembling yellow paint. The post-mortem appearances are generally stated with less detail than the symptoms, and in most fatal cases they are evidently very imperfectly described.

* Guy's Hospital Reports, Oct. 1841, p, 283.

† See a case communicated to Mr. Taylor by Mr. Foster of Huntingdon. Manual, p 139.

‡ Case of Waring, tried at the Leicester Lent Assizes, 1842.

§ Rust's Magazine, xx 492.

‖ Calcutta Quarterly Journal, Dec. 1827.

¶ Cited by Dr. Christison, p. 276.

** Manual, p. 141.

†† Christison on Poisons, p 321.

‡‡ Ibid. p. 289.

§§ Ed. Med. and Surg. Journal, April, 1843.

‖‖ The following are the general results of a large number of cases reported

Treatment.—As arsenic itself is a powerful emetic, it sometimes excites such effectual vomiting that the substance is completely rejected from the stomach. This is most likely to happen when the poison is swallowed soon after a meal. In other cases on the exhibition of an emetic, or the abundant use of diluents, the contents of the stomach are rejected, and with them the poison. When, on the other hand, the poison is swallowed on an empty stomach, it attaches itself to the mucous coat, excites violent inflammation, and the formation of a tenacious secretion, by which it is glued to its surface and protected from the action both of emetics and antidotes. In the first class of cases recovery is often attributed to some substance which is thought to possess the virtues of an antidote. This is the probable explanation of the praise which has been bestowed on the hydrated sesqui-oxide of iron. This, which is the only substance supposed to act as an antidote to arsenic, is prepared by adding liquor ammoniæ to a strong solution of the persulphate of iron. The precipitate which is thrown down is washed, and used in its moist state. Some careful experiments of Dr. McLagan, have shown that 12 parts of the hydrated oxide are required to neutralize one part of arsenious

in English and Foreign Journals, comprising those quoted in works on Toxicology.

Of 92 cases, 48 were fatal, and 44 recovered.

The cases of suicide were equally divided between men and women.

Of 46 cases, 21 were suicidal, 17 homicidal, and 8 accidental. Of the 48 fatal cases, 41 proved fatal within a day, and 7 lasted longer than 1 day.

In the 41 cases which proved fatal within a day, 3 were fatal in 2 hours; 1 in 2 hours and a half; 1 in 3 hours; 2 in 3 hours and a half; 8 in 4 hours; 6 in 5 hours; 6 in 6 hours; 2 in 6 hours and a half; 1 in 7 hours; 2 in 8 hours; 3 in 9 hours; 2 in 12 hours; 1 in 15 hours; 1 in 17 hours; 1 in 21 hours, and 1 in 24 hours. Of the 7 which lasted more than one day, 1 was fatal in 36 hours; 2 in 48 hours; 1 in 3 days and a half; 1 in 4 days and a half; 1 in 6 days, and 1 in 7 days.

The average duration of all the cases which terminated fatally in less than 24 hours, is somewhat less than 7 hours; the average of all the fatal cases is 20 hours. More than half the cases proved fatal within 6 hours; precisely two-thirds within 8 hours; and as many as 37 within 12 hours.

The recovery occupies a variable time. The convalescence is often very slow, and after months, or even years, a patient may be subject to the nervous symptoms which the poison has occasioned.

In the case of Mr. Gadsden, one of the victims of Eliza Fenning, epileptic fits, which had first come on as the effect of the poison, still continued after the lapse of 2 years.

The reader is referred to the following cases:—the cases of the Messrs. Turner, and Mr. Gadsden, poisoned by Eliza Fenning, in Mr. Marshall's Remarks on Arsenic; those of the Mitchells, reported by Mr. Alexander Murray, in the Edin. Med. and Surg. Journal, vol. xviii. p. 167, and three cases given by Mr. Alexander Mc Leod, in the same Journal, vol. xv. p. 553. These cases afford some of the best illustrations of the nervous symptoms which follow poisoning by arsenic. Also Ed. Med. and Surg. Journal, v. 389; liv. 106, 262; lvi. 295; lix. 250. Lancet, July 21, 1827; Aug 15, 1829; Oct. 34, 1829, vii. 254; Oct. 6, 1838; Nov. 3, 1838, and Nov. 24, 1838. Medical Gazette, v. 411; ix. 895; xiv. 62; xv. 828; xix. 238; xx. 309. London Medical Review, iv. 188; xix. 288. Guy's Hospital Reports, No. iv. 68.

acid in solution. The arsenious acid enters into a chemical combination with the hydrated oxide, from which it is readily separated by heat. If, then, the arsenious acid were given in a state of solution the hydrated sesqui-oxide of iron might be usefully employed, the resulting compound, though still poisonous, being less active than arsenious acid itself. When, however, the arsenic has been swallowed in the solid form, the antidote has little or no effect, and may safely be pronounced to be much less useful than emetics and mucilaginous drinks. On the tenacious paste which arsenic forms with the secretion of the mucous membrane this substance could have no effect, nor have emetics any power of removing it.*

The treatment of poisoning with arsenic, then, must consist in removing the poison as promptly as possible from the stomach. If the poison has been recently swallowed the stomach pump may be employed at once, or emetics of sulphate of zinc, followed by copious draughts of milk, lime-water and oil, gruel, linseed tea, or other mucilaginous substance. If sulphate of zinc cannot be immediately procured, one or two tea-spoonsful of mustard mixed with water will form a useful substitute. The subsequent treatment will consist in the constant use of mucilaginous drinks, and if the inflammatory symptoms run high the abstraction of blood from the arm, or by leeches from the pit of the stomach. The state of collapse must be met by stimulants, and the nervous symptoms by anodynes. The treatment must vary with each case, being directed to the relief of such symptoms as happen to be most urgent. It would be well to avoid the use of antimony as an emetic, inasmuch as the semblance of the crusts of antimony to those of arsenic gives rise to an objection to the chemical evidence. As, moreover, arsenic exists in many substances in common use, and has been asserted to be present in several other substances, it is better to avoid the administration of any thing which can furnish a plausible ground of objection.†

Arsenious acid has been introduced into the body in other ways than by the mouth. It has been inserted into the vagina, producing intense local inflammation, and the characteristic general symptoms of poisoning by arsenic. It has been applied to the skin in the form of ointment, and it has been inhaled in the form of vapour, as in the case mentioned in a note at p. 452. Arsenious acid sublimed from burning candles has also produced severe indisposition.

Several cases of poisoning by *arseniuretted hydrogen* are on record. A very interesting series of cases affecting a whole family, and due to

* It has been lately recommended to employ the hydrated persulphuret of iron. As this causes the formation of the sesquisulphuret of arsenic which is itself a poison, it is not likely to supersede the hydrated per-oxide. Among those who are inclined to attach value to antidotes in the treatment of poisoning with arsenic, are Bouchardat and Sandras, in the Annuaire de Thérapeutique.

† In the case of Madame Laffarge it was objected that the oxide of iron which had been given as an antidote might have contained arsenic.

the inhalation of that gas evolved from decomposing arsenite of copper, have been related by Dr. Elliotson. The symptoms were nausea, vomiting, thirst, watering of the eyes, red and foul tongue; a rapid pulse, ranging from 120 to 160, and, after apparent recovery, pains in the limbs. The patients derived much advantage from blood-letting.* The same gas proved fatal to M. Gehlen, a chemist of Munich. Several other cases are on record.†

Arsenious acid is contained in many substances in common use. Sulphuric acid, which is now made in large quantity from iron pyrites, frequently contains a large quantity of the poison. Dr. Rees found no less than 22½ grains to the pint, in one specimen, and 32½ grains in 20 ounces in another.‡ Mr. H. H. Watson states, that the smallest quantity which he found in 20 fluid ounces was 35½ grains, while in one specimen it amounted to the enormous quantity of 97½ grains.§ Dangerous and even fatal effects have resulted from the use of this impure acid in the formation of other chemical preparations, arseniuretted hydrogen being given off by its action on iron or zinc. Muriatic acid, which is formed by means of this impure sulphuric acid, has also been found to contain arsenious acid. M. Dupasquier has found it to contain as much as one part in 1000.‖

Arsenic, as has been stated, also enters into the formation of a species of candle, which is even now in the market.

The arsenious acid is readily detected, in the sulphuric acid by using it in the generation of hydrogen in Marsh's apparatus, in the muriatic acid by the introduction of a slip of copper and the application of heat, and in the candles by simply boiling them in distilled water, filtering the liquid, and using any of the tests. The presence of arsenic in candles is also recognized by the garlic odour given off during combustion.

Sesquisulphuret of arsenic has been given as a poison, producing symptoms similar to those of poisoning by arsenious acid, but less severe. Arsenite of copper has also been taken by mistake.¶ This latter substance has been found in green sweetmeats, both of French and German manufacture.**

Compound cases of poisoning by arsenic are not of rare occurrence, that by arsenic and opium jointly being the most frequent. The opium has the effect of masking the characteristic action of arsenic, so that the case resembles very closely the rare instances of arsenical poisoning, in which narcotic symptoms are very prominent. Such was the character of a case of poisoning by arsenic and laudanum, which occurred about a year ago in the King's College Hospital.

* Lectures on the Practice of Medicine.—Lancet, May 5, 1832.

† See Med. Gaz. xiii. 176, and xix. 591; and Dublin Journal of Medical Science, xx. 422.

‡ Med. Gaz. Feb. 1841.

§ Ibid. See also Dublin Journal of Medical Science, xx. 422.

‖ Ed. Med. and Surg. Journal, lvii. 524.

¶ Med. Gaz. xxxi. 270.

** Barruel, Annales d'Hygiène, vol. i. p. 420.

CHAPTER XVII.

MERCURY.

Preparations of Mercury. — *Properties of the Metal.* — CORROSIVE SUBLIMATE,—*Tests for Corrosive Sublimate.*—*In Powder.*—*Reduction Tests.*—*In Solution.*—*In Organic Liquids.*—*Symptoms.*—*Salivation.*—*Mercurial Tremors.* — *Post-mortem Appearances.*—*Treatment.* — *Antidotes.* — CALOMEL. — *Tests.* — *Other Preparations and Salts of Mercury.*

THE preparations of mercury are in common use in medicine and the arts, and are occasionally used as poisons. That which is most commonly employed is the corrosive sublimate. It was the cause of twelve out of 543 deaths from poison occurring in 1837 and 1838. Of these twelve cases two were accidental, and nine suicidal. This, like other preparations of mercury used in medicine, occasionally proves fatal when given in an over dose, or in an ordinary dose to persons very susceptible of the action of mercury.

Mercury itself is inert, and may be given in very large doses without injury. Its vapour is well known to produce injurious effects. One important property of metallic mercury requires to be noticed, as it is made use of in medico-legal inquiries. It sublimes unchanged at 660°. and if the sublimation is conducted in a glass tube, a white ring of small metallic globules forms on the cool part of the tube. These may be made to coalesce so as to form a distinct globule. When metallic mercury is in a still more minute state of division it has the appearance of a black powder. It is in this form that the metal is thrown down from the solution of its salts.

The most important salts and preparations of mercury are the following: the bichloride or corrosive sublimate; the proto-chloride, or calomel; the ammonio-chloride, or white precipitate; the red per-oxide, nitric oxide, or red precipitate; the bisulphuret, or vermilion; the sub-sulphate of the per-oxide, or Turbith mineral; the bicyanide, or prussiate of mercury; and the two nitrates of mercury. The black protoxide, and protosulphuret are of less importance.

Of these preparations of mercury by far the most important is corrosive sublimate.

CORROSIVE SUBLIMATE.—(*Oxy-muriate, Corrosive Muriate, Bichloride of Mercury.*)

This poison is found as a very heavy crystalline mass, or white powder, of a styptic metallic taste, permanent in the air, but slowly

decomposed in sunshine, an insoluble gray powder being formed. It is soluble in twenty parts of temperate water, and in two parts of boiling water. It is more soluble in alcohol and ether, for which reason ether is used to remove it from its aqueous solution. Common salt, also, increases its solubility.

Tests.—We may have to examine the poison in the solid form, in solution, and in organic liquids.

1. *Corrosive Sublimate in the Solid Form.*—On the supposition that we are ignorant of the nature of the substance submitted to analysis, we first heat a small quantity on platinum foil. It is completely volatilized. It may therefore be arsenic, corrosive sublimate, or calomel. The great solubility of corrosive sublimate in water distinguishes it at once from the other two substances. The addition of a few drops of liquor potassæ places the nature of the substance beyond a doubt. Corrosive sublimate is changed to a yellow colour, while arsenic undergoes no change, and calomel is turned black. We may obtain still further assurance by the following tests: 1. Hydro-sulphuret of ammonia changes the powder to a black. 2. A solution of iodide of potassium turns it to a bright scarlet. 3. Moisten a clean rag with dilute muriatic acid (one part of the acid to two of water), sprinkle upon it a small quantity of the powder, and rub it on a clean plate of copper. A silvery stain is formed which is readily volatilized by heat. 4. Mix one part of the poison with three or four parts of calcined carbonate of soda; place the mixture in a reduction tube, and apply the heat of a spirit lamp, having previously dried the upper part of the tube. A ring of globules will be formed on the cool sides of the tube.*

2. *Corrosive Sublimate in Solution in Water.*—On the supposition that we are ignorant of the contents of a liquid submitted to analysis we test for a base by sulphuretted hydrogen. Corrosive sublimate is one of those which yields a black precipitate, first giving a milky white appearance to the liquid. Hydro-sulphuret of ammonia also produces a black precipitate. With liquor ammoniæ it gives, in common with lead and bismuth, a white precipitate, but with liquor potassæ a yellow (the hydrated peroxide). By this we recognize a per-salt of mercury. The supernatant liquor contains chloride of potassium, and if we add to it nitrate of silver we obtain the white chloride of silver, which proves that the salt of mercury is a chloride. The colour of the precipitate with liquor potassæ shews that it is a per-salt. This precipitate being collected, washed, and dried, and heated in a reduction tube, gives a well-defined ring of mercury. The sulphuret precipitated by sulphuretted hydrogen, or by hydro-sulphuret of ammonia, when dried and heated with carbonate of soda, also yields a ring of mercury. By using either precipitate for that purpose we obtain conclusive evidence of the existence of mercury. The following

* Dr. Frampton has recommended the use of pure finely divided silver for this reduction. The finely divided silver may be most readily obtained by burning the tartrate of silver on platinum foil.

are additional tests: 1. Protochloride of tin. A solution of this substance throws down a white precipitate, turning rapidly to gray, and from gray to black. This consists of minutely divided mercury, from which the supernatant liquor may be decanted or separated by filtration. On introducing into the tube containing this precipitate a plug of blotting-paper, and pressing it firmly against the bottom of the tube, the globules are made to coalesce, so as to form a mirror of mercury. 2. Metallic test. Acidulate the liquid with a few drops of muriatic acid, and introduce a narrow slip of clean copper. A gray film will be formed on the surface of the metal. This being carefully dried may be introduced into a reduction tube, and heated with the flame of a spirit lamp. A ring of metallic globules will be deposited on the upper part of the tube. Pure tin, zinc, or silver, may be substituted for copper. The latter is to be preferred to any other metal. 3. Galvanic test. Take a narrow strip of sheet zinc of a size convenient for introduction into a reduction tube, moisten it, and take up as much gold leaf as will adhere to it. Introduce this into the solution slightly acidulated with muriatic acid; the gold will soon be covered with a gray film. Remove it from the solution and dry it carefully in the heated air above the flame of a spirit lamp. Introduce the dried metal into a reduction tube, and apply the flame of a spirit lamp. A ring of metallic globules will be formed. This test is one of extreme delicacy, and will give a characteristic result when all other tests fail. It is that which should be preferred for the discovery of very minute quantities of the poison. The metallic deposit may be readily obtained by placing a drop of the acidulated solution on a surface of clean copper or gold, and touching the moistened metal with a fragment of zinc or iron. Dr. Wollaston once employed a key and a sovereign for this purpose.

The acid in combination with the mercury may be shewn to be the hydrochloric by testing the fluid from which the mercury has, by any of the foregoing methods, been precipitated. On the addition of the nitrate of silver we obtain a white precipitate, the chloride of silver, which is insoluble in nitric acid. The nitrate of silver may also be applied directly to the solution.

Corrosive Sublimate in Organic Liquids.—As the poison is very soluble, it is rare to meet with it in a solid form. But when it has been taken in the mass it may sometimes be separated by merely stirring the liquid, at the same time adding, if it be very viscid, distilled water. The corrosive sublimate, from its great weight, will subside, and may be collected. As the poison is decomposed by the secretions of the body, by the mucous membrane, and by several articles of food, it might not be found in solution in the stomach, even though no antidote had been given. We must, therefore, expect to find it in one of two states,—in solution, or in combination with the solid contents of the stomach. In the former case we procure a clear liquid by diluting with distilled water, boiling if necessary, and filter-

ing. In the latter case one of two processes may be adopted. We may boil the solid matters in distilled water, and in this way bring the soluble salt of mercury into solution; or, if the solid matters treated in this way yield no trace of mercury, in consequence of the soluble salt having been decomposed, evaporate to dryness, and digest the dried residue in warm nitro-muriatic acid. The insoluble compound of mercury is thus re-converted into the soluble bichloride. This acid liquor must be evaporated to dryness, and the residue be dissolved in distilled water, and filtered.

The corrosive sublimate, originally existing as such in solution, or by either of these methods extracted from the solid contents of the stomach, may now be treated in any of the following ways:

1. It may be dissolved out by shaking the liquid in a bottle, with about a third of its bulk of sulphuric ether. On allowing the solution to stand for a few minutes, the ethereal solution will rise to the surface, and may be drawn off with the pipette. This solution must then be evaporated to dryness, and the residue must be dissolved in distilled water. The resulting liquid will contain corrosive sublimate in a state of purity, and fit for the application of the tests already described.

2. Instead of dissolving the corrosive sublimate by ether, we may proceed at once to add to the solution the protochloride of tin, so long as any precipitate falls. The precipitate may then be well washed, transferred to a small glass tube, heated, and sublimed.

3. The galvanic test, formed by a thin slip of zinc with a coating of leaf-gold, may be applied, and a sublimate of metallic mercury obtained in the manner already described; or pure silver may be employed, as recommended by Dr. Frampton.

There is another process recommended by Dr. Christison, which, where the quantity of mercury is considerable, has the advantage of saving time. It consists in triturating the solid matters, without previous filtration, with protochloride of tin, when the mixture will assume a slate gray colour, and separate readily into a liquid and coagulum. The liquid may be rejected, but the coagulum, having been washed on a filter, must be carefully removed and boiled in a moderately strong solution of caustic potash, until all the lumps disappear. The oxide of tin with the animal and vegetable matters are thus dissolved, and the solution, on remaining at rest, deposits a heavy gray powder, consisting chiefly of finely divided mercury. To separate the mercury completely, the solution must be allowed to remain at rest, at a temperature little short of boiling, for about twenty minutes. The supernatant liquor may then be drawn off, and the remaining black powder after repeated washings may be removed, heated, and sublimed. This process is a very delicate one.*

In the case of a liquid found in the stomach, or obtained by simple boiling, yielding mercury by any of the processes now described, we

* Christison on Poisons, p. 352.

have evidence of a soluble salt of mercury, and a strong presumption in favour of the bichloride ; but when the solid matters after evaporation to dryness are treated with nitro-muriatic acid, we have no evidence of a soluble salt, because even an insoluble salt, thus treated, would be converted into corrosive sublimate. This process, then, is open to the objection that the mercury which it is the means of discovering may have been administered for medicinal purposes in the form of calomel, blue pill, or hydrargyrum cum Cretâ. This objection could only be answered by distinct evidence of such substances not having been administered as medicine, or by the characteristic symptoms and post-mortem appearances due to corrosive sublimate.

Corrosive sublimate, like arsenic and other active poisons, may be rejected from the stomach so as not be detected after death. Like arsenic, too, it has been detected in the solids and fluids of the body, though the attempt to discover it has often been unsuccessful.*

Quantitative Analysis.—Employ for this purpose the mercury thrown down by the protochloride of tin. A hundred grains of metallic mercury correspond to one hundred and thirty-five grains of corrosive sublimate.

SYMPTOMS, POST-MORTEM APPEARANCES, AND TREATMENT.

Symptoms.—Immediately, or within one or two minutes of swallowing a substance or liquid of a peculiarly nauseous, metallic, and styptic taste, there is a sense of tightness and burning in the throat and gullet, greatly increased by pressure, and on every attempt to swallow, and speedily followed by burning pain in the epigastrium, also increased on pressure. Vomiting and purging of stringy mucus or of bilious matter often containing blood ensue, and the entire abdomen becomes distended and exquisitely painful. The face is generally flushed and swollen and the eyes sparkling; but in other cases the countenance is pale and anxious, the lips white and shrivelled, and the eyes dull but expressive of great anxiety. The diarrhœa is accompanied with tenesmus, and dysuria is often present, the secretion of urine being scanty or altogether suppressed. The pulse is full, quick, and frequent, or small, frequent, and intermittent, according as the symptoms are those of high fever or of collapse, and the breathing is quick and catching. There are sometimes intervals of comparative ease, during which the patient is drowsy ; and this drowsiness sometimes amounts to coma. Nervous symptoms are often present from an early period. These consist of cramps, twitches of the limbs and convulsions, and occasionally there is paralysis. Death takes place during a fainting fit, in the midst of strong convulsions, or during protracted insensibility. To

* For a learned dissertation on this subject, consult Christison on Poisons, p. 363.

these symptoms, in most cases which do not prove rapidly fatal, salivation is superadded, and the painful train of symptoms which arises from the specific effect of mercury on the system. As these are the most characteristic effects of the poison, it will be necessary to examine them somewhat at length.

The preparations of mercury exert their specific effects chiefly on the salivary glands and on the muscular system, in the form of mercurial salivation and mercurial tremors. These will have to be discussed separately.

Mercurial Salivation. — A coppery taste, a peculiar fetor of the breath, tenderness and swelling of the mouth, inflammation swelling and ulceration of the gums, and an increased flow of saliva, are the familiar symptoms of mercurial salivation. These symptoms vary greatly in severity in different cases. In the more severe forms the salivation is profuse ; the face, neck, and tongue, swollen ; the inside of the mouth ulcerated or gangrenous. These local affections are preceded or accompanied by a frequent pulse and hot skin, and other symptoms of fever.

Several interesting questions suggest themselves in connexion with this symptom of mercurial poisoning. The following are some of them : *a.* What dose is necessary to occasion salivation ? *b.* Can salivation be produced by other causes, and if so, can we distinguish the several kinds of salivation ? *c.* Can salivation take place after the mercurial preparation has been some time disused ? *d.* What is the earliest period at which salivation may occur ? *e.* What is the duration of mercurial salivation ? *f.* Can salivation cease and recur without a renewed use of the mercurial preparation ? *g.* Is it possible to distinguish gangrene of the mouth, the effect of mercury, from the same disease due to other causes ? These questions will be briefly examined.

a. What dose is necessary to occasion salivation ? There is much difference between different individuals, between persons of different ages, and even in the same person at different times, in respect of the quantity of mercury which they can bear. As a general rule, children are less susceptible of the action of mercury than adults, the robust than the delicate. The same female who in her ordinary state of health is affected with difficulty, shall, when suffering from anœmia, be salivated with a few doses of blue pill. In affections of the nervous system, also, very marked effects are produced by small doses of mercury.* Again, there are many persons peculiarly susceptible of the action of mercury, and others whom the largest doses continued for a considerable period will not affect. Many instances of severe and even fatal effects produced by small doses are on record. In one

* In a case of paralysis of the facial nerve which came under the author's notice, there was a distinct red line upon the gums of the paralyzed side, while the other was quite free. The sensibility of the affected side was perfect, though the patient complained of a sensation of tingling.

case given on the authority of Dr. Bright, five grains of calomel placed on the tongue of an apoplectic patient produced in three hours violent salivation, and such swelling of the tongue as to render scarifications necessary. Three grains of corrosive sublimate in three doses has caused violent ptyalism; three five-grain doses of blue pill, given one every night, have proved fatal; two grains of calomel have caused ulceration of the throat, exfoliation of the jaw, and death; and the external application of three drachms of mercurial ointment has destroyed life in eight days.* Other cases of an equally marked character are on record.

b. Can salivation be produced by other causes, and if so, have we any means of distinguishing the several kinds? Salivation may be produced by several causes. It may be spontaneous, constituting in itself a disease, or it may be due to the mere accumulation of saliva, in consequence of some disease of the throat preventing deglutition, such as quinsy. It may even be occasioned by the influence of the imagination, as in a case related by Dr. Christison.† Various metallic preparations are capable of producing it, among which are preparations of gold, copper, lead, arsenic, antimony, and bismuth. Several substances derived from the vegetable kingdom have also produced it, as castor oil, fox-glove, opium, and prussic acid. Sulphuric acid, iodine, and iodide of potassium may also be mentioned as having given rise to salivation.

The distinction between mercurial salivation and that dependent upon other causes is generally easy, in the first stage. The mercurial salivation is preceded by the coppery taste and fetor of the breath, and accompanied by redness, sponginess, and ulceration of the gums. These are wanting in spontaneous salivation, and in that produced by most of the medicines just mentioned. The advanced stage of mercurial salivation seems to differ less strikingly from some severe affections of the mouth due to other causes, and accompanied by ptyalism. Thus in a curious account of an epidemic salivation, forming a part of a tertian fever, quoted from Haller's Collections on the authority of Quelmelz, it is stated that in one instance it was as great as the most violent mercurial salivation, and was accompanied by fetor, superficial ulceration of the mouth, pustules on the tongue, relaxation of the gums, and looseness of the teeth.‡

c. Can mercurial salivation take place after the preparation of mercury has been for some time disused? This question may be answered in the affirmative on the authority of two cases quoted by Christison from Swediaur and Cullerier. In the one case there was an interval of several months, and in the other of three months.§

d. What is the earliest period at which salivation may occur? Mercurial salivation rarely sets in under twenty-four hours; but in

* For an exact reference to these cases, see Christison on Poisons, p. 379.
† Ibid. p. 382. ‡ Ibid. p. 382. § Ibid. p. 383.

Dr. Bright's case already cited, it appeared in three hours. In a case of poisoning by two drachms of corrosive sublimate, it began in four hours.* The shortest period, therefore, may probably be stated at three hours.

e. What is the duration of mercurial salivation? The duration of mercurial salivation is very variable, and may be very considerable. It may continue for any period from a few days to as many years. In one instance it lasted six years.†

f. Can salivation cease and recur without the renewed use of the mercurial preparation? This question was raised in a court of law in 1775, on the occasion of the trial of Miss Butterfield, for the murder of her master, Mr. Scawen, by corrosive sublimate. Mr. Bromfield and Mr. Howard, both surgeons of the Lock Hospital, gave evidence in favour of the possibility of recurrent salivation, and the former stated that he had known the interval in one case as great as three months. Many well authenticated cases of the same kind are on record. Dr. Christison relates a case in which mercury had been taken to salivation for a syphilitic sore throat, and about four months after the disappearance of the sore throat and salivation, both affections recurred, and the salivation continued, to the extent of twenty or thirty ounces daily, for two months, but without the characteristic fetor, redness, ulceration, and sponginess of the gums.‡

Some of the cases on record are open to the obvious objection that some preparation of mercury might have been given in the interval; but this objection does not apply to all the cases.

g. Is it possible to distinguish gangrene of the mouth, the effect of mercury, from the same disease due to other causes? We have no certain diagnostic marks. Cases of *cancrum oris* following debilitating diseases, or occurring in children badly lodged and badly fed are not of very rare occurrence. In such cases it very seldom happens that mercury in some form has not been given. Hence, a difficult question may arise as to the cause of the disease. In the absence of any exact means of discrimination, it may be sufficient to state that extreme debility, brought on by any of the causes just mentioned, is a sufficient cause of gangrene; and that even if the mercury which may have been given have contributed to the fatal result, the medical man is not to be blamed for the use of a medicine of great value in the diseases of children, and which less frequently causes salivation in them than in adults. It is generally stated that gangrene, the effect of mercury, may be distinguished by its beginning in the mucous membrane of the mouth and throat, while the cancrum oris begins in the skin of the cheek or chin. This statement is without foundation; for in a fatal case of mercurial salivation which occurred under the care of Dr. John Bright, of the Westminster Hospital, the gangrene began as

* Taylor's Manual of Medical Jurisprudence, p. 162.
† Colson, Archives Générales, xii. 99.
‡ On Poisons, p. 381.

a small black spot between the lower lip and chin.* Other cases of the same kind are on record.

Mercurial Tremors, Shaking Palsy, Tremblement Métallique. — This disease occurs in men whose work exposes them to the fumes of mercury, as the quicksilver miners, water gilders, mirror silverers, barometer makers, &c. It begins sometimes suddenly, sometimes gradually. The upper extremities are commonly first affected, and then, by degrees, all the muscles of the body. The patient cannot grasp any object, or place his foot firmly on the ground, but resembles a patient in a severe paroxysm of chorea. Salivation is seldom present, and the disease rarely proves fatal. The recovery generally occupies some weeks or months, but sometimes the disease does not admit of cure. As the subject belongs rather to Hygiène than to Forensic Medicine, it will not be pursued further in this place.

Post-mortem Appearances.—Poisoning by corrosive sublimate and the soluble salts of mercury gives rise to post-mortem appearances differing little from those due to other corrosive poisons. The effects are intermediate between those produced by the corrosive acid poisons and those caused by the stronger non-corrosive irritants, such as arsenic. The appearances of inflammation in the mouth, fauces, and œsophagus, are more strongly marked, and the mucous membrane of the stomach and intestines is more highly inflamed.

Corrosion, softening, and sloughing ulceration of the stomach and intestines are of frequent occurrence, and the peritoneum is often found inflamed. The sloughs have been found to yield mercury on analysis. The decomposition of the salt by contact with the mucous membrane, or with the contents of the stomach, or with antidotes, and the consequent deposition of mercury in a state of minute division on the lining membrane, as a thin slate-coloured covering, sometimes serves to identify the poison. This appearance is not always present, in consequence of the speedy rejection of the poison by vomiting. When mercurial salivation has existed during life, we shall find the mucous membrane of the mouth inflamed or sloughing.

One post-mortem appearance which has been more frequently encountered as the result of poisoning with corrosive sublimate than as a consequence of poisoning with arsenic, is the highly inflamed state of the urinary organs, and the contracted state of the bladder, corresponding to the very scanty secretion of urine during life.

Corrosive sublimate applied to the mucous membrane after death causes it to assume a white, wrinkled, and granulated appearance. It is also harder than natural, and of a dead whiteness, with rose-coloured vessels ramifying upon it. These appearances extend to the muscular and peritoneal coats. They were found by M. Orfila, in the mucous membrane of the rectum, with which corrosive sublimate in powder had been brought in contact after death.

* Lancet, No. 453.

Smallest Fatal Dose.—Very large doses of corrosive sublimate have been swallowed with impunity, having been rejected by vomiting, or decomposed by the prompt use of antidotes. The smallest fatal dose is *three* grains in the case of a child.

The *shortest period* within which death has been known to take place is *two* hours; at least this prompt action of the poison is inferred from the circumstances of a case reported by Mr. Illingworth, occurring in a man aged 30.* It may also be inferred from a case of poisoning by the nitrate of mercury, which proved fatal in two hours and a half, that corrosive sublimate may destroy life in as short a space of time.† In the case of this poison, as in that of arsenic, the period is extremely variable.

Treatment.—The antidotes to corrosive sublimate are albumen, gluten, iron filings, a mixture of gold dust and iron filings suspended in gum water, and the hydrated protosulphuret of iron.‡ The antidotes most readily procured are the white of egg and gluten. The white of egg should be given freely mixed with water, as long as urgent symptoms are present, and accompanied, if necessary, by emetics and diluents. If eggs cannot be procured, flour mixed with water or milk may be substituted. White of egg has been proved to be an efficient antidote in so many cases, that where it is at hand it is quite unnecessary to resort to any other.

The rest of the treatment will not differ from that proper to poisoning by the irritants generally. Where salivation is present, cool air, cold drinks, and gentle aperients, with gargles of alum or chloride of sodium, must be used. In very severe cases, large doses of acetate of lead, as recommended by Mr. Daniell, and approved by Dr. Christison §, may be advantageously employed. Occasionally, where the inflammatory symptoms run high, local or general blood-letting may be resorted to.

Corrosive sublimate acts as an irritant poison, and produces its characteristic effects in whatever way it may be introduced into the system. ‖

* Med. Gaz. vol. xxxi. p. 557.

† Case by Dr. Bigsby, London Med. Gaz. vol. vii. p. 329. The following periods are on record:—one of 2 hours; one of 2½ hours; one of 3 hours; one of 6 hours; one of 11 hours; and one of 3, 6, 8, and 11 days respectively. Of these nine cases, then, about half the number died in less than 12 hours, and the remaining half in a period varying from 3 to 11 days.

The reader is referred to the following cases of poisoning by corrosive sublimate:—Medical Gazette, vii. 329; viii. 616; xxix. 797; xxxi. 556. Ed. Med. and Surg. Journal (five cases by Mr. Valentine), xiv. 468; li. 114; liii. 404; lviii. 505.

‡ The first of these was originally recommended by Orfila, the second by Taddei, the galvanic antidote by Dr. Buckler, of Baltimore, and the hydrated protosulphuret of iron by M. Mialhe.

§ On poisons, p. 412.

‖ Two fatal cases in which corrosive sublimate was rubbed into the skin in an ointment are detailed in the Medical Gazette, iii. 666. Several other fatal cases from the application of corrosive sublimate to ulcerated surfaces are also

PROTOCHLORIDE OF MERCURY. CALOMEL.

Tests.—Calomel is a white or yellowish-white powder, which, unlike corrosive sublimate, is very insoluble in water, and insoluble in alcohol and ether. It is soluble in nitric and muriatic acids. The former decomposes it into corrosive sublimate and pernitrate of mercury, the latter converts it into corrosive sublimate and metallic mercury.

On the supposition that we are ignorant of the nature of the powder, we first apply heat, which, as in the case of corrosive sublimate and arsenic, volatilizes it. Its very sparing solubility in water at once distinguishes it from corrosive sublimate, but not from arsenious acid. On adding a few drops of hydro-sulphuret of ammonia, a black precipitate is formed. This at once distinguishes it from arsenious acid. Liquor potassæ, which changes corrosive sublimate to a yellow colour, turns calomel black; and liquor ammoniæ, which changes the former to a white, changes the latter to a black colour.

The following are additional tests: 1. A solution of protochloride of tin reduces the mercury to a state of minute division; 2. It yields a ring of mercury when heated with carbonate of soda in a test tube; 3. When rubbed with dilute muriatic acid on copper, it yields a silvery stain. In these properties it resembles corrosive sublimate, but their different solubility, and the different effect of liq. potassæ and liq. ammoniæ, at once distinguish the two substances.

Calomel, though generally a safe medicine when given in moderate doses, and administered in many diseases in large quantities often repeated, sometimes produces very violent effects, acting either as an irritant poison, or destroying life by producing gangrene of the mouth and throat. Cases are on record of fatal results following a single dose of a scruple,* and quantities so small as fifteen, eight, and six grains. On the other hand, doses of three drachms, and of one ounce have been taken without fatal consequences.† In the Asiatic cholera, and in many of the severe fevers of hot climates, calomel in repeated doses of one scruple has been found highly beneficial; and in the case of the cholera has rather allayed than increased the irritation of the alimentary canal.

The violent effects produced by calomel in the exceptional cases just alluded to, have been attributed to its partial conversion into corrosive sublimate by the free hydrochloric acid of the stomach, or by contact with some chloride, as the chloride of sodium, or the muriate of ammonia. The quantity of corrosive sublimate formed by the first

recorded. See London Medical Repository, xvi. 458; and Christison on Poisons, p. 390.

* Pereira's Materia Medica, part i. p. 469, quoted from the Times newspaper, April 26, 1836.

† Ibid., part i. p. 469.

of these reactions must be extremely small, as free hydrochloric acid exists in the stomach in very minute proportion. On the other hand, experiment has shewn that the quantity of corrosive sublimate formed by admixture with chloride of sodium at the temperature of the stomach itself is extremely small, and insufficient to account for the fatal result.* A minute quantity of corrosive sublimate is found mixed with calomel; but this, too, has been shewn by Dr. Christison to be insufficient to account for the occasional poisonous effects of calomel. In ten different specimens of calomel examined by him, the quantity of corrosive sublimate did not exceed a five hundredth of its weight.†

The other compounds and preparations of mercury possess poisonous properties; but as these have been very rarely taken as poisons, a very brief description of their properties will suffice.

Red Precipitate (red oxide of mercury).—The crystals of the red precipitate are small, brilliant, and of a scarlet or deep orange colour; the powder is orange coloured. It is very heavy, insoluble in water, but soluble in warm muriatic acid, which converts it into corrosive sublimate. When heated in a small glass tube it is entirely dissipated, metallic globules are sublimed, and oxygen gas is given off.

Cinnabar, *Vermilion* (bisulphuret of mercury). This substance is found in commerce in the form of a dark red semi-crystalline mass, or in that of a fine red powder. The former is cinnabar, the latter vermilion. When thrown down from a solution of a per-salt of mercury by sulphuretted hydrogen, it is black; but, when sublimed, becomes red. It is heavy, insoluble in water and muriatic acid, entirely dissipated by heat, but collects on the sides of the tube unchanged. When mixed with carbonate of soda, and heated in a reduction tube, globules of metallic mercury are sublimed; and on adding a mineral acid to the residue, sulphuretted hydrogen is given off, shewing the presence of sulphur.

White Precipitate (ammonio-chloride of mercury). This is found in the form of a white heavy powder, insoluble in water, and entirely dissipated by heat. It yields with carbonate of soda a metallic sublimate. The ammonia may be detected by boiling the powder in liquor potassæ. The gas is given off, chloride of potassium is formed, which may be detected by the nitrate of silver test, and the yellow peroxide of mercury remains.

Turbith Mineral (sulphate of the peroxide of mercury).—This is a heavy yellow powder, sparingly soluble in water, and yielding, when heated in a glass tube, a metallic sublimate, with fumes of sulphurous acid gas. When boiled in a solution of potash, the yellow peroxide is thrown down, and a sulphate of potash is formed, the acid of which may be identified by the nitrate of baryta test.

Nitrates of Mercury (protonitrate and pernitrate).—The pernitrate

* See the results of some experiments by Mr. Taylor. Manual, p. 179.

† Ed. Med. and Surg. Journal, vol. xlix p. 336.

of mercury is found in the form of white crystals, which are very soluble in water, the solution being highly acid and corrosive. When heated in a tube, the crystals give off nitrous acid gas, and a ring of metallic globules is sublimed. When mixed with carbonate of soda and heated, metallic mercury is sublimed. On adding liquor potassæ to a solution of the salt, a yellow precipitate is thrown down. The acid is readily detected by adding carbonate of potash till effervescence ceases, and filtering the resulting liquid ; nitrate of potash is formed, which is known by the properties already described (p. 434).

The protonitrate differs from the pernitrate, inasmuch as liquor potassæ throws down a black precipitate from a solution of the former, and a yellow precipitate from that of the latter.

Bicyanide of Mercury (prussiate of mercury). This salt is in the form of white, heavy, inodorous crystals, which have a strong metallic taste, are soluble in hot and cold water, and nearly insoluble in alcohol. When heated, the crystals yield metallic mercury and cyanogen gas, which is recognised by the characteristic purple colour of its flame. When heated with hydrochloric acid, hydrocyanic acid is given off. The solution yields with sulphuretted hydrogen, and hydro-sulphuret of ammonia, a black precipitate, but it is not precipitated by liquor potassæ.

All the foregoing preparations of mercury have, in rare instances, been taken as poisons. Their activity is proportioned to their solubility. Thus the soluble nitrates and bicyanide of mercury even in small doses are extremely active poisons, while the white and red precipitate, the turbith mineral, and vermilion act much less powerfully. The soluble salts act as corrosive poisons, the insoluble compounds simply as irritants. Both classes may produce the specific effects of mercury. In poisoning by the bicyanide of mercury, the symptoms are those of poisoning by a soluble salt of mercury. The cyanogen, which is in combination with the mercury, does not seem to modify the action in any material degree.

As poisoning by these preparations of mercury is extremely rare, it is unnecessary to detail any cases in illustration.

CHAPTER XVIII.

COPPER.

Salts of Copper.—Tests.—Symptoms.—Post-Mortem Appearances.—Treatment.—Accidental Poisoning from the Use of Copper Utensils.

Poisoning with the salts of copper is of very rare occurrence. Among the 543 cases of poisoning occurring in England and Wales in 1837–8, not one was due to this cause. In consequence of the marked colour of all the salts of copper, they are ill adapted to the purposes of the murderer, and, for the same reason, are not likely to be taken accidentally. They are, however, occasionally used by the suicide. The use of copper utensils in cookery sometimes leads to the accidental admixture of poisonous salts of copper with food.

Metallic copper is not poisonous ; but in consequence of the readiness with which it oxidates and combines with acids, it cannot be swallowed with impunity. Very injurious consequences have been known to be produced by sucking copper coin ; and in a state of minute division, and mixed with other metals, as in the process of printing in gold, it appears to act as a poison.

Copper in the form of hydrated oxide, and in combination with acids, is in common use in the arts. It will be necessary to particularise the following: the hydrated peroxide, the carbonate, the sulphate, and the acetates.

The Hydrated Peroxide.—Copper exists in this shape under the names of mineral green and verditer. Mineral green formerly consisted of arsenite of copper, but is now formed by a combination of the hydrated peroxide with pure lime or chalk, potash, and alumina. Verditer consists of the same materials in a different proportion.

The anhydrous peroxide of copper is a brownish black powder, which is readily dissolved by nitric acid, the solution assuming, on the addition of ammonia in excess, a deep blue colour. The *hydrated* peroxide of copper may be procured by adding liquor potassæ to a solution of any of the soluble salts of copper.

As none of the salts of copper assume the importance of arsenious acid or corrosive sublimate, it will be useful to consider the tests for copper generally, and then to describe and distinguish from each other those salts which are in common use.

Tests for the Salts of Copper.—All the salts of copper are either blue or green. Their colour, therefore, distinguishes them at once from most other substances. The salts of nickel and the sulphate of iron are also green, but the distinction between the green salts of

copper and these substances will be readily made by comparing them in a state of solution. In very dilute solution the colour of the salts of copper disappears, or is so masked that it may afford no clue to the nature of the substance with which we have to deal ; it will be necessary, therefore, to suppose that substance to be unknown to us. Acting on this supposition, we first test the liquid with sulphuretted hydrogen, when we obtain a deep brown or black precipitate. Hydrosulphuret of ammonia yields the same precipitate. On the addition of liquor ammoniæ the hydrated peroxide is first thrown down ; and this being dissolved, by the addition of ammonia in excess, the characteristic deep blue coloured solution of the hydrated peroxide is formed.

The salts of copper in solution may be further identified by the following tests: 1. Ferrocyanide of potassium yields a fine hair-brown gelatinous precipitate ; 2. Polished iron (a knife or a needle suspended by a thread) placed in a solution of a salt of copper, is speedily coated with a thin film of the metal ; 3. A few drops of the solution placed on platinum foil, and slightly acidulated, when touched with a strip of zinc, causes a similar metallic deposit.

Fallacies.—The salts of nickel give with ammonia a solution of a similar colour. This objection is removed by the use of the ferrocyanide of potassium, which yields with the salts of nickel a pea-green precipitate. Sulphuretted hydrogen also gives no precipitate with the salts of nickel in acid solutions.

As some of the salts of copper possess peculiar properties, and it may be necessary to distinguish them from each other, they will now be briefly described.

Carbonate of Copper (natural verdigris). — This is the greenish coating formed on the surface of copper and its alloys by the action of air and water. It is readily distinguished from the other salts of copper by effervescing with acids. The reactions of the base are the same as in the case of other salts of copper.

Sulphate of Copper (blue vitriol, blue-stone, Roman vitriol).—The base is detected by the tests already described. The salt is further known by adding a few drops of liquor ammoniæ, and a solution of arsenious acid. Green arsenite of copper is thrown down. The sulphuric acid in combination may be detected by the test of nitric acid and nitrate of baryta.

Subacetate of Copper (artificial verdigris).—The term artificial verdigris is sometimes applied to the unmixed subacetate, and sometimes to a combination of this with the neutral acetate and carbonate. Its colour accordingly varies, being sometimes blue and sometimes green. The subacetate is known by the effect of heat. When introduced into a test tube, and heated by the flame of a spirit lamp, a portion of acetic acid is given off; and another part being decomposed, leaves an ash of carbon, which deoxidizes the copper, so that a thin film of metal is left on the sides of the tube.

Acetic acid is also given off on boiling the salt with dilute sulphuric acid.

Nitrate of Copper.—This is in the form of deliquescent blue crystals. The acid in combination may be detected by the absence of a precipitate with nitrate of baryta, and with nitrate of silver; and by the ruddy fumes of nitrous acid gas evolved by boiling the crystals with tin filings in a few drops of distilled water. By adding liquor potassæ to the solution, nitrate of potash is formed, which may be identified by appropriate tests (see p. 434).

Chloride of Copper.—There is a soluble chloride, and an insoluble sub-chloride of copper. The chloride is of a bright green colour, the sub-chloride is white. An oxy-chloride is known in the shops as Brunswick Green.

The *chloride* is deliquescent and very soluble in water; the sub-chloride is insoluble in water, but soluble in acids. The tests for the base are the same as for other salts of copper. The muriatic acid in combination may be detected, in the case of the soluble chloride, by the addition of nitrate of silver. The insoluble subchloride must be converted into a soluble salt for the purposes of examination.

Arsenite of Copper.—This has already been mentioned in the chapter on Arsenic (see p. 465).

The several salts of copper are found in the shops, mixed in various proportions and under different names, as pigments.

Copper in Organic Liquids.—Solutions of copper are decomposed by several of the common contents of the stomach,—such as albumen, fibrin, milk, tea, coffee, &c., the sub-oxide being thrown down. They are also changed by the mucous membrane of the stomach. As the salt of copper is not always completely decomposed, it may often be obtained in sufficient quantity for analysis by simply boiling with distilled water and passing the solution through a filter. The insoluble substances must be reserved for further examination. The clear liquid which has passed the filter may be tested by any of the tests already described, or by all of them in turn. By slightly acidulating the liquid and then passing through it a stream of sulphuretted hydrogen, the brownish black sulphuret of copper is thrown down. This must be carefully collected, and washed, and incinerated in a glass tube. It is thus freed from any adhering organic matter. The sulphuret may now be converted into sulphate by treating it with a few drops of nitric acid. The solution will strike the usual deep blue colour with an excess of ammonia.

If copper is not by this means detected in the liquid which has passed the filter, the insoluble substances which remain on the filter, or are contained in the stomach, must be dried and heated to redness in a crucible, till they are completely charred. The residue contains metallic copper, and must be gently heated in equal parts of nitric acid and water. Nitrate of copper is thus formed, which may be identified by the usual tests.

Copper has been detected in the solid organs of the body, but more rarely in the secretions, in cases of poisoning by its salts.

Copper has also been found in several vegetable substances used as food, and is asserted to exist as a natural constituent of the fluids and solids of the human body. The existence of copper in vegetable substances has been confirmed and explained by M. Boutigny, who has traced it to the manure used in raising those substances. Its presence as a natural constituent of the human body, has, however, been rendered doubtful by the negative results of experiments performed by Dr. Christison and M. Chevreul.* The quantity of copper existing naturally in animal and vegetable substances is so minute, not exceeding in any case one part in 120,000, and in some instances being so little as one in 1,500,000 parts, that it can give rise to no fallacy even where large portions of the solid contents of the stomach or of the body itself are submitted to analysis. The discovery of so minute a trace would never be held to furnish sufficient evidence of poisoning by copper.

Quantitative Analysis.—Use for this purpose the precipitated sulphuret, digest it in nitric acid, and precipitate the oxide from the solution by potash. One hundred parts of the black oxide correspond to 312 of the crystallized sulphate.

Symptoms.—Pains in the abdomen resembling colic, nausea, eructations, vomiting of matters of a bluish or green colour, purging and cramps in the extremities, are among the common symptoms of poisoning by the salts of copper. Nervous symptoms also supervene. Convulsions, palsy of the limbs, tetanus, and insensibility have been present in different cases. As in the case of arsenic and mercury, the group of symptoms varies in each instance. One symptom of more frequent occurrence in poisoning with the salts of copper than in poisoning with other irritants is jaundice.

Post-mortem Appearances.—The mucous membrane of the stomach and intestines has been found inflamed, ulcerated, thickened, and of a green colour, and in parts apparently gangrenous. The salt of copper sometimes adheres to the surface of the membrane. The inflammation and discolouration of the mucous membrane occasionally extend to the œsophagus. The skin is yellow. The other post-mortem appearances are not characteristic.

In some instances the intestines have been found perforated.

Treatment.—The only substance which can be regarded as an effectual antidote to the salts of copper is albumen. Iron filings suspended in mucilage act less promptly and efficiently. Sugar, also, which has been recommended as an antidote, acts but feebly at the ordinary temperature of the human body. The treatment, then, will consist in the free administration of the white of egg, followed by mucilaginous drinks. If vomiting is not present the stomach-pump

* Christison on Poisons, p. 431.

may be used. The remainder of the treatment will vary with the state of the symptoms.

The symptoms make their appearance within a short period after swallowing the poison. In a case related by Orfila, colic pains occurred within fifteen minutes after swallowing half an ounce of verdigris.

Severe effects have been produced by comparatively small doses of the salts of copper. In a case mentioned by Dr. Percival, convulsions were occasioned by two drachms of blue vitriol.

The salts of copper have proved speedily fatal. A girl aged sixteen months died in *four* hours after swallowing several fragments of blue stone.* In other instances, death has taken place after a longer interval.†

Accidental poisoning by Copper.—Serious and even fatal accidents have occurred from the use of copper vessels in cooking. The following example will serve to prove this, and to illustrate the symptoms produced by such accidental poisoning.

"Gmelin was consulted by the abbot of a monastery, on account of a violent disease which prevailed throughout the whole brotherhood of monks. The symptoms were obstinate and severe colic, retching, and bilious vomiting, costiveness, flatus, burning pain in the pit of the stomach, under the sternum, in the kidneys and extremities, and paralytic weakness in the arms. On inquiring into the cause of this singular combination of symptoms, Gmelin found, that every vessel in the kitchen, the pots and pans, and even the milk pails and butter dishes for storing the butter, were made of copper."

The principal facts established in reference to the impregnation of various fluids and articles of food with copper, in consequence of being prepared or kept in copper vessels, are the following. Distilled water kept in contact with clean copper is not impregnated with it. Solutions of several saline matters, as common salt, alum, nitre, and Epsom salts, when heated in copper vessels are found to contain the poison. Acids, and fatty and oily matters, especially when rancid, act still more strongly on copper vessels. One general principle applies to all these substances, which is, that provided the vessels be clean, they may be boiled in them with comparative safety, but cannot be allowed to stand in them without danger. The contact of air with the moistened copper leads to the formation of the hydrated carbonate, which is dissolved by any acid that the substance may happen to contain. As however saline, acid, or oily matters act strongly on copper vessels, it would be well to avoid using such vessels in preparing articles of food containing any of these matters. Milk, tea, coffee, beer, and many of the more common

* This case is quoted by Mr. Taylor as occurring in London in 1836. Manual. p. 196,

† Cases are on record of death after 12 hours, 13 hours, 60 hours, 72 hours, and 78 hours.

articles of diet have been boiled in copper vessels without becoming impregnated with the poison.*

Sulphate of copper has been used to promote the fermentation of dough, to decolourize sugar, and to give a green colour to pickles.

The arsenite of copper, as has been already stated, has been used to colour sweetmeats.

CHAPTER XIX.

LEAD.

Salts of Lead.—Tests.—Symptoms.—Painters' Colic.—Lead Palsy.—Post-mortem Appearances.—Treatment.—Impregnation of Water with Lead.—Use of the Salts of Lead in the Arts.

Acute poisoning with the salts of lead is an event of rare occurrence ;† but from the great use made of lead in the arts, its effects as a slow poison are familiar to every medical man. The metal itself does not possess any poisonous properties ; but as it is readily acted on by acids, it may become poisonous by combining with the contents of the stomach. The preparations of lead which are used in medicine or the arts, are the two oxides, the carbonate, the acetate and subacetate, the sulphate, the chloride, and the nitrate. Of these, the carbonate and the acetate are of most importance in a medico-legal point of view.

Tests for the Salts of Lead.—On the supposition that we are ignorant of the nature of a base contained in a solution presented for analysis, we first transmit sulphuretted hydrogen through it, or add a few drops of the hydrosulphuret of ammonia. Lead is one of those bases which give with this reagent a black precipitate. Liquor ammoniæ throws down a white precipitate. Liquor potassæ gives the same precipitate, as does also dilute sulphuric acid. By this succession of trial tests, the solution is known to contain a salt of lead. (See Appendix, Table I.)

The base is still further identified by the following tests: 1. Chromate of potash throws down a gamboge-yellow precipitate,— the

* See on this subject, Falconer on the Poison of Copper, and Christison on Poisons, p. 419.

† There is only a single case of poisoning with lead among the 543 cases of poisoning occurring in England and Wales in 1837—38. This was by Goulard's extract.

chromate of lead. 2. Iodide of potassium yields an iodide of lead of the same colour. 3. A piece of zinc kept for some time in the solution, provided it be not too much diluted, displaces the lead, which is deposited upon it in an arborescent form. This change is hastened by the addition of a small quantity of acetic acid. 4. Place a few drops of the solution on platinum foil, acidulate slightly, and bring a fragment of zinc into contact with the metal. The zinc will be speedily coated with lead.

These tests are sufficient to identify the base, and may be applied to any of the soluble salts of lead.

Such being the properties of the base, it is necessary to describe the several preparations and salts of lead in turn.

Oxides of Lead.—There are three oxides of lead: the protoxide, red lead, and the peroxide. The protoxide, in the form of a yellow semi-crystalline glass, is the *litharge* of commerce; in that of a fine powder, it goes by the name of *massicot*. A combination of protoxide and peroxide of lead is the minium, or red lead, of commerce. The brown peroxide is little known out of the laboratory.

Litharge (protoxide of lead).—This is in common use by painters and glaziers, and is used as a cheap glaze for the common kinds of earthenware. Serious accidents have arisen from this glaze being acted upon by acids. Litharge has also been used to impart a sweet taste to sour wines. As already stated, it is a constituent of the hair dyes in common use. It possesses the following properties: it is found in the form of reddish or yellowish scales, which are volatile at a red heat, insoluble in water, but perfectly soluble, when pure, in nitric acid, the solution possessing the properties of nitrate of lead, and the base giving the reactions already described. When placed on a piece of charcoal, it is readily reduced by the heat of the blow-pipe.

Minium or Red Lead.—This is the common colouring matter of the red wafers. It is in the form of a rich red powder, insoluble in water, and but partially dissolved by nitric acid. When heated, it gives off oxygen, and is reduced to the orange yellow protoxide of lead. It is readily reduced under the blow-pipe on a fragment of charcoal, and on burning the wafers which contain it, little globules of lead will be observed to form on the edges, mixed with the unreduced yellow protoxide.

White Lead (ceruse, carbonate of lead).—This is extensively used in the arts, chiefly as the basis of colours, and as such is the most common cause of colica pictonum and of other forms of chronic poisoning by lead. It is found in the form of white masses, or of a heavy white powder, and possesses the following properties: When heated to redness, it loses its carbonic acid, and is changed to the yellow protoxide. It is insoluble in water, but soluble with effervescence in nitric acid. If quite pure, it is completely soluble in the acid; but as it is usually found mixed with some sulphates, it is not

completely dissolved. In large doses it may act as a poison, though it is very insoluble in water. It is, however, dissolved in considerable quantity in water which contains free carbonic acid.

Sugar of Lead (acetate of lead).—This substance is sold in the form either of a crystalline mass resembling lump sugar, or in that of a glistening, heavy, white powder. It is very soluble in water, has a slight odour of vinegar, and a sweetish astringent taste. When heated, it first dissolves in its water of crystallization, then gives off a part of its acid, chars, and is partly reduced to the metallic state. When heated in the mouth of a glass tube under the blow-pipe, distinct globules of lead are formed. If boiled with dilute sulphuric acid, acetic acid is given off, which may be known by its odour. The powder is also blackened by hydro-sulphuret of ammonia, and changed to a fine yellow colour by iodide of potassium and chromate of potash. In a state of solution, it gives the characteristic reactions of all the soluble salts of lead.

Goulard's Extract (subacetate of lead).—This is found in the shops in the form of a whitish or yellowish-white solution. It has an alkaline reaction, and is distinguished from a solution of the acetate by the copious precipitate of carbonate of lead, formed by transmitting a stream of carbonic acid gas through it. Goulard's extract is an active poison, and has more than once proved fatal.

Sulphate of Lead.—This is a heavy white powder, insoluble in water and in acids, and unchanged by heat. It is blackened by the hydro-sulphuret of ammonia. If it is suspended in water, and sulphuretted hydrogen gas is transmitted through it, the black sulphuret of lead is formed, the sulphuric acid remaining in the supernatant liquor, in which it may be detected by the nitrate of baryta. This salt of lead, in consequence of its extreme insolubility, is stated not to be poisonous ; but it is possible that if given in a very large dose, it would not be quite inactive.

Chloride of Lead.—This is in the form of a white powder, sparingly soluble in cold, but more soluble in hot water, soluble in dilute nitric acid, but insoluble in alcohol. It has a sweetish taste. At a heat below redness, it fuses into a semi-transparent horny mass (*plumbum corneum*), but is volatilised by an intense heat. Its solution has the reactions of a salt of lead.

There is a yellow oxychloride of lead used as a pigment under the name of *mineral*, or *patent yellow*, and *Turner's yellow*. Like the chloride, it is fusible, and remains fixed when melted.

Nitrate of Lead.—This is found in the form of tetrahedral or octohedral crystals, soluble in water. Filtering paper dipped in the solution and dried, burns like touch paper. When heated in a glass tube, nitrous acid vapour is given off, and the yellow protoxide remains behind. The solution gives the characteristic reactions of a salt of lead.

Salts of Lead in Organic Liquids.—Add to the suspected liquid a little nitric acid ; boil, and filter. Transmit sulphuretted hydrogen

gas through the filtered liquid. If a salt of lead be present, a black precipitate will be formed.

If no precipitate falls when the liquid is treated in this manner, collect the solid matters remaining on the filter, incinerate, dissolve the ash in nitric acid, dilute and filter the resulting liquid, and transmit the sulphuretted hydrogen gas as before.

If by either or both of these processes a black precipitate is obtained, it may be proved to contain lead in either of two ways. 1. By placing the dried precipitate on a fragment of charcoal, and reducing the metal by the blow-pipe. Or, 2, By exposing the sulphuret to a red heat in a tube open at both ends, to burn off the sulphur, treating it with strong nitric acid, and diluting the resulting solution with distilled water. The solution must then be filtered, evaporated to dryness, and gently heated to expel the excess of nitric acid. The residue, being dissolved in distilled water, will give the characteristic reactions of lead. Care must be taken in these experiments to avoid the use of ordinary flint glass, which always contains lead.

If no lead should be obtained by either of the foregoing methods, the stomach itself may be cut into fragments and incinerated.

Quantitative Analysis.—Use for this purpose the sulphuret of lead. 100 parts are equivalent to 86½ of metallic lead. The corresponding quantity of the several salts may be ascertained by simple calculation.

Symptoms.—All the salts of lead, with the exception, perhaps, of the sulphate, act as weak irritant poisons, differing from the other irritants chiefly in the absence of diarrhœa, and the presence of the opposite state—constipation. Even the most soluble preparations of lead act feebly as compared with most of the metallic irritants, and rarely prove fatal.

The usual symptoms produced by a large dose of a soluble salt of lead are a burning and pricking pain in the throat and gullet, thirst, vomiting, colic pains, with tenderness of the belly, obstinate constipation, cramps in the extremities, cold sweats, and, in fatal cases, convulsions, and tetanic spasms. In one recorded case the pulse fell to 40.

The most important and interesting form of lead poisoning is that which is induced slowly by the long continued use of preparations of lead, whether as medicine, in the arts, or in consequence of the accidental impregnation of water or articles of food. The form in which the effects of the poison first shew themselves is that of the painters' colic ; its more remote effects are known as the lead palsy.

The Painters' Colic, or, as it is called from the place where it was first observed, *Colica Pictonum*, is marked by excruciating pain of the abdomen, especially in the pit of the stomach and around the navel. This pain is almost always relieved by pressure. The belly is hard, the muscles of the abdomen strongly contracted, and the navel drawn inwards. The bowels are either obstinately confined or scanty motions are passed with much suffering. Very rarely diarrhœa is present. The urine is small in quantity, and passed with difficulty. The coun-

tenance is dull and anxious, the skin bedewed with cold perspiration, the pulse commonly of the natural frequency, but sometimes accelerated, the breathing quick and catching. In rare instances febrile symptoms are present.

The painters' colic sometimes comes on without previous symptoms of disease, at others after long-continued indigestion and disorder of the bowels. It may terminate either in complete recovery, or may pass into the second form of chronic poisoning—lead palsy. In rare instances it terminates in a species of apoplexy, which comes on with giddiness, extreme weakness, and torpor. As these symptoms increase, the pains in the belly subside, and the patient at length dies convulsed and comatose.

Lead Palsy.—This is sometimes the termination of a single attack of colic, but more commonly it supervenes after repeated seizures. In some cases, again, it comes on without any previous attacks of colic. The disease chiefly affects the upper extremities, especially the muscles of the hand and forearm, which first lose their power and then gradually waste away. The loss of power is chiefly in the extensor muscles, so that when the arm is raised, the hand falls by its own weight. Hence the expression, dropped hand. The patient generally raises one hand by the aid of the opposite arm, which is very characteristic of the loss of power in the muscles of the forearm and hand.

This affection is in all cases difficult of cure, and very apt to recur on the renewed application of its cause. The persons most subject to the action of lead are those employed at furnaces for smelting lead ore, manufacturers of litharge, and of red and white lead, house-painters, colour-makers, plumbers and workers in lead, glass-blowers, glaziers, potters, and manufacturers of glazed cards. It occurs occasionally in persons who make comparatively little use of lead, as in compositors from the handling of the types, in fishmongers from the use of lead counters covered with brine.* In other cases, where it cannot be traced to the use of lead in any way, it is attributable to the drinking of water contained in leaden pipes or cisterns, under the circumstances presently to be mentioned.

In the course of the several employments just mentioned, lead finds its way into the system either by the skin, the lungs, or the stomach.

The chief practical rule for the prevention of disease consists in the strict enforcement of cleanliness. A great amount of disease has been prevented by the substitution of moist for dry grinding.

There is one symptom which has been pointed out as characteristic of the action of lead on the system; viz., a blue line on the gums round the margin of the teeth. This is a valuable indication, and one rarely absent where marked symptoms of lead poisoning are present. It exists in many cases where it is not possible to prove the introduction of lead into the system, and when it is necessary to assume that

* I have witnessed two or three cases among this class of tradesmen.

it finds its way into the body through the water which the patient drinks.

Post-mortem Appearances. — In one case of acute poisoning by Goulard's extract, the morbid appearances were the following :—The lower end of the gullet, the whole stomach and duodenum, a part of the jejunum, and the ascending and transverse colon were greatly inflamed, and the villous coat of the stomach appeared as if it had been macerated. The stomach contained six ounces of a reddish-brown fluid which had a sweetish, styptic, metallic taste, exhaled the odour of vinegar while evaporating, and yielded globules of lead when the dry residue was subjected to the process of reduction.*

In colica pictonum there are no constant morbid appearances beyond an unusual constriction of the large intestines. In lead palsy the affected muscles are found pale and flaccid, and when the disease has been of long continuance they resemble white fibrous tissue.

Treatment.—The antidotes to the salts of lead are the soluble alkaline or earthy sulphates—the sulphates of soda or magnesia. These should be freely administered, dissolved in water. If vomiting is absent, it may be excited by emetics of sulphate of zinc, and encouraged by copious draughts of warm water, or the stomach-pump may be used. Milk and white of eggs may be given with advantage. When the colic pains are severe, and the bowels costive, opium may be administered in combination with aperients, and copious injections of warm water may be given. The remainder of the treatment is that proper to the irritant poisons.

In consequence of the extensive use of lead in pipes and cisterns for conveying and holding water, and the ill effects which sometimes result from the action of the water upon it, it is important to examine the circumstances under which that action takes place. This subject has been carefully examined by Dr. Christison† and Mr. Alfred Taylor.‡ The principal results of their inquiries may be briefly stated as follows :—

The salt of lead formed by the contact of water with the metal is the carbonate. This salt is produced either by the action of water containing carbonic acid, or by water containing little or no saline matter. The carbonate is mixed with a small proportion of the hydrated oxide of lead. In the case of pure water, the free access of atmospheric air is essential to the change, for distilled water deprived of its gases by boiling, and excluded from the air has no action on lead. When rain, or distilled, or very soft water is left in contact with pure lead, with the free access of air, a white powder collects in a few minutes around the metal, and this goes on increasing till, in a few days, white, pearly scales are formed, which either float on the water, or fall to the bottom of the vessel. The formation of the carbonate

* This case is quoted by Dr. Christison from the Journal Universel, xx. 353.
† On Poisons, p. 476.
‡ Guy's Hospital Reports, No. vi.

and the corrosion of the metal go on as long as the air has free access to the water. At the same time a small quantity of lead is dissolved.

On the other hand, various saline substances held in solution in water, have the effect of preventing the formation of the carbonate. Indeed, all the neutral salts possess this power in a greater or less degree. Sulphate of lime affords the most complete protection, so small a quantity as one part in 5000 effectually preventing the formation of the carbonate. Some kinds of river water, as that of the Thames and the water used in Edinburgh, contain saline matters in sufficient proportion to render the use of lead perfectly safe. The same remark applies to most spring waters. But the waters of some rivers and springs are so destitute of saline matters as to act powerfully on lead.

It may be stated, then, as a general result, that the action of water on lead, and the consequent danger of conveying and preserving it in pipes or cisterns made of that material varies directly as the purity of the water. It follows that we may render the use of lead for such purposes perfectly safe by the artificial admixture of saline matter with the purer kinds of water. Sulphuric acid by forming an insoluble sulphate of lead is also an efficient protection. The use of lead is attended with most danger when it is employed to collect or preserve rain or snow-water, or spring-water of unusual purity, and the danger is increased by the use of leaden lids to cisterns, the pure water rising by a natural process of distillation, and collecting on the lid.

There is one cause which greatly facilitates the action of water on lead, and which may act with sufficient energy to neutralise the preservative effects of saline matter, and be even increased by its presence, namely, the galvanic action excited by the contact of some other metal with the lead, or of the solder used for joining the sheets of lead. It must, moreover, never be forgotten that carbonic acid, if present in the water, will completely counteract the preservative effect of the salts above mentioned. We cannot, indeed, too strongly deprecate the use of lead for cisterns and water-pipes under any circumstances

The vegetable acids and fatty substances have the property of dissolving lead ; hence the danger of keeping ascescent fruits, or liquors, or fatty matter, in vessels made of that material, or glazed with the oxide. Sour milk, cider, wine, and rum, have obtained poisonous properties in this way. Shot used for cleaning wine-bottles, and then carelessly left in them, have impregnated the wine with lead. In many instances lead has been ignorantly used to correct unsound wines, and for other similar purposes.*

* For a case by Dr. Otto, of Copenhagen, in which red oxide was mixed with snuff, see Medical Gazette, vol. xxxii. p. 138. The use of the oxide as the colouring matter of hair-dyes has already been pointed out (p. 19).

CHAPTER XX.

ANTIMONY, ZINC, TIN, SILVER, IRON, BISMUTH, AND CHROME.

Poisoning by ANTIMONY — *Tartar Emetic* — *Tests and Symptoms* — *Post-mortem Appearances* — *Treatment* — *Chloride of Antimony* — ZINC — *Sulphate of Zinc* — *Other Salts of Zinc* — TIN — *Chloride of Tin.* — SILVER — *Lunar Caustic.* — IRON — *Sulphate and Muriate of Iron* — BISMUTH — *Nitrate of Bismuth.* — CHROME.

THESE metals have been thrown together in the same chapter in consequence of their comparatively slight importance, from the rare occurrence of poisoning by them.

ANTIMONY.—The *metal* antimony possesses one property which has already been noticed, but which may be advantageously alluded to in this place. Like arsenic it combines with nascent hydrogen, and may be reduced by burning the flame or heating the glass tube through which it is passing. The crust thus formed is less volatile than the arsenical crust.

The *Sulphuret of Antimony* is found in two forms—as the prepared sulphuret and the precipitated sulphuret. The prepared sulphuret is met with as a brownish black cake or powder, and may be identified by placing it in a glass tube, transmitting a stream of hydrogen through the tube, and applying to it the heat of a spirit-lamp. The metal is reduced, and sulphuretted hydrogen is given off.

The *Precipitated Sulphuret*, procured by transmitting a stream of sulphuretted hydrogen through a solution of a salt of antimony, is of a dirty scarlet or orange-red colour. Like the prepared sulphuret it yields metallic antimony when heated in a current of hydrogen gas.

There are only two salts of antimony which require to be particularly noticed as poisons—Tartar Emetic and Butter of Antimony.

Tartar Emetic (Tartarized Antimony, Stibiated Tartar, Potassio-tartrate of Antimony). This is found in the shops as a white powder, or in the form of yellowish-white efflorescent crystals.

Tests.—It may be necessary to examine it in a solid form, in solution, or in organic mixtures.

In a Solid Form.—Tartar emetic has the following properties. 1. When heated by the flame of a spirit-lamp it decrepitates and

chars; and if the heat is increased by the use of the blow-pipe, the metal is reduced. This experiment is best performed in a glass tube. No metallic sublimate is formed. 2. It is soluble in about three parts of boiling and fifteen parts of temperate water. 3. It is insoluble in alcohol. 4. When dropped into a watch-glass containing hydro-sulphuret of ammonia the characteristic orange-red sulphuret is formed, which is soluble in an excess of the precipitant.

In Solution.—Tartar emetic in solution in water, has a weak acid reaction, and a slightly sour and metallic taste, and yields, on evaporation, tetrahedral crystals. It is at once distinguished from all other metals by the effect of sulphuretted hydrogen or hydro-sulphuret of ammonia, which throw down the orange-red precipitate just mentioned. If, then, we were ignorant of the base existing in solution, it would be at once detected by this test. It is of so characteristic a colour, that it is scarcely necessary to insist upon any means of distinguishing it from other sulphurets. It is sufficient to state that it is soluble in caustic potash, in a large excess of ammonia, and in strong muriatic acid. It is also decomposed when boiled in muriatic acid, sulphuretted hydrogen being given off, and chloride of antimony remaining in solution. The sulphuret may also be reduced to the metallic state by heating it in a current of hydrogen gas, as recommended by Dr. Turner. The indication afforded by this test is confirmed by the following tests: 1. The three dilute mineral acids throw down a white precipitate, which is re-dissolved by the acid in excess, and by a solution of tartaric acid. Of these acids the nitric acid is least open to objection as a test, but the three conjointly are conclusive as to the presence of antimony. 2. A strong infusion of gall-nuts gives a dirty yellowish-white precipitate. 3. Ferrocyanide of potassium, causes no precipitate.

Caustic potash, lime-water, and carbonate of potash, throw down a white precipitate—the oxide of antimony; but as these reagents cause a similar precipitate in several other solutions, they are not sufficiently characteristic to be regarded in the light of tests for antimony.

4. Introduce a portion of the solution into a Marsh's apparatus, and proceed in the way pointed out in the case of arsenic (p. 458). The crusts obtained on a plate of glass by inflaming the jet generally possess a less distinct metallic lustre, and a more smoky appearance than those of arsenic, but crusts are sometimes obtained which may be very readily mistaken for those of the latter metal. The same remark applies to the crusts obtained by heating the horizontal tube. For the mode of distinguishing the crusts of the two metals, the reader is referred to p. 459. When the quantity of metallic sublimate is considerable, it may be identified by digesting it in nitro-muriatic acid, evaporating to dryness, and treating the residual oxide of antimony by hydro-sulphuret of ammonia. If the crust is of antimony the orange-red sulphuret is formed.

In Organic Liquids.—All vegetable substances containing tannin

decompose the salts of antimony. Several other vegetable substances affect the action of the tests, and milk is coagulated by strong solutions of those salts. Coloured fluids, though they modify the action of the other tests, have little effect upon sulphuretted hydrogen, the precipitated sulphuret retaining its characteristic colour. The following process of analysis, recommended by the late Dr. Turner, is simple and effectual. Add to the suspected liquid a little muriatic acid and tartaric acid ; the first with a view of coagulating any animal principles which may be present, the latter in order to dissolve all other precipitates formed with tartar emetic, except the sulphuret. Filter the resulting liquid, and transmit sulphuretted hydrogen through it. Collect, wash, and dry the precipitate, and introduce it into a horizontal tube connected with a vessel in which hydrogen is generated. Transmit the gas freely till all risk of an explosion is passed, and apply the flame of a spirit-lamp to the part of the tube containing the precipitate. The metal is reduced, remaining in the place of the sulphuret if the stream of gas is slow, but undergoing a spurious sublimation if it is rapid, and collecting on the sides of the tube in the form of detached crystals, or of a crystalline crust. The metal is apt to be concealed by the presence of animal or vegetable matter. In this case it should be heated in an open tube, when it oxidates and sublimes as a glimmering white powder, which, unlike arsenic, is not crystalline ; or the antimony may be dissolved by nitric acid, the resulting solution neutralized, and the orange red sulphuret be again thrown down by a stream of sulphuretted hydrogen.*

The discovery of antimony in the contents of the stomach proves that some preparation of antimony has been taken either as medicine or as a poison. If the quantity discovered exceeds that of an ordinary medicinal dose, a strong presumption of poisoning is thereby afforded ; but when the quantity is small it will be impossible to state that it has been administered as a poison, unless it can be distinctly shewn that it was not given as a medicine. Antimonial emetics are rarely administered in cases of poisoning, but the possibility of their being given in such cases should be borne in mind.

Antimony, like arsenic, is absorbed, and may be found in the secretions, in the blood, and in the solid viscera of the body. The process for detecting the poison in the blood or solid viscera, differs very slightly from the second process recommended for arsenic (p. 463). The animal substance must be dried, cut into fragments, and added little by little to boiling nitric acid, till all the fragments are dissolved. The resulting liquid must be evaporated to dryness and carbonized, and the ash is then to be boiled in muriatic acid, to which a small quantity of nitric acid is added. The antimony is thus converted into chloride of antimony, which may be introduced into

* By this process, which is recommended in preference to those suggested by Orfila and O'Shaughnessy, Dr. Christison has been able to detect the metal in as small a quantity as a tenth of a grain of the sulphuret.

Marsh's apparatus (see p. 458), or submitted to the action of any of the tests just described. If a metallic crust should be obtained it must be distinguished from the crust of arsenic by the methods described at p. 459. By boiling the crust in nitro-muriatic acid, the chloride may be obtained, and the sulphuretted hydrogen test may be applied. By this process Orfila has succeeded in discovering antimony in the liver and other viscera, and in the urine. It is probable that by the same process it would be discovered in the blood.

Quantitative Analysis.—Use for this purpose the precipitated sulphuret, carefully washed and dried, one hundred parts of which correspond to 202¾ parts of crystallized tartar emetic.

Symptoms.—Poisoning by tartar emetic is not characterised by any peculiar symptoms. A metallic taste, nausea, vomiting, pain and tenderness of the epigastrium, extending to the whole abdomen, constriction of the throat, and severe cramps of the extremities are among the more common effects of large doses of this poison. In one case related by Orfila, on the authority of Recamier, there were present, in addition to these symptoms, delirium and convulsions.*

Large doses of the poison have been frequently swallowed with impunity, in consequence of its prompt rejection from the stomach. When the poison proves fatal, it does not destroy life very rapidly. Thus, in the case just alluded to, forty grains of the poison were taken, but the patient survived nearly five days. Very severe effects have, however, been produced by so small a dose as six grains. It has often been given in inflammation of the lungs, in doses of two grains, repeated at short intervals, without producing any injurious effects.

Tartar emetic applied externally in the form of lotion or ointment excites inflammation of the skin and a crop of pustules, and if continued it may cause intense inflammation and sloughing. Nausea and vomiting have sometimes attended this external use of the poison.

Post-mortem Appearances.—These, like the symptoms, are not characteristic. They are those of inflammation in various degrees in the mucous membrane of the stomach and duodenum. In animals the lungs have been found inflamed.

Treatment.—The best antidote is decoction of cinchona bark. When this is not at hand, or cannot be immediately procured, the powder may be substituted. The tincture is still more effectual, as combining a stimulant with the bark. Any decoction or infusion containing tannin, such as tea, or decoction of oak bark, may be employed as an antidote. During the preparation of the antidote vomiting should be promoted by warm water, milk, or mucilaginous drinks, or the stomach-pump may be employed. The after treatment must be determined by the symptoms. General or local bloodletting may be necessary, and opium may be prescribed with advantage.

* Orfila, Toxicologie, i. 478. Christison on Poisons, p. 449.

Chloride of Antimony. (Butter of Antimony.)—Chloride of antimony is a corrosive liquid of a light yellow or dark red colour, which yields with sulphuretted hydrogen the characteristic orange red precipitate of the salts of antimony. When largely diluted with water the white oxychloride of antimony falls down, and the clear liquid is proved to contain muriatic acid by the addition of nitrate of silver. The subsidence of a white precipitate on the addition of water in excess is common to this substance and the salts of bismuth, but the colour produced in the liquid by sulphuretted hydrogen gas at once distinguishes the two bases. Bismuth yields a black, and antimony, an orange-red precipitate.

The action of the chloride of antimony is both prompt and violent. In one case, which proved fatal, death took place in ten hours and a half after swallowing between two and three ounces of the liquid. Narcotic symptoms were added to those of violent irritation of the alimentary canal, and after death the mucous membrane of the entire canal presented a charred appearance, and was softened and abraded.*

ZINC (sulphate of zinc, white vitriol).—This is the only preparation of zinc which requires notice. As a poison it is unimportant; but from its frequent use as an emetic, whether for common purposes or in cases of poisoning by other substances, it has an importance which would not otherwise attach to it.

The sulphate of zinc is found in the form of white prismatic crystals, of a styptic taste, and very soluble in water. It resembles in appearance oxalic acid and sulphate of magnesia. From the former, it is distinguished by the tests described at p. 440, and from the latter by adding to their respective solutions sulphuretted hydrogen or hydro-sulphuret of ammonia. The sulphate of zinc yields a white precipitate, but there is no precipitate with the sulphate of magnesia.

Sulphate of zinc in solution possesses the following properties: 1. It is precipitated as a white sulphuret, by sulphuretted hydrogen and hydro-sulphuret of ammonia, provided the solution does not contain an excess of acid. 2. Liquor ammoniæ and the sesquicarbonate of ammonia throw down a white precipitate soluble in an excess of the precipitant. 3. Ferrocyanide of potassium also causes a white precipitate. As the sulphate of zinc often contains a proportion of iron, the several precipitates are apt to be tinged with the colours of the precipitates which iron gives with these reagents. The sulphuretted hydrogen gives a white precipitate both with zinc and the persalts of iron. The presence of a small quantity of free acid completely prevents the precipitation of the zinc by sulphuretted hydrogen.

In organic Liquids.—Sulphate of zinc is decomposed by albumen and milk, which form with the oxide an insoluble compound, and also by substances containing tannin. The first step of the process for

* Three cases of poisoning by this substance will be found recorded in Mr. Taylor's Manual of Medical Jurisprudence, p. 209.

organic liquids consists in acidulating with acetic acid, by which any oxide thrown down in union with animal matters is dissolved. The mixture must then be filtered, and hydro-sulphuret of ammonia must be added to it. A white sulphuret of zinc is thrown down. The precipitate must be washed, carefully collected, dried, and heated to redness in a glass tube. The residue is then to be acted on by strong nitric acid, which dissolves the zinc; and the acid solution, being neutralized by carbonate of ammonia, is ready for the application of the tests. The carbonate of zinc which results from this decomposition becomes yellow when heated, and resumes its white colour on cooling. It is also redissolved by an excess of the carbonate of ammonia.

Quantitative Analysis.—For this purpose use the oxide of zinc, obtained by igniting the carbonate, every 100 parts of which correspond to about 386 parts of the crystallized sulphate of zinc.

Symptoms.—Zinc is one of the simplest of the irritant poisons, causing, in large doses, vomiting, purging, and pain of the abdomen. In consequence of its strong emetic properties, it is very soon rejected from the stomach, and has, therefore, rarely proved fatal. It has been administered medicinally in doses of two scruples three times a day for several weeks, without injurious consequences.*

The Post-mortem Appearances are those of simple inflammation of the mucous membrane of the stomach and intestines.

Treatment.—This consists in the free administration of milk, of the white of egg in large quantity, and of liquids containing tannin, such as tea, and decoctions of oak or peruvian bark. The remainder of the treatment is that common to all the irritant poisons.

TIN.—*Chlorides of Tin.* There are two chlorides of tin, the protochloride, and the perchloride. A mixture of these two salts in solution is known by the name of *dyers' spirit.* They also exist in the form of yellowish-white acicular crystals. These are the only preparations of tin which require notice.

Tests.—The *protochloride* has the following properties: 1. The sulphuretted hydrogen or hydro-sulphuret of ammonia throws down a precipitate of a dark chocolate colour, soluble in an excess of hydro-sulphuret of ammonia. 2. The bichloride of mercury gives a gray precipitate of finely divided mercury. 3. Chloride of gold gives a deep purple precipitate (the purple of Cassius). These are the tests for the base. The acid is detected by the white precipitate insoluble in nitric acid, thrown down by nitrate of silver.

The *perchloride* is precipitated yellow by sulphuretted hydrogen, and hydro-sulphuret of ammonia, the precipitate being soluble in an excess of the hydro-sulphuret. In colour, therefore, the precipitated sulphuret resembles the sesquisulphuret of arsenic and the sulphuret of cadmium. It differs from the former in being insoluble in ammonia,

* See a valuable paper by Dr. Babington in the 12th number of the Guy's Hospital Reports.

and from the latter in being insoluble in muriatic acid. Neither the bichloride of mercury nor the chloride of gold gives any precipitate with the perchloride.

The acid in combination with these salts of tin may be detected by the nitrate of silver.

The salts of tin produce the common symptoms of irritant poisoning, which must be met by the free use of albumen or milk, and of diluents. Emetics, or the stomach-pump may be employed if necessary.

SILVER.—*Nitrate of Silver*—(Lunar Caustic). This substance i met with in the form of tabular crystals, or fused into small cylinders. It has the following properties:—It is very soluble in distilled water. Its solution has an acid reaction, and a strong styptic, metallic taste; is a very powerful corrosive; and, when mixed with organic matter, is blackened by light. The base is detected by the following tests:—1. Sulphuretted hydrogen or hydro-sulphuret of ammonia yields a black precipitate. 2. Liquor ammoniæ throws down the brown oxide, which is dissolved by the precipitant in excess. 3. Hydro-chloric acid yields a white clotted precipitate, the chloride of silver, which is insoluble in nitric acid, and when heated on platinum foil fuses into a horny mass. 4. On adding to the solution liquor ammoniæ, until the brown oxide is redissolved, and then arsenious acid, the yellow arsenite of silver is thrown down. 5. A strip of copper introduced into the solution is speedily coated with silver. The acid is detected by adding to the filtered liquid, remaining after the application of the tests, carbonate of potash, when nitrate of potash is formed.

No detailed cases of poisoning by nitrate of silver have been placed on record, but, from experiments on animals, it appears that it acts as a simple corrosive and local irritant.

The *treatment* consists in converting the soluble nitrate of silver into the insoluble chloride, by the free use of a solution of common salt.

IRON.—The sulphate and muriate of iron possess sufficiently active properties to entitle them to the name of poisons, but they are among the least active of the irritants. The base may be detected by the following tests:—1. Sulphuretted hydrogen gives no precipitate, but the hydro-sulphuret of ammonia throws down a black sulphuret. 2. Infusion of galls also gives a black precipitate. 3. Ferrocyanide of potassium throws down a blue precipitate, which deepens by exposure to the air. 4. Sulphocyanide of potassium gives a deep blood-red precipitate. The acid in combination in the sulphate and muriate, respectively, may be detected by the nitrate of baryta and nitrate of silver.

The *sulphate of iron* (green vitriol, copperas) and the *chloride*, in the form of tincture, have both proved fatal, and have in one or two other instances produced severe effects. The symptoms and post-mortem appearances in one case of poisoning by the tincture, recorded by Dr. Christison, were those of a strong irritant. The treatment would consist in the free use of emetics and diluents.

BISMUTH.—*Trisnitrate or subnitrate of Bismuth.*—This substance

has proved fatal in a large dose, with the symptoms and post-mortem appearances proper to irritant poisoning. It is found in the form of a white, insoluble powder, which is blackened by sulphuretted hydrogen, and hydro-sulphuret of ammonia. It is soluble in nitric acid, but it is again thrown down when the solution is largely diluted with water. The solution resembles that of the salts of lead in being precipitated white by liquor ammoniæ and liquor potassæ, but differs from it inasmuch as it gives no precipitate with dilute sulphuric acid. It gives a deep brown precipitate with iodide of potassium.

CHROME.—The *bichromate of potash* is much used as a dye. It is found in the form of deep orange red crystals, which yield a solution of the same colour. The solution has an acid reaction. With the salts of lead it gives a yellow, and with those of silver a deep red precipitate. Little is known of the action of this substance on man, but experiments on animals have shewn that it possesses the properties of an irritant poison. The treatment would not differ from that proper to the class of irritants.

CHAPTER XXI.

VEGETABLE IRRITANTS.

Substances belonging to the Class of Purgatives.—Aloes, Colocynth, Gamboge, Jalap, Scammony, Castor-oil Seeds, and Croton-oil.—Savin.—Yew-berries.—Decayed Vegetables.

THE greater number of poisons belonging to this class of vegetable irritants or vegetable acrids are, like most of the poisons belonging to the mineral kingdom, employed as medicines. All the more active purgatives when given in large doses, or to a person suffering from great debility, may act as poisons. Aloes, colocynth, gamboge, jalap, scammony, castor-oil seeds, and croton-oil, administered either alone or in combination have proved fatal.

The symptoms produced by this class of poisons are those of irritation of the alimentary canal, vomiting, and purging, with pain in the abdomen, tenesmus, and strangury. The patient falls into a state of collapse, attended occasionally with drowsiness and slight nervous symptoms.

The post-mortem appearances are those of inflammation of the alimentary canal in various degrees and stages, as inflammatory redness, ulceration, softening, and effusion of dark blood into the submucous tissue.

The treatment proper to the whole class of vegetable acrids consists

in the free use of diluents, in the administration of emetics when vomiting is absent, in local or general blood-letting when the inflammatory symptoms run high, and in stimulants or narcotics if collapse or nervous symptoms are present.

The symptoms and morbid appearances present, and the treatment proper to be adopted in cases of poisoning by the several substances just-mentioned, differ so little that it is quite unnecessary to specify them separately. Neither the symptoms nor the morbid appearances are in any case so peculiar as to aid the medical man in discovering the precise poison which has been taken, and chemical analysis gives him no assistance. Where the vegetable acrids have been taken as leaves, fruits, or berries, portions of them may be found in the vomited matters or in the contents of the stomach.

Besides the substances commonly administered as purgatives, there are others which do not belong to this class. Such are the savin, and the leaves and berries of the yew tree.

Savin (Juniperus Sabina). The leaves of this plant, in powder or infusion, and the oil are often given with a view to procure abortion, and sometimes with the effect of sacrificing the life of the mother. It is a simple irritant, causing pain in the belly and vomiting, and sometimes severe strangury, but rarely acting upon the bowels.

The leaves and berries of the *yew tree* have proved fatal to several children, with symptoms of irritant poisoning, combined with some degree of nervous affection as indicated by drowsiness and convulsions. A long list of substances belonging to this class might be given, and each might be treated with some detail, but this would not be attended with any practical benefit.

A few cases have occurred of poisoning by spoiled vegetables. One instance of poisoning by spinach has been lately recorded in a foreign periodical. Vomiting, purging, and pain of the abdomen were the principal symptoms. This form of poisoning, however, is of rare occurrence.

Another article of food which has obtained poisonous qualities is bread made of wheat, rye, or barley. When spoiled or mouldy it may act as an irritant poison. Several cases of this form of poisoning have occurred on the Continent. In some cases of poisoning by spoiled rye-bread described by Dr. Westerhoff, the features were red, the tongue dry, and the pulse small and frequent. There were violent colic pains, urgent thirst and headache, and vomiting and diarrhœa, alternating with exhaustion and sleepiness.* These poisons have been classed with the narcotico-acrids.

* Journal de Chimie Médicale, vii. 122.

CHAPTER XXII.

ANIMAL IRRITANTS.

Cantharides.—Poisonous Fish.—Diseased and Decayed Animal Matter.

In this chapter it is proposed to consider briefly the effects of such substances derived from the animal kingdom as produce poisonous effects when taken internally. Of these, some possess independent properties, others owe their poisonous effects to a change wrought by putrefaction. To the first class belong cantharides and the poisonous fish, and to the second, the several kinds of diseased and decayed animal matter.

Cantharides.—The common blistering fly in the form of powder or tincture, or mixed with oily matters is an active irritant poison, characterised by its energetic action on the urinary and generative organs. It has been taken with a view to procure abortion, or for lascivious purposes, and has been sometimes given by way of a joke. It is also occasionally used internally as a medicine.

The blistering fly may be detected in the contents of the stomach by its glistening green colour. It may also be dissolved by ether, evaporated to the thickness of an extract, and applied to the skin. If a blister is raised, it gives convincing evidence of the presence of cantharides. By these two tests Barruel succeeded in detecting cantharides in some cakes of chocolate, of which a part had been maliciously given to several persons.*

Symptoms.—There is a burning pain in the throat and pit of the stomach, increased by pressure, and extending at length over the whole abdomen, accompanied by excessive pain in swallowing, dryness of the fauces, great thirst, copious discharge of blood or bloody mucus from the stomach, mixed with shining, green particles, and, in less quantity from the bowels; tenesmus, distressing strangury, bloody urine, priapism, and inflammation of the genital organs. The patient is extremely restless, the breathing laborious, the pulse quick and hard. Occasionally headache, delirium, and convulsions are superadded.

Among the occasional symptoms recorded are salivation, vomiting of tenacious mucus taking the shape of the gullet, or of the mucous membrane itself, redness of the eyes and lachrymation, and violent nausea.

* Annales d'Hygiène, xiii. 455.

Cantharides produces these symptoms in whatever form it is administered or applied. It has produced fatal effects when applied externally to the skin.

When given as a medicine, in the form of tincture, the poison produces a marked effect in very small doses. Though the dose of the tincture usually recommended is ten drops to two drachms, and of the powder from half a grain to two grains, I have never found it necessary in cases of incontinence of urine in young persons of either sex, to give more than three or four drops of the former three times a-day. In a lad who was taking only four drops, a slight degree of pain in the urethra followed each dose. A considerable number of cases have been completely cured by this remedy in these doses. On the other hand, very large quantities, as six ounces of the tincture, have been taken without bad effect,* a fact only to be accounted for by the badness of the preparation.

The smallest quantity of the tincture which has proved fatal is one ounce, and two doses of the powder of twenty-four grains each, taken at an interval of a day, have destroyed life after producing abortion.

Post-mortem Appearances.—These correspond with the symptoms just detailed. There are marks of inflammation in different degrees and stages in the whole length of the alimentary canal, and in the urinary and genital organs. The brain has been found gorged with blood. The powder may be found in the stomach for long periods after death. According to Orfila and Leseur, it may be found unchanged after an interment of nine months.

Treatment.—There is no antidote to this poison. Vomiting must be excited and encouraged by emetics and warm liquids. The free use of diluents, with oily or demulcent injections into the rectum and bladder, and leeches or bleeding, if the inflammatory symptoms run high, constitute the remainder of the treatment. Laudanum may be advantageously added to the injections, or suppositories of opium may be introduced into the rectum.

Poisonous Fish.—Several kinds of fish belong to the class of irritant poisons. Some of these are constantly poisonous, others occasionally so, and others again act injuriously on certain persons only.

The most important of these poisonous fish is the common *muscle*, which becomes poisonous in certain circumstances not yet well understood. The symptoms generally come on after an interval of one or two hours, with swelling and itching of the eyelids, and watering of the eyes, and an eruption on the skin in most cases closely resembling common nettle rash, and attended with intense heat and itching. Dyspnœa generally follows, but occasionally precedes these symptoms; there is extreme weakness; and in fatal cases delirium, convulsions, and coma have supervened. Symptoms of irritation of the stomach are not always present, but in some instances there have been nausea,

* Beck's Medical Jurisprudence, p. 574.

pain in the pit of the stomach, vomiting, and difficulty in swallowing.

The treatment will consist in the free use of emetics, purgatives, and diluents. Ether may also be given with advantage.

Instances are on record in which oysters, eels, and salmon have produced injurious effects. The richer fish also habitually disagree with some persons. When fish owe their poisonous properties to putrefaction, they belong to the next class of poisons.

Diseased and Decayed Animal Matter.—There is a disease prevalent among cattle on the continent, but little known in England, which consists in the formation of large boils upon different parts of the body. The flesh of animals which have died of this disease has often produced severe effects by contact with the skin, and when eaten has destroyed life either by producing violent cholera, or by creating a similar disease to that under which the animal laboured. The glanders communicated to man from the horse, and the diffuse inflammation excited by punctured wounds inflicted in dissection, or in preparing meat for the table, are familiar examples of the effect of diseased animal matter applied externally to the human body.

Decayed Animal Matter is a common cause of severe and dangerous symptoms allied to those of irritant poisoning. The articles of food which have most frequently acted as poisons are sausages, especially those made of liver and blood, bacon and ham, cheese, and goose grease. The symptoms produced by these substances do not differ materially, and are probably due to the formation of a substance closely allied to sebacic acid. The following case which occurred in Germany, in the year 1829, will prove a very good illustration of this form of poisoning:

On the 2nd of April, 1829, Dr. Siedler was called to attend four persons, two men, aged 31 and 28, and two children, one a girl aged four years, the other a boy aged two-and-a-half. They all laboured under the following symptoms:—Cold sweats, anxiety, vertigo, pallor and prostration of strength, eyes sunk and pupils dilated, burning pain in the lower part of the belly increased by pressure, violent vomiting, ardent thirst, dry tongue, and involuntary discharges of urine and fæces. The oldest adult was insensible for six minutes, his breathing was scarcely visible, his pulse imperceptible, and the heart's action exceedingly weak. The younger adult had vomited blood several times, but he had less pains in the abdomen than the others. The symptoms were clearly traced to some goose grease which had been used in preparing meat of which the four patients had partaken.*

The symptoms of poisoning by decayed animal food rarely come on till the lapse of three or four hours. In many cases they are accompanied by narcotic symptoms, which would entitle these poisons to a place among the narcotico-acrids.

* Hufeland's Journal.

It appears that the poisonous quality of the food is developed only in the first stages of putrefaction, but disappears when that process is far advanced.

The milk of cattle fed in particular pastures, containing poisonous plants, is said to acquire poisonous properties, just as the honey of bees, which feed on certain poisonous flowers, produces delirium and symptoms of narcotic poisoning.

The treatment of these cases, after the removal of the poison from the stomach, would be determined by the nature of the symptoms present.

CHAPTER XXIII.

IRRITANT GASES.

THE irritant gases in common use are the nitrous-acid gas, the muriatic-acid gas, the sulphurous-acid gas, chlorine, and ammonia. Of these the most important are the nitrous-acid gas, chlorine, and ammonia.

Nitrous-acid Gas.—This gas in a concentrated state destroys life by exciting violent inflammation in the lungs. When it is mixed with a larger quantity of common air, and inhaled day by day, as by men employed in the unhealthy work of brass-finishing and water-gilding, it produces a more chronic form of the disease. A man following the first of these employments, who came under the author's care, was constantly troubled with a dry cough, and redness of the eyes, but each fresh exposure to the fumes of the acid was followed by extreme dyspnœa, and a great increase of suffering. A case of poisoning by this gas has already been given at p. 437. A second case in which the gas proved fatal in two days, with symptoms of violent pneumonia, is quoted by Christison from the bulletins of the Medical Society of Emulation. There was in this instance peripneumony of one side, and pleurisy of the other ; the uvula and throat were gangrenous, and the windpipe and air-tubes dark red ; the veins throughout the whole body were much congested, the skin very livid in many places, and the blood fluid in the heart, but coagulated in the vessels.*

Chlorine.—The following case of poisoning by this gas is quoted by the same author from Wibmer. A young man after breathing diluted chlorine as an experiment, was instantly seized with violent irritation in the epiglottis, windpipe, and bronchial branches, cough, tight-

* Christison on Poisons, p. 735.

ness and sense of pressure in the chest, inability to swallow, great difficulty in breathing or articulating, discharge of mucus from the mouth and nostrils, severe sneezing, swelling of the face, and protrusion of the eyes. Ammonia was of no use; but singular relief was obtained from the inhalation of a little sulphuretted hydrogen, so that in an hour and a half he was tolerably well.*

Ammonia.—The following case is given by Nysten:—A medical man, liable to epilepsy, was found in a fit by his servant, who ignorantly tried to rouse him by holding to his nostrils a handkerchief dipped in ammonia. In this way about two drachms appear to have been consumed. On recovering his senses, the patient complained of burning pain from the mouth downwards to the stomach, great difficulty in swallowing, difficult breathing, hard cough, and copious expectoration, profuse mucous discharge from the nostrils, and excoriation of the tongue. The bronchitis increased steadily, and carried him off in the course of the third day, without convulsions or any mental disorder having supervened. After death the nostrils were found blocked up with an albuminous membrane; the whole mucous membrane of the larynx, trachea, and bronchi, and even of some of the bronchial ramifications, was mottled with patches of lymph; the gullet and stomach shewed red streaks here and there; and there was a black eschar on the tongue, and another on the lower lip.†

It is not probable that the effects of the other irritant gases will differ materially from those set forth in the preceding cases. Inflammation of the mucous membranes of the several parts with which the gas comes in contact, and the symptoms of such inflammation, by whatever cause produced, will be present in a greater or less degree according to the degree of concentration of the gas.

* Christison on Poisons, p. 736.

† Bulletins de la Société de Médicine, t. iv. p. 352; and Christison on Poisons, p. 225.

CHAPTER XXIV.

NARCOTIC POISONS.

Symptoms and morbid appearances—their resemblance to those of disease.—Apoplexy.—Epilepsy.—Diseases of the Brain and Spinal Cord.—Diseases of the Heart.

THE narcotic poisons are characterized by the disorder which they produce in the nervous system, more especially in the brain, symptoms of narcotism being the most prominent.

In examining this class of poisons we encounter difficulties which do not occur in the case of the irritant poisons. The symptoms which they produce during life are more obscure, and more apt to simulate the effects of disease, and the post-mortem appearances are very slight and indistinct. The chemical analysis, moreover, except in the case of one or two of the more common narcotic poisons, is far from being sure or satisfactory.

The *symptoms* of narcotic poisoning are giddiness, headache, dimness of sight, confusion of mind, stupor, and palsy: convulsions, and tetanic spasms, are sometimes superadded, terminating at length in perfect coma.

The *morbid appearances* are often slightly marked, consisting in fulness of the veins and sinuses of the brain, and an effusion of serum at the base and into the ventricles. Extravasation of blood, though of very rare occurrence, has been observed more than once.

There are several diseases affecting the brain and nervous system which in the symptoms they present during life, and the morbid appearances they leave after death, may be confounded with the effects of narcotic poisons.

Of these the principal are apoplexy—simple, congestive, and serous; epilepsy, meningitis, inflammation of the substance of the brain, hypertrophy of the brain, diseases of the spinal chord, and syncopal asphyxia, or asphyxia idiopathica.

In this enumeration, and in the lengthened discussion by which it is often accompanied, there is a little over refinement. It is true that any of these diseases may, under rare circumstances, resemble in more than one of their symptoms or post-mortem appearances the symptoms and morbid effects of narcotic poisoning, but there is little hope of clearing up the difficult questions which may occasionally arise by lengthened discussions on the symptoms of poisoning and disease respectively. Some of the diseases now enumerated prove suddenly fatal; these diseases, then, can only be confounded with the effects of a

narcotic poison also proving suddenly fatal—and hydrocyanic acid is the only one in common use which does this. No lengthened discussion, therefore, is necessary to shew that difficulties may arise if we do not take all the circumstances into the account, but if we do, it is impossible to make any mistake. In all cases of poisoning by hydrocyanic acid, where the examination of the body is not too long delayed, the smell of the poison is sufficient distinction, and the absence of this odour is in itself the strongest presumptive evidence that death was due to natural causes.

Where death takes place more slowly, and after an interval, the distinction becomes more difficult. Even supposing opium to have been taken, it cannot always be detected, and therefore the most satisfactory proof of poisoning is wanting. The interval which elapses between the last meal and the death of the party may sometimes assist us, death, if caused by apoplexy, often occurring in too short a space of time to allow us to attribute it to poison, and in other instances, after an interval too great to countenance the supposition of poisoning. In other instances, again, it takes place within the period at which poisons may prove fatal; and here we must rely on other means of discrimination, which, though slight in themselves, may altogether amount to a strong presumption.

There are many cases in which the post-mortem appearances are in themselves decisive against the supposition of poisoning; as, for instance, where we have extensive disease or disorganization of the brain, never produced by poisons, or diseases of other organs known to be accompanied by narcotism, such as those of the kidney. In by far the majority of cases of death by narcotic poison, there are no post-mortem appearances in the brain or in any other part of the system; but, as there are one or two cases on record in which blood or serum was thrown out in consequence of poisoning, the presence of these appearances will merely create a strong presumption in favour of death from disease, and against poisoning.

Though the distinction between narcotic poisoning and diseases accompanied by narcotic symptoms is not readily made, and many of the diagnostic marks insisted upon by authors are very trivial, it may be well to specify very briefly the chief points of difference.

Apoplexy.—There is little difference between the *symptoms* of apoplexy and those of narcotic poisoning. The diagnosis is generally made to turn upon the following points:—1. Apoplexy is sometimes preceded by marked premonitory symptoms of long continuance. 2. Apoplexy is rare in persons under thirty years of age, while many cases of poisoning by narcotics occur in young persons. 3. The effect of narcotic poisons taken with a meal is rarely postponed beyond four hours, and, in the case of the most common narcotic poison, opium, it commonly shews itself in from a quarter of an hour to half an hour afterwards. Hence, symptoms of narcotism, occurring more than four or five hours after taking food, might, with a very high probability,

be referred to apoplexy. It must be borne in mind that apoplexy sometimes follows directly upon a full meal. In other instances it is readily traced to sudden exertion or violent passion under circumstances precluding the idea of poisoning. 4. The progress of the symptoms is often characteristic, insensibility coming on gradually in cases of poisoning, but suddenly in cases of apoplexy. 5. It is much more easy to rouse a patient who is labouring under the effect of narcotic poisoning, than one who is suffering from apoplexy. In many cases of apoplexy, moreover, there is rather a loss of power to move and to articulate than a loss of the intellectual faculties. In cases of narcotic poisoning, the mind is evidently more strongly affected; the stupor is more complete, the loss of power much less marked. In the former case, the muscles are paralysed, in the latter the will. When, however, the apoplectic patient is insensible, he is more difficult to rouse than one who has taken narcotic poison. 6. Narcotic poisons, when they prove fatal, destroy life much more rapidly than most apoplectic attacks. On the other hand, when apoplexy destroys life very rapidly, it does so sooner than any other poison except hydrocyanic acid or the narcotic gases.

The distinction between the *post-mortem appearances* in cases of apoplexy, and those due to poison, is still more difficult to make. All that can be said about it is, that effusion of blood upon the surface, in the ventricles, in the substance, or at the base of the brain, is rarely present in cases of poisoning; that its presence, therefore, affords a strong presumption in favour of sanguineous apoplexy; that a copious effusion of serum in the same situation affords a less forcible presumption in favour of serous apoplexy, and that a mere turgescence of the veins and sinuses of the brain furnishes in itself a presumption in favour either of poisoning or of simple apoplexy. The discovery of a narcotic poison in the stomach would be quite conclusive.

Epilepsy.—Epilepsy is one of the occasional symptoms of irritant poisoning, and of poisoning by the narcotico-acrids.* It also closely resembles poisoning by prussic acid. When it is merely one of a group of symptoms due to poisoning, the concomitants will serve to distinguish it at once from a case of simple epilepsy. The points of distinction most insisted upon are the following: 1. The epileptic fit almost always begins abruptly, and in most cases without any previous warning. The premonitory symptom, if present, is rarely such as to be confounded with the effects of a narcotic poison. The symptoms of narcotic poisoning, also, gradually increase in severity. 2. In epilepsy the patient cannot be roused by external stimuli. The reverse obtains in most cases of narcotic poisoning. 3. In fatal cases of epilepsy, death does not take place so rapidly as in poisoning by prussic acid,

* I was lately called to see a child to whom camphorated oil had been given by mistake for castor oil. The symptoms at the moment of my arrival were those of an epileptic fit. The child brought up the poison from its stomach, and was immediately relieved.

and generally after a longer interval than in poisoning with opium. 4. Epilepsy never proves fatal in the first paroxysm. Prussic acid, the poison which produces the symptoms most resembling epilepsy, would be at once detected by its smell. In fatal cases, the morbid appearances will render little assistance. There are no morbid appearances proper to epilepsy, but the brain is often found extensively diseased. If that disease is of a very marked character, it renders the supposition of poisoning improbable, but if it consist simply in congestion, or in a moderate effusion of serum, it is consistent with the supposition of poisoning, apoplexy, or epilepsy.

Diseases of the Brain and Spinal Cord.—The symptoms of several diseases of the brain nearly resemble, previous to their fatal termination, those of narcotic poisoning. When this is the case, a careful post-mortem examination would, in most instances, at once reveal their cause. In the absence of a post-mortem examination, the cause of death could be doubtful only in those cases in which death took place at the same interval after the first appearance of the symptoms as in cases of poisoning. This rarely happens, for in by far the greater number of cases the death is either very sudden, or it takes place beyond the period at which the more common narcotic poisons prove fatal. In this, as in the case of the other diseases already mentioned, the negative result of a chemical analysis of the contents of the stomach would tend to lessen the probability of poisoning.

The diseases of the brain commonly specified as liable to resemble the effects of the narcotic poisons are inflammation of the membranes, of the substance of the brain, softening, hypertrophy, and abscesses or tumours in the substance of the organ. The symptoms attending disease of the spinal cord are but little liable to be confounded with those of narcotic poisoning. They rarely prove fatal so speedily as the narcotic poisons, and are, moreover, characterized by very marked post-mortem appearances.

Diseases of the Heart and large Vessels.—Sudden death from disease of the heart or large vessels is a frequent event, and in most cases accompanied by such marked lesions of structure as to remove all difficulty. The only disease of the heart which proves fatal without leaving very distinct traces of its existence after death, is atrophy, the cause of the so-called *asphyxia idiopathica.*

Idiopathic or *Syncopal Asphyxia.*—Death here takes place in a fainting fit, and so suddenly as to admit of being attributed to poisoning by prussic acid. The absence of the characteristic odour of the poison would suffice to render the supposition of poisoning untenable.

To all the objections which have been now discussed the same observations apply. If it can be proved that food has not been taken for several hours before the presumed poisoning, the supposition of poisoning is negatived. If death takes place very suddenly, poisoning, except by prussic acid or the more active of the gaseous poisons, is out of the question. The absence of the peculiar odour, in the one case,

and of the conditions necessary for the production of these gases, in the other, will also negative the supposition of poisoning. If death take place with symptoms similar to those of narcotic poisoning within the time at which such poisons may prove fatal, recourse must be had to the post-mortem appearances. These will often be of so marked a character as to explain the death without having recourse to the supposition of poisoning. But if the post-mortem appearances should happen to be such as are found in cases of poisoning, recourse must be had to an analysis of the contents of the stomach, which may issue in rendering the previous exhibition of poison improbable, or in proving that this was the cause of death.

The most important of the narcotic poisons are opium and hydrocyanic acid. Henbane, lactuca, and dulcamara are of less importance.

The narcotic gases—carbonic acid, carbonic oxide, sulphuretted and carburetted hydrogen—complete the list.

CHAPTER XXV.

OPIUM.

Opium and its preparations in common use as Poisons.—Properties of Opium.—Preparations of Opium.—Constituents of Opium.—Morphia and Meconic Acid.—How extracted.—Properties and Tests of Morphia—of Meconic Acid.—Symptoms of poisoning by Opium and its Preparations.—Post-mortem Appearances.—Quantity required to destroy Life.—First appearance of Symptoms.—Shortest period at which they prove fatal.—Treatment.

The importance of opium and its preparations as poisons will be understood from the statement, that of the 543 cases of poisoning brought under the notice of the Coroner's court in England and Wales, during 1837—38, no less than 200 were cases of poisoning by opium or its preparations, either alone or in union with other poisons. This number will appear the more striking when it is stated that it exceeds the total number of cases (184) of poisoning by arsenic.

The following is an analysis of these 200 cases. Poisoning by opium 42 cases, by laudanum 133, by other preparations containing opium 21, by acetate of morphia 2, cases of mixed poisoning (laudanum and prussic acid, and laudanum and aquafortis) 2. Of the 200 cases, 64 occurred in children, and the remainder in adults, and of these 64, 41, or a fifth

of all the cases, were over doses of cordials or medicines, administered to children by their mothers or nurses.

Opium and its preparations are often employed as poisons both by the suicide and murderer; and it is not rarely used with a view to the commission of other crimes, as theft or rape; in such cases it is generally given after the sense of taste has been deadened by intoxicating liquors.

Opium.—This substance has the following familiar properties: It is of a reddish brown colour, of a strong and peculiar odour, and a bitter and rather acrid taste. It consists of a number of distinct principles, combined with a peculiar acid and mixed with resin and extractive matters. These principles are dissolved by water at ordinary temperatures, by alcohol, and by the mineral and vegetable acids.

The principal preparations of opium are its tincture, or *laudanum*, which contains one grain in every nineteen drops; the *wine of opium*, which contains one fifth less opium than the tincture; the *black drop*, said to contain four times as much opium as the tincture; *Battley's sedative liquor*, which is stated to have three times the strength of laudanum, (both these are said to be solutions of opium in vegetable acids); and Dover's powder, which contains one grain of opium in ten. *Paregoric*, a compound tincture containing opium, camphor, benzoic acid, and oil of aniseed dissolved in alcohol, and having one grain of opium in every half ounce, also requires notice, from having been taken as a poison. Godfrey's cordial, Dalby's carminative, and several mixtures given to children for the same purpose, contain laudanum as their chief ingredient in combination with syrups, stomachics, and magnesia. The quantity of laudanum in these preparations is probably very variable.

The active principles contained in opium are very numerous. Morphia, narcotine, narceine, meconine, and codeïne, have been found in a separate state, but the most important, indeed the only ones of any medico-legal importance, are *morphia* and *meconic acid*, which exist in combination in the opium as a *meconate of morphia*. Opium may be recognized either by its peculiar properties, of which the smell is the most characteristic, or by the properties of the morphia and meconic acid which it contains.

The morphia and meconic acid are extracted and separated by the following process:

The opium is infused in successive portions of cold water. This solution in water is then boiled with magnesia. A precipitate is thus obtained, which after being well washed and dried, is boiled with proof spirit. The watery solution holds the active principles dissolved, and these are thrown down in combination with the magnesia. The proof spirit dissolves the narcotine and resin, leaving the morphia and meconate of magnesia behind. The morphia is now separated from the meconate of magnesia by boiling in strong alcohol, which dissolves the former, mixed with a small proportion of resin. From

this impure spirituous solution, the morphia may be obtained pure by crystallization or by digesting it with animal charcoal. The impure meconate of magnesia is now to be boiled in dilute sulphuric acid, and the mixture to be partially evaporated. The sediment which falls on cooling is to be dissolved in water, and acetate of lead is to be added to the solution. A meconate of lead is thus formed. This is to be washed and suspended in water, and a stream of sulphuretted hydrogen gas is to be transmitted through it. Sulphuret of lead is formed, and free meconic acid is left in solution. On evaporation, impure scaly crystals of meconic acid may be obtained. The morphia and meconic acid thus procured are to be identified by their appropriate tests.

TESTS FOR MORPHIA AND MECONIC ACID.

Morphia has the following properties: 1. It is in the form of small prismatic crystals, which vary in colour according to their degree of purity, when quite pure being of a beautiful white, but, as generally met with, being more or less discoloured by resin. 2. They have a bitter taste, but no smell. 3. When gently heated, they melt, and on again cooling, present a radiated crystalline appearance. When a stronger heat is applied, they first fuse, then burn like a resin, depositing charcoal, and giving out ammonia. 4. They are sparingly soluble in cold and in hot water, but more soluble in ether, and still more so in alcohol. They are also dissolved by oils and the caustic alkalies, and are very soluble in the mineral and vegetable acids. It is in combination with these latter that they are used in medicine. 5. In solution they have a slight alkaline reaction.

The *tests* for morphia or its salts are, 1. *Nitric Acid*, 2. The *Sesquichloride of Iron*, and 3. *Iodic Acid and Starch.*

1. *Nitric Acid.*—When morphia is treated with nitric acid, it becomes instantly orange-red, and at the same time is dissolved with effervescence, nitrous acid fumes being given off. On the addition of a larger quantity of acid the colour of the solution changes to a bright yellow. On the application of heat to the solution, it becomes of a straw colour. Hence in employing the nitric acid test we must take care not to add it to a hot solution of the alkali. When nitric acid is added to a solution of morphia the same change of colour occurs, the intensity of the colour varying with the strength of the solution.

2. *Permuriate of Iron.*—This test added guttatim to a solution of morphia, or to morphia suspended in water, strikes a rich indigo-blue colour, turning to green when added in excess. The peroxide is reduced to the protoxide, and unites with the morphia in a peculiar combination. On the application of heat it again acquires a brownish tint, resuming its original colour on cooling. The colour is entirely destroyed by acids. Hence this, like the former test, should not be applied to a hot solution, nor must the solution be acid. If the

solution have an acid reaction, it should be neutralized by caustic potash.

The *nitric acid* destroys the colour and then produces its own characteristic effect. Hence we may, if we please, apply the *permuriate* of iron first, and then the *nitric acid*, to the same portion of morphia.

3. *Iodic Acid and Starch.*—Morphia, when added to iodic acid, combines with its oxygen, and sets the iodine free, which may be detected by its brown colour and the deep blue which it strikes with starch.

There is one fact necessary to be borne in mind in applying this test, viz. that iodic acid is very liable to decomposition, so that it may contain free iodine, and yield a blue colour with starch without the presence of morphia. The iodic acid, then, must be first tried without morphia, and its purity ascertained. This test is a very characteristic one, as no other alkaloid yet discovered has the same effect. It is also extremely delicate, but at the same time liable to be interfered with by slight causes, and in any case requiring time for the complete development of its effect. It is much less constant in its action than either of the foregoing tests. Like them it must not be applied to an acid or hot solution.

Neither of these tests is free from objection, and some of the objections which may be urged against one test, apply with equal force to a second.

Objections to the Nitric Acid Test.—1. The first objection urged against the nitric acid test, is that it only produces its characteristic effect with impure specimens of morphia. This objection is not valid, for I have obtained the most characteristic reaction with the whitest and purest specimens of morphia; and this statement is borne out by the experience of others.

2. The infusion and tincture of galls yield with nitric acid a purplish red precipitate. This objection is readily obviated by the very mode of applying the test, which is not to a coloured solution, but to a colourless liquid formed by suspending morphia in water or dissolving it in acid.

3. Other alkaloids are asserted to give similar results with nitric acid. Strychnia, brucia, delphinia, and veratria give a colour more or less closely approaching the orange-red of morphia, and ranging between a light and a dark red. It is not necessary to enter into a minute description of these reactions or of the colour of the resulting solutions. It is sufficient to state that none of these alkaloids decompose iodic acid.

Nitric acid also turns narcotine of a gamboge yellow, and therefore narcotine resembles morphia when the acid is added in excess. But no difficulty can arise from this resemblance, as both these alkalis exist in opium and its compounds.

Objection to the Sesquichloride of Iron Test.—The only objection to this test is, that infusion and tincture of galls also strike with the salt of iron a blue colour. This objection is at once obviated by the

employment of a colourless solution of the morphia. It is to such a solution that the test is presumed to be applied.

Objections to the Iodic Acid Test.—Iodic acid is not only liable to spontaneous decomposition and the consequent formation of free iodine, but it is also decomposed by several substances, as sulphuretted hydrogen, sulpho-cyanide of potassium, sulphurous acid, and gallic acid. Having ascertained that the iodic acid contains no free iodine, the remaining objections may be readily obviated by the mode of performing the experiment. Such objections lose their force when it is recollected that the iodic acid is presumed to be added to a salt or to its pure solution. Sulpho-cyanide of potassium would be readily distinguished from morphia by striking a blood-red with the persalt of iron. Gallic acid alone gives a similar reaction with all the tests,—a red with nitric acid, a blue with the persalt of iron, and with the mixture of iodic acid and starch. There is, however, this obvious difference. Morphia gives an alkaline, and gallic acid, an acid reaction. Gallic acid is also much more soluble in water than morphia.

To each of the tests for morphia, then, when taken separately, there is some objection, but on the supposition that the three tests act characteristically and on a colourless fluid, or a colourless solution of a crystalline substance, there can be no reasonable doubt of the existence of morphia or its salts.

Meconic Acid.—This is obtained from solutions of opium in the form of reddish scaly crystals, which are very soluble in water, the resulting solution having an acid reaction. When heated in a glass tube the crystals are partly decomposed and partly sublimed, and the sublimate condenses on the sides of the tube in the form of filamentous radiated crystals. The only test of any value for meconic acid, whether in crystals or in solution, is the sesquichloride of iron, which has been just mentioned as one of the tests for morphia. This reagent strikes with meconic acid an intense cherry-red colour.

Objections to the Test.—1. The sulpho-cyanide of potassium also gives a deep red colour with the sesquichloride of iron, and as this salt almost always exists in the saliva, the secretion is reddened by the test. The objection is easily obviated by introducing into the fluid a morsel of zinc and a drop or two of dilute sulphuric acid. If sulphur is present a minute quantity of sulphuretted hydrogen is given off, which may be detected by the smell, and by the effect on lead-paper. As common mustard contains sulpho-cyanic acid in union with a principle called sinapisin, it undergoes the same change of colour on the addition of the test. 2. Alkaline acetates give the same colour with the sesquichloride of iron. The distinction is readily made. The solution of these salts is neutral, and, when boiled with any of the mineral acids, acetic acid is given off.

The objections to the tests for morphia and meconic acid jointly, as affording evidence of the existence of opium in a fluid submitted to analysis or obtained from the contents of the stomach, are of little

force, provided the tests all act characteristically, and are applied to a clear and colourless solution. When the reactions are but obscurely marked, but little dependance is to be placed upon them.

Opium in Organic Mixtures.—A solution of opium itself may be regarded as a suspension of its active principles in an organic mixture, for opium, in addition to those principles, contains a large amount of resin and extractive matters. When the contents of the stomach are submitted to analysis, the process for the detection of the poison is as follows: Any solid matters which may be among the contents must be cut into small fragments, and well mixed with the more liquid contents, distilled water being added if necessary. The mixture must then be slightly acidulated with acetic acid, and after being allowed to stand for several hours must be filtered. If the filtered liquid is coloured, the colour may be removed by boiling it with animal charcoal. If the quantity is too large it may be concentrated by evaporation. To this solution acetate of lead must be added as long as any precipitate falls, and the liquid must be boiled and filtered. An impure meconate of lead remains on the filter, while the fluid part contains the morphia. Through this fluid part sulphuretted hydrogen gas is to be transmitted, by which any lead it may contain is thrown down as a sulphuret. The liquid must again be filtered, and on evaporation crystals of acetate of morphia will remain, which must be purified by being dissolved in alcohol. The impure meconate of lead remaining on the filter must now be suspended in distilled water, and sulphuretted hydrogen must be transmitted through it. A sulphuret of lead is formed, and meconic acid remains in solution. The acid may be obtained in a state of greater purity by repeating the same process. The fluid may then be concentrated by evaporation. The morphia in the one case, and the meconic acid in the other, may be identified by the tests already pointed out.

This process, in skilful hands, is very delicate; two grains of morphia in eight ounces of the most complex mixture yielding distinct evidence of opium. Now it must be recollected that two grains of morphia are equivalent to about a scruple of solid opium, or half an ounce of laudanum; and we can rarely expect to find so large a quantity as this in the contents of the stomach. Christison states, that by a process similar to the one just described, he has succeeded in obtaining distinct evidence of morphia and meconic acid by all the tests, in an infusion of ten grains of opium in four ounces of water. But on proceeding to apply the process to organic mixtures he found that when the soluble part of ten grains of opium was mixed with four ounces of porter or milk, he could detect no property of morphia, except its bitterness, and but faint indications of meconic acid by the permuriate of iron.*

The fact now stated would lead us to expect few or no traces of

* On Poisons, p. 641.

opium in the stomach in the majority of cases of poisoning by it and its preparations. Very large quantities of the drug in its fluid preparations may be taken, and yet be detected neither by the smell, nor by the taste, nor by the several tests, even where death takes place most rapidly; and it may be stated as a general rule that, in poisoning with opium, the medical jurist, by the best methods of analysis yet known, will often fail in procuring satisfactory evidence, and sometimes fail to obtain any evidence at all, of the existence of the poison in the contents of the stomach. Even the smell will be frequently absent, and when present is so mixed up with other odours, that it cannot be detected with any certainty. In a remarkable case published by Dr. Bright, it is stated that the matter removed from the stomach only half an hour after an ounce and a half of laudanum had been taken on an empty stomach, did not smell of opium.*

The tests act very characteristically on the meconic acid, the sesquichloride of iron sometimes yielding a distinct ruby-red colour when the tests for morphia fail. This, though not in itself sufficient evidence of the existence of opium, would strongly confirm other presumptions. The objection founded on the existence of the sulpho-cyanide of potassium in the saliva is not of any great force. The sulpho-cyanide of potassium is stated by Dr. Christison† rarely to exist in the saliva in sufficient quantity to yield characteristic results, unless the saliva is first evaporated, and then dissolved in a small quantity of distilled water; I have never failed to detect it in that secretion without any preparation. As, however, it is highly improbable that the sulpho-cyanide of potassium would exist in the stomach after the complex process just described, this objection has little force, and might be obviated by the use of a fragment of zinc and dilute sulphuric acid.

The tests for opium, then, are much less satisfactory than those for the mineral acids, and they would fail altogether in the majority of cases. Even in the class-room, some of them as often fail as succeed.

It is of some importance to know what quantity of morphia may be obtained from a given quantity of opium. This differs materially with the quality of the drug, and varies with the place of its growth. Thus French and German opium (at least some specimens of it) contain as much as 16 to 28 per cent. of morphia. On the other hand, as little as 2 per cent. of morphia has been obtained from a specimen of French opium. The average obtained from good Turkey opium seems to be about 10 per cent. The quantity of meconic acid has not been accurately determined.

SYMPTOMS, POST-MORTEM APPEARANCES, AND TREATMENT.

Symptoms.—These vary with the dose. As a general rule, small doses of opium, or its preparations, are soon succeeded by excitement

* Reports of Medical Cases, ii. 203. For similar cases, see Christison on Poisons, p 642.

† On Poisons, p. 644.

both bodily and mental; but large doses are generally followed by the symptoms of narcotism. To both these rules, however, there are exceptions; small doses being sometimes followed by narcotic symptoms, without any previous excitement, and large doses by excitement, followed by narcotism.

The symptoms due to a large dose of opium, or its preparations, are giddiness, drowsiness, and listlessness, followed by stupor, passing by degrees into a state of complete insensibility. The patient lies as if in profound sleep, breathing slowly and almost imperceptibly, with the eyes shut, the pupils contracted, and the pulse either very frequent, or full and slow. At first the patient can be easily roused by loud noises, sudden movements, or slight blows; but, in a more advanced stage, he is kept awake with great difficulty, and at length falls into a state of complete coma, with stertor, and a slow and full pulse. Nausea and vomiting are sometimes present from the first, but in other cases they are among the early signs of recovery. When the patient is kept roused, by being briskly moved about, he is subject to constant retching, even though no emetic has been used. Occasionally there is diarrhœa. Convulsions are sometimes present. Recovery is generally perfect, but accompanied by nausea and peculiar nervous excitement.*

* There is much difference between the symptoms present at different stages of the action of opium, and in different persons under its influence. For this reason it may be useful to notice some of the principal symptoms somewhat in detail.

The *insensibility* produced by opium differs, except on the near approach of death, from that present in apoplexy, or epilepsy. At first the patient is easily roused, but in the more advanced stages this can be effected only by violent shaking, loud speaking, tickling the nostrils, injecting water into the ear, or flecking the hands and feet with a towel.

Convulsions.—These are of comparatively rare occurrence, but have been observed in more than one case in a marked form, sometimes constituting the most prominent symptoms, at other times alternating with stupor. Locked-jaw and violent tetanic spasms have also been present in a few cases. The reflex function is often extremely active, the leg being forcibly retracted when the foot is tickled, though the patient lies quite insensible.

Delirium.—This symptom is of rare occurrence, but has existed either with or without convulsions.

The *pupils* are almost always contracted, and nearly, or altogether insensible to light.

The *countenance* is commonly pale and calm, as in a person in a profound sleep; but it has been observed flushed and excited.

The *breathing* is generally slow, except in some instances in the first stage. In the long sleep which follows recovery from the urgent symptoms, the respiration is remarkably slow. I have counted it in a female as low as 6 in the minute, while the pulse was upwards of 80.

The *pulse* sometimes is nearly natural in frequency and force; in other cases it is full and accelerated, but this happens chiefly in the first stage. In the stage of insensibility, while the patient can still be roused, the pulse is generally full and slow, but towards the fatal termination it becomes small, frequent, and irregular. The respiration is much more uniformly affected than the pulse.

The *secretions*, with the exception of the perspiration, which is sometimes

Post-mortem Appearances.—These are neither constant nor well marked. Turgescence of the vessels of the brain, with or without serous effusion into the ventricles and at the base, and very rarely accompanied by extravasation of blood, forms the most marked morbid appearance. Lividity of the skin, congestion of the lungs, a fluid state of the blood, and early putrefaction of the body are among the less constant appearances.

First Appearance of the Symptoms.—The poison, when taken in a large quantity, and in a fluid state, may begin to act within a few minutes, and coma may be fully formed within half an hour. Even when taken in the solid form, complete stupor has been present in as little as fifteen minutes. Sometimes, however, the action of the poison, even though a large dose has been taken, is postponed for half an hour, an hour, or an hour and a half. The action is more prompt when the poison is taken on an empty than on a full stomach, when in a liquid state than when swallowed in the solid form, when the patient remains still than when he takes exercise immediately after swallowing the poison.* The action is also postponed and diminished by the effect of spirituous liquors. This statement is made on the authority of a case related by Mr. Shearman, and quoted by Dr. Christison.

The *shortest period* within which opium or its preparations have proved fatal is *three* hours ;† few cases are prolonged beyond *twenty-four* hours, and the *average* may be stated at from *seven* to *twelve* hours.‡ When a patient survives *twelve* hours there is good hope of his recovery.§

The *smallest* quantity which has proved fatal in the adult is four

very abundant, are diminished, and the bowels are generally inactive; but cases are recorded in which both diarrhœa and diuresis were present.

Vomiting.—This, as stated in the text, is often spontaneous, and leads to the recovery of the patient. It also follows the successful application of remedies.

* The effect of exercise in postponing the action of the poison, is well illustrated by the following case. A farmer took from the hands of his father a quantity of laudanum instead of some other medicine. "The mistake was instantly discovered, but the young man had sufficient energy and presence of mind to combat the operation of the drug. While all around him were stupid with fear, he rose, saddled his horse, and rode to Selkirk (six or seven miles); thus saving the time that the doctor must have taken in coming to him. It is very curious that his agony of mind was able to suspend the operation of the drug until he had alighted, when it instantly began to operate. He recovered perfectly."—Lockhart's Life of Sir Walter Scott, vol. v., p. 186. If we substitute the word exercise for "agony of mind," we have here a very apt illustration of the effect of exertion, as stated in the text.

† London Med. and Phys. Journal, xxxi. 468. The case of Kinnear v. Borrodaile, quoted by Beck, affords a slight probability of poisoning in two hours. Medical Jurisprudence, p. 984.

‡ Christison on Poisons, p. 656.

§ Cases are quoted by Christison of 3, 4, 5, 6, 9, 15, 17, and 24 hours. On Poisons, p. 656.

and a half grains.* Enormous quantities have been taken with impunity. In one instance recovery took place after no less than eight ounces of solid opium.

In very young children extremely small doses produce very marked effects, and have proved fatal. Two and a half drops of laudanum have destroyed an infant three days old; three drops a strong child of fourteen months; four drops an infant of a few weeks old. These cases are given on the authority of Dr. Christison, Dr. Simson, and Dr. Alison.† Additional cases are referred to by Mr. Taylor, in one of which two drops of laudanum killed an infant, one minim and a half an infant of two days old, four drops one of nine months old; a single grain of Dover's powder a child of four months, and four grains of the same powder a child of four years and a half old.‡

There are some persons on whom comparatively small doses of opium and its preparations, in consequence of peculiarity of constitution, produce unusually severe effects. On the other hand, the power of habit in lessening the effect of the poison must not be overlooked.

The effect of opium, when taken habitually, has been thus described by Hobhouse, in the case of the Turks of Constantinople: "Pale, emaciated, and ricketty, sunk into a profound stupor, or agitated by the grimaces of delirium, their persons are, after the first view, easily to be recognised, and make an impression too deep to be easily erased. The increasing attachment for wine has diminished the consumption of opium, but there are still Teriakis who will swallow in a glass of water three or four lozenges, amounting to 100 grains."

Mr. Madden confirms this account, and adds, that a regular opium eater seldom lives beyond thirty years, if he commence the practice early.

It has been denied that the practice of opium-eating tends to shorten life, and there is no doubt that many persons who indulge in it live to a good age; but it is probably with opium as with spirits, those who indulge in them and live long would attain a much greater age if their habits of life were other than they are. At any rate, the facts hitherto collected are not sufficient to decide this question.§

Opium is not only administered by the mouth, but applied to the skin, and used in the form of injection. In these modes of application it may produce dangerous or fatal results. M. Tournon, of Bourdeaux, relates a case in which death was attributed to four grains of opium introduced into the external meatus of the ear.

Treatment.—The first point to be attended to is the removal of the

* This was mixed with nine grains of camphor. Case reported to Dr. Christison by Mr. W. Brown. On Poisons, p. 657.

† Christison on Poisons, p. 658.

‡ See these cases at greater length in Mr. Taylor's Journal of Medical Jurisprudence, p. 238.

§ For some interesting facts in illustration of this point, see Christison on Poisons, p. 661.

poison from the stomach. For this purpose the stomach-pump must be used. If this cannot be immediately applied, an emetic of sulphate of zinc should be given; or, if this is not at hand, a tablespoonful of mustard, mixed with water. At the same time, vomiting should be encouraged by the free use of warm water, and by tickling the throat with a feather. Next in importance to the removal of the poison is the keeping the patient roused: this may be effected by causing him to walk rapidly between two assistants, by smart blows on the hands and feet with a wet towel, and by dashing cold water in the face. In small apartments, where it is inconvenient to move the patient about, the object of keeping the patient roused may be accomplished by flecking the feet with a towel, which is by far the most effectual method. When the patient is beginning to recover, strong coffee should be freely administered. If emetics administered by the mouth do not act, they may be injected into the bowels, and, in hopeless cases, tartar-emetic may be introduced into a vein. Galvanism and artificial respiration have been used in extreme cases. In the stage of excitement which follows recovery, as well as in the early stage of the poisoning, cold affusion has been practised with excellent effect.

Morphia and its Salts.—There are some differences worth observing between the poisonous effects of opium and those of the salts of morphia; for morphia itself is not likely to be administered. In addition to coma and its allied symptoms there have been observed, as nearly constant symptoms, great dimness of vision or actual blindness, and intense itching of the skin. In two instances there were tetanic spasms and strong convulsions. The treatment of such cases does not differ from that proper to poisoning by opium and its preparations. One part of morphia is stated by Orfila to be equal to four parts of crude opium; and, according to Christison, half a grain is equivalent to two or three grains of the best Turkey opium.

The quantity of the salts of morphia required to destroy life has not yet been ascertained. In the case of this, as of most other active poisons, very large doses have been taken with impunity, and very small ones, in certain states of system, have been followed by dangerous symptoms. One case has been reported in which half a grain of the acetate of morphia given as a medicine to a female in ill health was supposed to have proved fatal.*

Opium enters into the composition of several medicines in common use, which have destroyed life. In the black drop and Battley's sedative liquor, it exists as acetate of morphia; in Dover's powder it is in a state of minute division; in Godfrey's cordial, Dalby's carminative, and several similar preparations, the tincture is combined with syrups and carminatives, and, in the paregoric elixir, with camphor, benzoic acid, oil of aniseed, and alcohol. As opium or its preparations form the active principle of these several substances, cases

* Lancet, Nov. 1838.

of poisoning by them do not differ so much from those of poisoning by opium or laudanum as to require a minute description.

Cases of poisoning by the infusion or decoction of the heads of the *white poppy* have also occurred. Like opium, they contain the meconate of morphia but in a small proportion, not exceeding five per cent. of the extract, Syrup of poppies is a mixture of the decoction of the heads of the white poppy with sugar. This syrup is sometimes carelessly made with the tincture, and is probably kept in different shops of very variable strength.

CHAPTER XXVI.

HYDROCYANIC ACID.

Exists naturally in several Plants.—Strength of different Preparations.—Tests for the Acid.—Experiments on Animals.—Symptoms.—Post-mortem Appearances.—Smallest Fatal Dose.—Rapidity of its Operation.— Treatment.—Essential Oil of Almonds.—Laurel-water.—Cyanide of Potassium.

This poison forms in the extraordinary rapidity of its operation a remarkable contrast to opium ; and, indeed, to almost all other poisons. Its promptitude recommends it strongly to the suicide and murderer and its extensive employment in cookery exposes it to be taken by accident. On these accounts it ranks high in the list of poisons and is on every account well worthy of attention.*

Several poisons depend for their energy on the hydrocyanic, or prussic acid which they contain. For medicinal purposes the acid is formed by a complex chemical process, but it also exists as the result of a simple decomposition in the leaves, bark, and fruit-kernels of many plants. Of these the chief are the *bitter almond*, the *cherry-laurel*, the *peach-blossom*, the *cluster cherry*, and the *mountain-ash*. The prussic acid obtained from these sources is mixed with an essential oil, and distils along with it. The cherry-laurel water was administered as a poison in the well-known and very interesting case of Sir Theodosius Boughton. The acid is met with under two forms—as a pure acid, and

* In the years 1837-8, twenty-seven cases of poisoning by prussic acid were brought under the notice of the coroner's court, of which eight occurred in members of the medical profession and druggists. They were all cases of suicide. Four cases of poisoning by essential oil of almonds also occurred in those years, and one of poisoning by prussic acid mixed with arsenic.

diluted with water. The pure acid is limpid and colourless, has an acrid, pungent taste, and a peculiar odour, bearing some resemblance to that of the bitter almonds.* It boils at 80°, freezes at 5° ; is highly inflammable, and, at ordinary temperatures, decomposes spontaneously, and rapidly turns brown. The pure acid is not likely to come under notice in medico-legal cases ; it is in the form of the dilute acid, and as kept in the apothecaries' shop, that it is commonly used as a poison. The dilute acid has the same appearance, smell, and taste, as the strong acid, but, provided it be kept from the light, it is not so apt to decompose. Like the strong acid it is volatile, though in a less degree, and loses its activity by exposure. There is one mode of preparing the acid—namely, by decomposing a solution of ferrocyanide of potassium by sulphuric acid—which seems to render it an exception to the general rule. It appears on the authority of Giese, Pfaff, and Christison, that so prepared it may be kept for years, even exposed to diffuse light, without undergoing decomposition.

The quantity of the strong acid contained in the dilute acid employed in medicine differs with the mode of preparation. The prussic acid of the London Pharmacopeia contains about 2 per cent., that of Vauquelin, 3·3 per cent., and that of Scheele about 5 per cent. The strength of the dilute acid employed in other countries varies from 1 to 50 per cent.

The same preparation of prussic acid varies greatly in strength, in consequence of evaporation and decomposition. This fact is well illustrated by the case of a French physician, referred to by Christison, who swallowed a whole ounce of one sample of Scheele's acid, and a drachm of a stronger sample without injury ; but on trying some recently prepared by Vauquelin, he had a narrow escape of his life.†

Tests.—The tests for hydrocyanic acid are much more satisfactory than those for opium. We owe our knowledge of them to Lassaigne, Orfila, and the late Dr. Turner. They are, its odour, the salts of copper, the protoxide of iron, and the nitrate of silver.

1. The odour, as has been stated, is very peculiar and very delicate, exceeding in delicacy any other test. When relied on as a test, it is advisable that it should be identified by more than one person. In the case of Sir Theodosius Boughton this was the only test relied upon, and on the strength of this and the symptoms the accused was condemned. It is necessary to bear in mind that the presence of a smell like that of prussic acid is not always decisive, for it is stated that the brain has commonly an odour closely resembling it. But as the odour is usually perceived in the stomach, the fact of its being naturally present in the brain can form no valid objection. It is not affirmed or imagined that the stomach itself, or any of its ordinary

* There is a rare chemical compound called nitrobenzine, the odour of which bears a close resemblance to that of prussic acid.

† On Poisons, p. 690.

contents, ever has the odour of prussic acid. There seems to be, therefore, no objection to this test, where it is distinctly perceived by more than one person. When combined with the other tests it must be admitted to have a high value.

2. *Sulphate of Copper.*—This test, added to hydrocyanic acid rendered slightly alkaline by potash, throws down a greenish precipitate, which, on the addition of a little hydrochloric acid, becomes nearly white, the blue oxide of copper thrown down by the potash being redissolved.

This test, according to Lassaigne, detects the poison in $\frac{1}{20000}$ of water, but, from the absence of colour, it is not a very characteristic test.

3. The *Protoxide of Iron.*—To obtain the proper indications from this test, the fluid is first rendered alkaline by caustic potash, a salt of the protoxide of iron (common green vitriol, for instance), is then added, when a greenish-brown precipitate is thrown down, which, on the addition of a little dilute muriatic or sulphuric acid, becomes of a deep prussian blue colour.

It is necessary to employ a proto-salt of iron, for the peroxide of iron yields merely a brownish precipitate, which is re-dissolved by the dilute acid.

In order, also, that the test may act perfectly, a recent solution of the sulphate of iron should be employed, for by exposure to the air, oxygen is rapidly absorbed, and the protoxide is partially converted into peroxide. When the peroxide contains a portion of protoxide the test will succeed to a certain extent, but not very characteristically; the pure peroxide, as has been stated, entirely fails.

4. *Nitrate of Silver.*—This test gives a dense white clotted precipitate, which is distinguished from the other white precipitates with nitrate of silver, by its insolubility in nitric acid at common temperatures, and its solubility at a boiling temperature. At this higher degree of heat the salt is decomposed, nitrate of silver being re-formed, and the acid given off. It is also soluble in ammonia and liquor potassæ. But the most conclusive evidence of the white precipitate being the cyanide of silver, is obtained by the application of heat. The precipitate, after being well washed and dried, is to be introduced into a tube closed at one end, and drawn out at the other end into a fine point. On applying heat to the precipitate, cyanogen is given off, which burns with a characteristic purple flame, surrounded by a blue halo.

This test is very delicate, as so small a quantity of the cyanide as three quarters of a grain gives a distinct though momentary flame.

The last two tests—the protoxide of iron, and the nitrate of silver—are free from objection, and conclusive as to the existence of hydrocyanic acid. The odour and the sulphate of copper are less conclusive, and more open to objection.

Hydrocyanic Acid in Organic Mixtures.—It is necessary to premise, that from the volatile nature of the acid, if the body remains exposed

for so long as three days, it can be no longer detected. If, on the other hand, after being exposed to the air twenty-four hours, it be then buried, the poison can be detected as late as the seventh or eighth day.*

For the detection of hydrocyanic acid in compound mixtures, nitrate of silver cannot be immediately employed, as it throws down a white precipitate with muriatic acid, of which there is always some in the contents of the stomach. Orfila recommends that the colour of the fluid, if it should be coloured, be removed by animal charcoal, digested without heat, and that the fluid be then filtered. If the acid is in any quantity we shall get our tests to act upon this clear fluid. If by this means we do not get evidence of the acid, the liquid must be distilled by a gentle heat, in the following manner:—

The filtered liquid, if alkaline, is to be neutralized by sulphuric acid, which will fix any ammonia disengaged in the process of putrefaction. The mixture is then to be distilled from a vapour bath, at a temperature of about 150°, till about an eighth part has passed over into the receiver. This distilled fluid is then to be tested by the reagents already mentioned.

It has been objected to this, and every other process in which heat is employed, that hydrocyanic acid may be formed during the distillation by the decomposition of animal matter. This is a mere conjecture, altogether unsupported by experiment. There is another more valid objection still to the assertion, that hydrocyanic acid found in the stomach after death has been introduced from without, namely, that hydrocyanic acid may be formed during the changes produced by putrefaction in various animal and vegetable matters. Instances of its formation in the decomposition of unsound cheese, and in the production of the ergot of rye, have been put on record.

An answer to any objection which might be brought forward to the assertion, that hydrocyanic acid found in the stomach was introduced from without, and given as such, may be found in many cases by analyzing the fluid contents of other parts of the body, as, for instance, the serum contained in the brain. In a case which the author saw during his pupilage, hydrocyanic acid could be readily detected by the smell in all parts of the body, and was found in the brain by a delicate process of analysis performed by Mr. Everett. The objection, of course, falls to the ground if the tests act characteristically on the filtered liquid previous to distillation.

Quantitative Analysis.—Use for this purpose the precipitated cyanide of silver, every 100 grains of which correspond to 20·33 grains of the pure anhydrous acid, of which the prussic acid of the London pharmacopeia contains about two per cent.

* In a medico-legal case which occurred in France the acid was detected at the end of seven days in a dismembered body which had been for some time lying in a drain. Annales d'Hygiène, &c., ix. 337.

SYMPTOMS, MORBID APPEARANCES, AND TREATMENT.

Symptoms.—Hydrocyanic acid is, in all its forms, a very active and energetic poison. In the form of vapour its action is extraordinarily rapid. M. Robert found that a bird and a rabbit, which were made to breathe air saturated with its vapour, died in *one* second, a cat similarly circumstanced in *two*, one dog in *five*, and another in *ten* seconds.* The promptitude of its action in this form is doubtless dependent upon its ready absorption by the lungs, and its speedy conveyance to the right side of the heart. In the fluid form it is scarcely less rapid in its action. In the concentrated state Magendie says that, if a single drop be put into the throat of a dog, the animal makes two or three deep hurried respirations, and instantly drops down dead; that it caused death almost as instanteously when dropped under the eyelid; and that when it is injected into the jugular vein, the animal drops down dead at the very instant, as if struck with a cannon ball, or with lightning.

In repeating these experiments to determine, as he states, less figuratively, the shortest period which elapses before the poison begins to operate, as well as the shortest time within which it proves fatal, Dr. Christison found, that a single drop, weighing scarcely a third of a grain, dropped into the mouth of a rabbit killed it in eighty-three seconds, and began to act in sixty-three seconds; that three drops weighing four-fifths of a grain killed a strong cat in thirty seconds, and began to act in ten seconds; and another was affected by the same dose in five seconds, and died in forty seconds; that four drops weighing a grain and a fifth did not affect a rabbit for twenty seconds, but killed it in ten seconds more; and that twenty-five grains, corresponding with an ounce and a half of medicinal acid, began to act on a rabbit as soon as it was poured into its mouth, and killed it outright in ten seconds at farthest. Three drops projected into the eye, acted on a cat in twenty seconds, and killed it in twenty more, and the same quantity dropped on a fresh wound in the loins, acted in forty-five seconds, and proved fatal in a hundred and five seconds. In the slower cases, there were fits of violent tetanus; but in the very rapid cases the animals perished just as the fit began to shew itself with retraction of the head. In rabbits opisthotonos, in cats emprosthotonos, was the chief tetanic symptom.† The concentrated acid, then, given to animals, according to the quantity of it, and the mode of administration, may begin to act instantaneously or in from five to sixty-three seconds, and may prove fatal in from ten to one hundred and five seconds.

The point most important to be remembered is that, when dropped into the mouth of an animal, it may begin to act in from five to ten

* Annales de Chimie, xcii. 59. † Christison on Poisons, p. 694.

seconds, and prove fatal in from thirty to forty seconds. These experiments have an important practical bearing.

The effects of the diluted acid on animals have been examined by Emmert, Coullon, Krimer, and Christison.

Christison states as the result of his own and Macaulay's experiments, that when a large dose of the diluted acid is given, death takes place as promptly as after the concentrated acid; that is to say, in a few seconds; but when the dose is less, death has been observed to take place in from two to fifteen minutes, and occasionally to be delayed even longer, as in one experiment mentioned by Schubarth. Coullon even saw the poison prove fatal to a dog after nineteen days of suffering. Where the symptoms produced by the poison are strongly marked, but the dose is short of a fatal one, they are chiefly the following: The animal is seized in one or two minutes with giddiness, weakness, and salivation, then with tetanic convulsions, and at last with gradually increasing insensibility: after lying in this state some time, the insensibility goes off rapidly, and is succeeded by a few attacks of convulsions and transient giddiness; and the whole duration of such cases of poisoning sometimes does not exceed half an hour, but may extend to a whole day or more. When the dose is somewhat larger the animal dies convulsed or comatose.* During the course of the symptoms the breath of the animal is said to smell of the poison.

The *Post-mortem Appearances* in the animals submitted to experiment were not well marked. The brain is generally natural in appearance, though its vessels have been found turgid, and in one instance, in the horse, there was extravasation of blood between its external membranes. The heart and great vessels are distended with blood, which is commonly fluid, but occasionally coagulated. The lungs are sometimes pale, but more generally gorged with blood. According to Magendie the pure acid so completely destroys the irritability of the heart and voluntary muscles, that they are insensible even to the stimulus of galvanism. It appears, however, that this result was not met with by other observers, and in Christison's experiments was not constant, occurring in some instances, but not in others. "In eight experiments on cats and rabbits with the pure acid the heart contracted spontaneously; as well as under stimuli, for some time after death, except in the instance of the rabbit killed with twenty-five grains, and one of the cats killed by three drops applied to the tongue. In the last two the pulsation of the heart ceased with the short fit of tetanus which preceded death; and in the rabbit, whose chest was laid open instantly after death, the heart was gorged, and its irritability utterly extinct."†

These experiments on animals admit of application by analogy to the human subject, and serve to shew both the extreme rapidity with which the poison acts, and its mode of operation.

* Christison on Poisons, p. 695. † Ib. p. 697.

The symptoms of poisoning by hydrocyanic acid in the human subject vary with the dose. When a large dose is taken, the symptoms probably begin within a few seconds of the swallowing of the poison, and are soon followed by insensibility, deep catching respiration, and death.

The following case forms a very good illustration of the effects of a very large dose of the acid :

A man on being apprehended for theft, swallowed an ounce of alcoholized acid, containing about forty grains of the pure acid. He was observed immediately to stagger a few steps, and then to sink down without a groan, apparently lifeless. A physician, who instantly saw him, found the pulse gone, and the breathing for some time imperceptible. After a short interval he made so forcible an expiration that the ribs seemed drawn almost to the spine. The legs and arms then became cold ; the eyes prominent, glistening, and quite insensible ; and after one or two more convulsive expirations he died, five minutes after swallowing the poison.*

When the dose is smaller, death does not take place so rapidly, or the patient completely recovers after symptoms of very severe affection of the nervous system, of which convulsions and tetanic spasms are the most prominent. The following case affords a very good illustration of this class of symptoms :

Dr. B——, a physician at Rennes, having taken a teaspoonful of prussic acid, prepared by himself, in the morning, without inconvenience, took another teaspoonful, prepared after Scheele's method, after dinner. These two doses produced no marked effect. He then took a third teaspoonful of a preparation purchased of M. Vauquelin, and after an interval of a few seconds, another teaspoonful. This new preparation tasted a little stronger than the former doses, but Dr. B—— remarked that " it had not hurt him." But on walking out of the shop in which he had made this last experiment, he felt an alarming kind of disturbance in his head, and on returning he uttered a few expressions of fear, and fell down as if he had been struck by lightning. The teeth were, at this time, firmly closed, there was continually-increasing dyspnœa, with noisy and rattling respiration, coldness of the extremities, distortion of the mouth, redness and swelling of the face and neck, fixed and dilated pupil, and a pulse imperceptible in the left, and very small in the right arm. The trismus continued to increase in intensity, a short and violent convulsion followed, and the abdomen, especially about the epigastrium, became rapidly distended. Attempts were now made to rouse the patient by stimulant frictions, with ammonia and cantharides, and by stimulant applications. Vomiting was also excited by tickling the throat with a feather, and some dark-coloured mucus was thrown off. After re-

* A case closely resembling this was communicated to Mr. Alfred Taylor by Mr. French. Manual of Medical Jurisprudence, p. 250.

maining in this state for two hours and a-half, he began to shew signs of returning reason, and recognised those around him. The intellectual faculties were gradually restored, but considerable difficulty of breathing and very distinct rattle remained, with occasional expectoration of yellowish black mucus. During the whole of this time the breath smelt strongly of prussic acid. Dr. B. was thirteen days before he could go out to see his patients, during which time the dyspnœa was frequently distressing, particularly when he turned in bed, and when he awoke in the morning. At last he quite recovered. During the first four days very little urine was passed.*

In smaller doses the action of the poison seems to be still further modified, as appears from the experiments of Coullon, made on his own person. When he took from twenty to eighty-six drops of the diluted acid, he was attacked for a few minutes with nausea, salivation, hurried pulse, weight and pain in the head, succeeded by a feeling of anxiety, which lasted about six hours.

A remarkable symptom, observed in more than one case, is salivation, attended with ulceration of the mouth. This has occurred in the experience both of Dr. Macleod and Dr. Granville.

Post-mortem Appearances.—The countenance is pale and composed, the eyes glistening, the venous system gorged with blood of a glimmering blue tint, the vessels of the brain charged with blood, with some effusion of serum into the ventricles. The stomach and every part of the body exhales the odour of hydrocyanic acid.

Traces of inflammation of the mucous membrane of the stomach, congestion of the lungs, and a deep blue colour of the bile, have been mentioned among the occasional symptoms. Putrefaction takes place rapidly, as in most other cases of sudden death.

The odour of prussic acid is by no means constant. It may be expected to be absent in cases of poisoning, where the patient survives long enough to exhale it freely from the lungs, or where the body has been for some time exposed to the air under circumstances favourable to evaporation. It has been recognised in the stomach, and not in other parts of the body, and, on the other hand, it has been perceived in other parts of the body when there was no trace of it in the stomach. The odour is most conclusive when perceived in the blood or limbs ; for it has been asserted occasionally to exist in the stomach and intestines, and in the brain, where no substance containing prussic acid has been taken.

Smallest fatal dose.—This may be fixed for the adult at somewhat less than a grain of the pure acid. In the case of seven epileptic patients, who took by mistake a dose equivalent to seven-tenths of a grain of the pure acid, the symptoms began in ten minutes, and death took place in from half an hour to three-quarters of an hour. Recovery

* Revue Médicale, Fevrier, 1825, and London Med. Repos. vol. iii. No. 17, New Series.

has taken place after doses probably much more considerable than this.

Commencement of the Symptoms.—The period at which the symptoms first shew themselves is a point of considerable importance, and closely connected with a question which has been raised in a court of law—namely, what amount of voluntary motion is possible after swallowing a large dose of the poison?

Few opportunities have been afforded of observing with any approach to accuracy the earliest period at which the symptoms set in. In the case reported by Hufeland, of a man who was seen to swallow the poison, he was observed to stagger a few steps, and then to sink down without a groan apparently lifeless. The dose in this case was equivalent to as much as forty grains of the pure acid. It is highly probable, that where the dose is less considerable a longer interval would elapse. In the case of the French physician, Dr. B., already referred to, in which the dose was evidently little short of a fatal one, there was time to leave the shop and return, and to utter some expressions of fear. It may be fairly assumed then, that when the dose is very large, the symptoms manifest themselves almost instantaneously, and in the case of smaller fatal doses, or doses productive of severe effects, a very short interval elapses between the taking of the poison and the loss of sense and power.

What amount of voluntary effort can be made in this interval can be determined only by an appeal to recorded cases. The importance of this question will be understood from the following case:

An apothecary's maid-servant at Leicester, who was pregnant by Freeman, her master's apprentice, was found dead in bed, poisoned with prussic acid. The apprentice was suspected of having been accessory to her death; but, as it was proved that the deceased had made preparations for a miscarriage by artificial means, it was probable that she had taken the poison of her own accord. The question, then, arose, whether the poisoning was suicidal or homicidal, and this could be answered only by a reference to the condition in which the body was found. It appeared, from the evidence, that the body was found lying at full length on the bed, with the head turned a little on one side, the arms crossed over the trunk, and the bed-clothes pulled smoothly up to the chin; under the clothes, on her right side, lay a corked phial, wrapped in paper, and containing three drachms and a half of the poison. The leather and string which had fastened the cork were found in the chamber-vessel.* It was probable, therefore, that four and a half drachms of the poison had been swallowed, and the question arose, could the girl, after swallowing this quantity of the poison, have corked the bottle, wrapped it up, and adjusted the bed-clothes?

This question can be answered only by an appeal to cases in which acts of volition have been performed, or by actual experiment as to

* See this case very fully reported, Medical Gazette, vol. viii. p. 759.

the time which such acts require for their performance, and a comparison of that time with well-observed cases of poisoning in the human subject. The experiments on animals resorted to by some of the medical witnesses examined in this case are quite inconclusive.

The following facts are recorded in illustration of the question raised in this case: 1. An apothecary's assistant in Germany took four ounces of the hydrocyanic acid of the Bavarian pharmacopeia, and was found dead in bed, with an empty two-ounce phial on each side of the bed, the mattrass (used in Germany as a covering) was pulled up as high as the breast, the right-arm extended beneath it, and the left-arm bent at the elbow. 2. An apothecary's apprentice-lad was sent from the shop to the cellar for some carbonate of potash, but he had not been a few minutes away when his companions heard him cry, in a voice of great alarm, "Hartshorn! hartshorn!" On instantly rushing down stairs, they found him reclining on the lower step, and grasping the rail; and he had scarcely time to mutter, "Prussic acid!" when he expired, not more than five minutes after leaving the shop. It appears that he had taken a drachm of the Bavarian acid, had tried to get at the ammonia, but had not strength to uncover the bottle.* 3. A third case of the same kind was communicated to Mr. Taylor by one of his pupils. A man found dead on the seat of a water-closet, had the bottle from which the poison was taken corked in his pocket.†

These facts are sufficient to prove the possibility of some slight voluntary efforts being made after swallowing a large dose of prussic acid, and they must be held to justify, as far as this particular question is concerned, the verdict of acquittal pronounced in favour of Freeman.

Duration of poisoning.—Where a large dose is taken death commonly ensues in about five minutes. This was the interval in Hufeland's case, in a case reported in Horn's Journal, and in the case of the apprentice-lad just described. In a fourth case of a chemist's servant, poisoned by a large dose of an alcoholic solution of the acid, death is stated to have occurred in two minutes.‡ On the other hand, some of the epileptic patients already referred to did not die till after the lapse of three-quarters of an hour. Very large doses would probably prove fatal in from two to five or ten minutes.

Treatment.—There is no substance which can be regarded as an antidote to this poison. The treatment, therefore, must consist in the administration of stimulants, and the use of the means commonly employed to rouse the body from a state of torpor, however induced. The best stimulant is ammonia applied to the nostrils; the best remedy of the latter class is cold affusion applied to the spine of the back. Frictions of the chest, with stimulating liniments, may be

* Both these cases are quoted by Christison on Poisons, p. 706.
† Manual of Medical Jurisprudence, p. 255.
‡ Christison on Poisons, p. 702.

combined with the use of the vapour of ammonia. Electricity and the vapour of chlorine have been recommended. Cold affusion has the advantage over all other modes of treatment, inasmuch as cold water is always at hand ; next in value to this is the vapour of ammonia.

Prussic acid acts characteristically, in whatever way it may be applied to the body. The vapour of the acid produces an enduring sense of numbness in the part to which it is applied, and the oil of bitter almonds applied by Emmert to the unbroken skin on the back of a rabbit killed it. In one case, the acid applied to a wound in the hand proved fatal.* The fatal effects of the vapour when inhaled have been already alluded to.

A question has been raised whether hydrocyanic acid is a cumulative poison, but the weight of authority is decidedly in the negative. It would require several cases to establish the affirmative, and care must be taken to distinguish between the effects of accumulation and the variation in the strength of different preparations. There are no facts on record by which this question can be determined with certainty.

Oil of Bitter Almonds.—The bitter almond itself and its essential oil are in common use in cookery, and both have proved poisonous. Both of them owe their poisonous property to the prussic acid which they contain. The quantity contained in the oil appears to vary from $8\frac{1}{2}$ to $14\frac{1}{3}$ per cent.† The essential oil does not exist ready formed in the almond, and is only procured when the pulp of the almond comes in contact with water. The presence of the acid may be detected by the nitrate of silver or by the sulphate of iron test already described.

The symptoms, post-mortem appearances, and treatment, are those present in poisoning by prussic acid. The following case will suffice by way of illustration : A hypochondriacal gentleman, 48 years old, swallowed two drachms of the essential oil ; a few minutes afterwards his servant, whom he sent for, found him lying in bed, with his features spasmodically contracted, his eyes fixed, staring, and turned upwards, and his chest heaving convulsively and hurriedly. A physician, who entered the room twenty minutes after the draught had been taken, found him quite insensible, the pupils immovable, the breathing stertorous and slow, the pulse feeble and only thirty in a minute, and the breath exhaling strongly the odour of bitter almonds. Death ensued ten minutes afterwards. After death the whole blood and body emitted a smell of almonds ; putrefaction had begun though the inspection was made twenty-nine hours after death, the blood throughout was fluid, and flowed from the nostrils and mouth ; the veins were everywhere turgid ; the cerebral vessels gorged ; the stomach and intestines very red.‡

* Case of an apothecary at Vienna, mentioned by Sobernheim.
† Christison on Poisons, p. 718.
‡ Quoted from Metzdorff, Christison on Poisons, p. 721.

Cherry Laurel Water.—The leaves of the cherry laurel (*Prunus lauro-cerasus*) yield both a distilled water and an essential oil which have the same properties as the oil of bitter almonds, and were formerly employed for the same purposes. The quantity of the prussic acid in the distilled water is about a quarter per cent., and in the essential oil three and a quarter per cent. The cherry laurel water has proved fatal in more than one case, but the one which possesses the greatest interest is that of Sir Theodosius Boughton, poisoned by Captain Donellan in 1781.

Sir Theodosius Boughton, a healthy young man of twenty years of age, was in the habit of taking a laxative draught from the hands of his mother. On the morning of his death she observed, while giving him his draught, that it had a strong smell of bitter almonds. "Two minutes after he took it she observed a rattling or gurgling in his stomach; in ten minutes more he seemed inclined to dose, and in five minutes afterwards she found him quite insensible, with the eyes fixed upwards, the teeth locked, froth running out of his mouth, and a great heaving at his stomach, and gurgling in his throat. He died within half an hour after swallowing the draught." The body was carelessly inspected ten days after death, but the post-mortem appearances threw no light on the cause of death. The odour of the draught, the rapid occurrence of symptoms so closely resembling those present in recorded cases of poisoning by prussic acid, and the speedy death of the sufferer at an age when apoplexy is so rare, combine to leave no reasonable doubt of the real cause of death.

The common peach, the cluster cherry, and the mountain ash, also derive poisonous properties from the prussic acid which they contain.

Prussic acid is poisonous in all its combinations. The only preparation of any importance as a poison is the cyanide of potassium, lately brought into use in the electrotype process.

Cyanide of Potassium.—This is found in the shops in the form of crystals or of a white powder, which when moistened gives out the odour of prussic acid. It gives the same reaction as prussic acid with the nitrate of silver, and with a solution of sulphate of iron and muriatic acid. The potash is detected by the chloride of platinum. This salt is highly poisonous, and has recently proved fatal.*

POISONING WITH HYOSCYAMUS, LACTUCA, AND SOLANUM.

These poisons are not of sufficient importance to require a chapter to themselves. In their action they bear some resemblance to opium, and are properly grouped with the narcotics. The only one which has proved fatal to the human subject is hyoscyamus. Its effects are illustrated by the following cases:—

Two soldiers ate the young shoots dressed with olive oil. "They

* See Lancet, January, 1843.

presently became giddy and stupid, lost their speech, and had a dull, haggard look. The pupils were excessively dilated, and the eyes so insensible that the eyelids did not wink when the cornea was touched, —the pulse was small and intermitting, the breathing difficult, the jaw locked, and the mouth distorted by *risus sardonicus*. Sensibility was extinct, the limbs were cold and palsied, the arms convulsed, and there was that singular union of delirium and coma which is usually termed typhomania. One of the men soon vomited freely under the influence of emetics, and in a short time got quite well. The other vomited little. As the palsy and somnolency abated, the delirium became extravagant, and the patient was quite unmanageable till the evening of the subsequent day, when the operation of brisk purgatives restored him to his senses. In two days both were fit for duty."*

* Corvisart's Journal de Médicine, xxvi. 353. Christison on Poisons, p. 684.

CHAPTER XXVII.

POISONING BY NARCOTIC GASES.

CARBONIC ACID GAS.—*Sources of the Gas.—Death from this cause generally accidental.—Symptoms.—Post-mortem Appearances.—Subject to considerable variety.—Modus operandi of Carbonic Acid.—Treatment.—Tests for the Gas.—Case of James Trickey.—Questions arising out of it.—Smallest quantity which may destroy life.—Does the Gas accumulate in the lower part of an apartment?—Experiments of Devergie.—Products of the Combustion of Charcoal and Coal.*—SULPHURETTED HYDROGEN.—CARBURETTED HYDROGEN.

ONE class of gaseous poisons—the irritant gases—has already been treated in a former chapter (chapter xxiii. p. 509). Those remain to be examined which act as narcotic poisons. The most important of these gases are carbonic acid, sulphuretted hydrogen, and carburetted hydrogen. Carbonic oxide, nitrous oxide, cyanogen, oxygen, and hydrogen complete the list of narcotic gases, but have little medico-legal importance.

It is necessary to premise, that the narcotic gases, in a pure and undiluted state, may, like the irritant gases, be purely asphyxiating agents, excluding the air from the lungs by creating a violent spasm of the glottis. When they are received into the lungs in a more diluted state they produce their characteristic effects—the irritant gases exciting intense inflammation in the air-passages and lungs, the narcotic gases destroying life by affecting the brain. It is in a state of dilution, and mixed with atmospheric air, that these gases will have to be examined.

Carbonic Acid Gas.—This gas holds the first place among the narcotic gases on account of the great variety of ways in which it is produced. It is formed during the combustion of fuel, the calcining of chalk or limestone, and the fermentation of vegetables; it is a product of respiration, is given out by plants during the night, and collects in mines, caverns, pits, and wells. From the inhalation of the gas, produced in these ways or collected in these situations, many fatal accidents have occurred.

In one respect the subject of poisoning by this as well as the other narcotic gases is comparatively simple. There can rarely be any question of accident, suicide, or homicide. The circumstances or place in which a body is found are generally decisive as to the cause, which in by far the majority of cases is accidental. It is rarely, if ever, em-

ployed in this country as a means of committing suicide, though the practice is common in France; and it is not likely to be made use of by a murderer.

Some cases, however, have been lately related by Devergie, in the Annales d'Hygiène, in which there was ground for supposing that carbonic acid gas had been resorted to with a view to murder. Its employment in this way may be readily imagined. A choffer is ignited near the bed of the intended victim, whilst the murderer contrives to breathe a purer air, or pretends to have suffered less severely from the common cause.

Though the cause of death in poisoning by carbonic acid will generally be easily deduced from an examination of the surrounding objects, and the nature of the place in which a body is found, it is sometimes ignorantly overlooked, and may give rise to unfounded suspicions. Of this, the following case is an example: "A woman, who inhabited a room with five other people, alarmed the neighbours one morning with the intelligence that all her fellow-lodgers were dead. On entering the room, they found two men and two women actually dead, and another man quite insensible, and apparently dying. This man, however, recovered; and as it was said that he was too intimate with the woman who gave the alarm, a report was spread that she had poisoned the rest, to get rid of the man's wife, one of the sufferers. She was accordingly put in prison, various articles in the house were carefully analysed for poison, and an account of the supposed barbarous murder was hawked about the streets. At last, the man who recovered remembered having put a choffer of coals between the two beds, which held the whole six people; and the chamber having no vent, they had thus been all suffocated."* In this case, carbonic acid was the principal cause of death.

Symptoms.—Where the gas is pure and unmixed with any other air, it seems to act as an irritant, causing a spasmodic contraction of the glottis, and consequent asphyxia; such at least is the result of Sir H. Davy's experiments on himself. On mixing the gas with about twice its volume of air, he found that he could breathe it, though it soon produced symptoms of vertigo and somnolency. In a diluted state, then, carbonic acid may be breathed, and it produces symptoms varying in intensity according to the quantity of the gas, and in character according to the other gases with which it may happen to be mixed. When the poison is diluted with air, but still in large quantity, it gives rise to the following symptoms—a sensation of weight in the forehead and back of the head, and of tightness in the temples, giddiness, ringing in the ears, dimness of vision, drowsiness, sudden loss of power, hurried respiration and violent pulsation of the heart, a pungent sensation in the nose, nausea, and, in most cases, vomiting. The debility seems to come on so suddenly, that the patient is unable to make his escape. These symptoms are followed by complete insen-

* Christison on Poisons, p. 730.

sibility, with slow pulse, and stertorous breathing, foaming at the mouth, pale and livid skin, and soon terminate in death. Convulsions and tetanic spasms are occasionally present. In other instances, a deep sleep gradually terminates in death, or the symptoms set in with delirium.

The effects of a smaller quantity of the poison are well illustrated by a case in which fourteen persons were more or less affected by the vapours arising from wood in slow combustion. The symptoms came on gradually in the person first affected, the most remarkable being an intolerable headache. One person after another, called in to assist the sufferers, were themselves affected more or less, the first symptom being headache, followed by confusion of mind and somnolency, or by violent spasms and vomiting. After fourteen persons, one by one, had suffered more or less, and had been restored with some difficulty, a fire burst out in the house, and the beams were found to have been in a state of slow combustion for some days. The combustion was traced to the contact of a heated flue.*

All the symptoms now enumerated are not present in every case. Vomiting. for instance, does not always happen, but it is probably present in about half the cases.

Post-mortem Appearances.—The body is generally swollen, and marked more or less extensively with livid spots; the limbs are frequently rigid, and the abdomen distended with air; the countenance is, in some cases, pale and composed, in others livid and bloated; froth, or froth tinged with blood, is sometimes found about the mouth and nostrils; the tongue is sometimes found protruded between the teeth; the eyes are bright and prominent. The animal heat is retained longer than usual, cadaverous rigidity is slow to shew itself, and putrefaction is retarded. Internally the body presents the following appearances: The large veins and the right cavities of the heart are gorged with black blood, the lungs and lining membrane of the air-passages are congested; the membranes of the brain are injected, the veins and sinuses distended, the substance of the brain is also injected, serum is found in the ventricles, and at the base, and effusions of blood on the surface of the brain or into the ventricles are occasionally met with. The base of the tongue is injected, and ecchymosed patches are sometimes found in the alimentary canal.

The post-mortem appearances, like the symptoms, are by no means constant, and probably vary with the quantity of the poison, and the rapidity with which it takes effect.†

Some of these appearances bear a close resemblance to those present in cases of apnœa, but the turgescence of the brain is much more remarkable in cases of poisoning by carbonic acid than in cases of apnœa

* Henke's Annals for 1830, and Annales d'Hygiène, &c., vol. xiii. p. 448.

† As the value of some of the post-mortem appearances has become a subject of controversy in the case of Trickey, presently to be alluded to, the following particulars are subjoined from a valuable paper published by Dr. Golding Bird, in the Guy's Hospital Reports (vol. viii. p. 75), with a view of throwing

from other causes. Positive experiment, indeed, has proved that carbonic acid gas does not act as a mere asphyxiating agent, but as a specific narcotic poison.

Treatment.—This consists in the prompt removal of the patient to a pure air, the use of cold affusion, and, where the countenance is bloated and livid, of general or local blood-letting. Ammonia, and stimulant embrocations to the chest, may be used with advantage. Artificial respiration, galvanism, and the inhalation of oxygen gas have also been recommended in extreme cases.

The presence of carbonic acid is readily ascertained by the white coating formed on the surface of lime-water; and, when the gas exceeds fifteen to twenty per cent. by the extinction of the flame of a taper.* The proportion of carbonic acid may be ascertained by the degree of absorption which takes place in a graduated glass jar into which caustic potash is introduced. The absorption of carbonic acid collected in wells or pits may be effected by letting down into them a vessel of slaked lime. The air may be collected for analysis by inverting a vessel containing water.

There are several interesting and practically important questions connected with poisoning by carbonic acid which require examination. Some of these are set forth in the following case, which, at the time of its occurrence, excited a lively interest, and gave rise to a very animated discussion.

James Trickey, aged 66, watchman and steeple-keeper of St. Michael's Church, Cornhill, was placed in the church, in charge of a

light upon the cause of death in that case. The general results of his inquiries will be found embodied in two carefully prepared tables.

The *expression of countenance* in twelve cases in which it is described, was pale and calm in 5 cases; bloated in 7. *Vomiting* had occurred in 3 cases, and was absent in 5 in which that symptom was noticed. There was *froth at the mouth* in 6 cases; it was absent in 4. There was *froth and serum* at the nostrils in 4, and they were lined with black mucus in 2. The *eyes* were injected in 2; dilated, prominent, and shining in 3; closed and dull in 3. The *limbs* were rigid in 5; flexible in 2. The *tongue* was protruded and grasped by the teeth in 6; drawn in and concealed in 2. There were livid patches on the skin in 10 cases; they were absent in 2. The *abdomen* was distended with air in 9, not distended in 4. The *membranes of the brain* were injected with blood in 8, and described as congested in 4; there was serous effusion beneath the arachnoid in 3. The *vessels and sinuses* were turgid in all the cases in which those parts are mentioned. The *blood* was not always of the same colour. There was *no effusion of serum* on the brain in 6 cases. *Serous effusions* in 3 cases. The substance of the brain was injected in 8. Blood was effused on the surface in 1; the brain was in its natural condition in 2. Serum in the *ventricles of the brain* in 6; absent in 3. Blood was effused into them in one case.

Among the post-mortem appearances on which the greatest stress has been laid is the rosy or livid discoloration of the skin. Devergie places great reliance upon this sign. The long continuance of animal heat, and rigidity, and the slow progress of putrefaction, are also points which have been much insisted on. (Annales d'Hygiène, vol. xvii. p. 225.)

* The quantity of the gas which suffices to extinguish a burning body varies greatly with the intensity of the combustion. A small and feeble flame may be extinguished by as little as 10 or 12 per cent.

stove heated by charcoal (one of Harper's and Joyce's patent apparatus). The first night it was tried he entered at 11 o'clock, p. m., on the 17th of November, 1838; and the next morning was found dead, lying on his face, with his feet about three feet from the stove; and his head lower than the rest of his body, the trunk resting on a step. A considerable quantity of vomited food was found on the floor near his mouth. The church was so full of some vapour that the respiration of the persons who first entered in the morning was considerably affected. The principal post-mortem appearances were as follows: The countenance calm and composed, the eyes lustrous, the vessels of the brain gorged with blood, considerable serous effusion between the arachnoid and pia mater, and at the base of the brain; numerous bloody points in the substance of the brain; the blood in all parts of the brain fluid. The lungs were almost black, the vessels turgid with blood, the trachea contained a frothy mucus, and the lining membrane was injected. The blood in the large veins was dark, but fluid; the stomach was nearly full of undigested food. Every other part of the body healthy.

On the inquest, considerable difference of opinion existed among the medical witnesses as to the cause of death. All agreed that he had died of apoplexy, but some thought this mode of death was sufficiently explained by his advanced age, by his apoplectic make, and by the full meal which he had taken before he commenced his watch in the church. Others, on the contrary, though they likewise attributed the death to apoplexy, attributed the apoplexy itself to the inhalation of carbonic acid.

The question to be decided, therefore, ultimately took this shape: Was there a sufficient quantity of carbonic acid in the church to account for the man's death; and supposing the quantity diffused through the church not to be sufficient to account for the fatal event, might not the part in which he lay (for he was on the floor close to the stove) contain a sufficient quantity of the gas to prove fatal? These important questions are suggested by a single case, but there is every reason to suppose that similar cases will again arise, and present the same difficulties. It may be well, therefore, to say a few words on each of these two points.

1. What is the smallest quantity of carbonic acid diffused through the air which may prove fatal?

2. Is the carbonic acid produced in the burning of fuel equally diffused through the apartment in which the fuel is burnt, or does it accumulate in one part of the apartment more than in another?

With regard to the first question—the smallest quantity of carbonic acid which may prove fatal.

There are no positive data by which to solve this question. Müller says that atmospheric air, which contains more than 10 per cent. carbonic acid, quickly produces asphyxia. This is the opinion of Berzelius and of the greater number of physiologists. From the experiments of Allen and Pepys we learn that air, once inspired, becomes charged

with from 8 to 8½ per cent. of carbonic acid, and, however often it may be respired, never acquires more than 10 per cent. This fact alone would lead us to conclude that air containing 10 per cent. must prove speedily fatal to life. There is reason to believe, in the absence of all experiment on the subject, that a quantity of carbonic acid much less considerable will suffice to destroy life, though it would require a much longer time to prove fatal. But the minimum quantity which may prove fatal has not yet been ascertained.

Attempts have been made to ascertain the smallest quantity of carbonic acid which may prove fatal to life, and a burning taper has been used as the test. Cavendish made a number of experiments to determine this question, and found that a lighted candle was instantly extinguished when the air contained little more than $\frac{1}{10}$ of its bulk of carbonic acid. Mr. Taylor has also made some experiments which led, however, to somewhat different results. He found that a candle burnt very well in air containing $\frac{1}{10}$ of carbonic acid, less brilliantly in air containing $\frac{1}{8}$, and that it was slowly extinguished when the quantity was increased to $\frac{1}{4}$. According to Dr. Ure 15 per cent. or about $\frac{1}{7}$, according to Turner 20 per cent. or about $\frac{1}{5}$, is the proportion capable of extinguishing a candle. Dr. Golding Bird attributes these discrepancies to the circumstance that receivers of different diameters were employed, and lights of different intensities. Thus Dr. Bird found that 11 per cent. of carbonic acid extinguished a thin wax taper but not a candle; that 20 per cent. extinguished both the taper and the candle, whilst a brilliantly burning thick tallow candle continued to burn dimly. 25 per cent. of gas instantly extinguished the candle also.*

It is necessary to bear in mind, that in these experiments $\frac{1}{10}$ or $\frac{1}{8}$ of carbonic acid was simply introduced into the air, not actually formed in it. Where the carbonic acid is the product of respiration or combustion, the air is not merely contaminated by it, but the oxygen which enters into the composition of the gas is actually withdrawn from the air. So that not only is a poison introduced into the atmosphere, but that part of it which is essential to the support of life is withdrawn. Thus supposing 10 per cent. of carbonic acid to be formed by respiration or combustion, we have the atmosphere deprived of the oxygen which enters into the formation of that 10 per cent., and rendered much less fitted for the support of life, independently of any poisonous effect due to the carbonic acid gas. Taking this fact into account, we shall have reason to conclude that a much less quantity of carbonic acid than 10 per cent. formed in the atmosphere by the process of combustion may prove fatal to life. What the smallest quantity is, and what length of time it would require to produce fatal effects has not yet been ascertained, nor can it be very readily discovered. Some have stated the quantity very low. Thus, Mr. Coathorpe states, that he suffered most severely from inhaling an

* Guy's Hospital Reports, No. viii. p. 75.

atmosphere containing at the outside, according to his own calculation, 2 per cent.*

Whichever of these estimates we regard as the correct one, it is necessary to bear in mind a fact not generally known to the vulgar —that a candle will burn in an atmosphere which will speedily prove fatal to life. On the other hand, a man may breathe with impunity an atmosphere in which candles are extinguished. Thus, Mr. Coathorpe cites a case, which occurred in his own neighbourhood, "of a man descending into an abandoned coal-pit, in which ignited candles were repeatedly extinguished, and remaining in it for several minutes, until he successfully effected the object of his descent, viz. bringing to light the body of an unfortunate child, who had, through its youthful wantonness, been precipitated from a part of the old machinery."†

In the case mentioned by M. Marye, and quoted by Devergie, a candle was extinguished in an atmosphere which produced only a slight sensation of uneasiness in a gentleman who made an abortive attempt at suicide. In another attempt which succeeded, a candle was found burning on the table, whilst he was lying dead on the floor. In the former instance, the candle was probably below the level of the body, in the latter it was above it.‡

To return to the case of St. Michael's Church, it appears that the contents of the building were 110,000 cubic feet of air, and the quantity of carbonic acid which might have arisen from the charcoal employed was 1500 cubic feet. So that there was only about $1\frac{1}{3}$ per cent. of carbonic acid diffused through the building—a quantity much too small to destroy life, and probably too small to be in any way injurious. At any rate, it is a quantity much smaller than that contained in crowded rooms, in which a number of persons are congregated. If this calculation, then, be correct, the death of James Trickey could not be attributed to the inhalation of carbonic acid, on the supposition that the gas is uniformly diffused through the air of the building.

This leads to a discussion of the second question, Is the carbonic acid produced from burning charcoal diffused equally through an apartment; or has it a tendency to accumulate more in one part than in another? If so, is it more abundant on the floor (Trickey lay on the floor) than in the higher parts of the apartment, and close to the stove than at a distance from it? (Trickey lay within three feet of the stove.)

The solution of these questions presupposes a knowledge of more than one fact of which we are at present ignorant.

1. Does the carbonic acid, produced by the ignition of charcoal or other fuel occupy the lower part of the apartment rather than the higher?

The affirmative of this question has been rather hastily assumed from a forced analogy with the phenomena of the *grotto del cane* and valley of death in Java. In the case of the grotto del cane, the

* Lancet, xxxi. 261. † Ibid. vol. xxxi. p. 410.
‡ Annales d'Hygiène. vol. xxiii. p. 190.

carbonic acid rises through crevices in the ground, and collects in a sort of basin a few feet in depth. If a dog be plunged into this basin he immediately becomes asphyxiated, and would die if not promptly removed, but a human being may enter it with safety, the stratum of carbonic acid not rising so high as to corrupt the air which he breathes. Now it has been somewhat hastily assumed that the carbonic acid collects in this basin simply on account of its great density, and that it remains there without rising to the upper part of the cavern; but this is not the case: the carbonic acid does mix itself with the atmosphere of the cavern, but it is speedily diffused into the open air when the door has been opened for a short time. But it is well known that it is not the custom to enter the cavern until it has been for some time ventilated; and if rashly entered immediately the door is opened, the man will suffer as much as the dog who breathes the lower stratum of air.

There is reason to believe that the same observation will apply to all enclosed spaces in which carbonic acid accumulates. But there is obviously no analogy between the case of the *grotto del cane* and a building filled with carbonic acid from a single point, and that point the source of heat as well as of the gas. It has been seen that in the grotto del cane the carbonic acid is not confined to the bottom of the cavern, but that it rises to the top, and diffuses itself through the entire space. On account of its greater density, for it is much heavier than the atmospheric air, it is natural to expect that it will occupy the lower part of the cavern at its first admission into it, but it must also obey the law of the diffusion of gases, and gradually mix with the upper stratum of air. In the same manner, in the case of a church or other large building, the carbonic acid, whether it enter by crevices from below or is given off from a point, must at first (supposing all the air of the building to have the same temperature) occupy the lower part of the building, and especially that part of it which is in the neighbourhood of the source whence the gas is supplied. But a portion of the gas will soon become diffused through the air of the building, and, provided a sufficient length of time is allowed, and the gas is given off in comparatively small quantities, the carbonic acid will ultimately become uniformly diffused through the entire space. If the gas is given off very rapidly, and especially if the air be quite undisturbed by currents, there is reason to believe that the gas will accumulate in considerable quantity in the lower part of the building, the diffusion of the gas taking place more slowly than the accumulation of it. In a confined space then, where the air is tranquil, and gas is rapidly thrown into it, we shall expect to find the lower stratum of air more charged with carbonic acid than the higher strata. A current of air will necessarily diffuse the gas in the direction in which it flows. But where carbonic acid is given off by burning fuel, we have a new element to consider—the heat which accompanies its formation. Now how does this modify the diffusion of the gas through the air?

Where the combustion is vivid, and the heat thrown out intense, the gas as it leaves the stove or choffer will rise towards the higher parts of the apartment, so that we may conceive a column of heated air and gas to extend from the source of heat upwards. Where there is a regular draught formed by means of an aperture in the ceiling, this column of air may be clearly perceived, and the differing density of the parts which form it may be traced by the phenomena of the mirage. This takes place very remarkably in large halls, heated by means of open charcoal fires, for instance the dining hall of St. John's College, Cambridge. Now, in a case like this, we may conceive the carbonic acid to rise at once to the top of the apartment, without being at all diffused in the surrounding atmosphere. That no considerable quantity of the gas exists in the air immediately around the fire may be inferred from the fact, that in cold weather a close circle of gownsmen stand about the fire without suffering any inconvenience. But suppose the apartment not to be furnished with a vent at all, the carbonic acid generated must be diffused in some way or other through the space. Now what is the law of its diffusion? As it issues from the brazier it has a high temperature, and must needs rise towards the ceiling, until its temperature becomes lowered to a point at which its specific gravity does not exceed that of the air with which it is in contact. When, however, it reaches the same low temperature with the rest of the atmosphere, it must of necessity sink, provided that it has not become diffused through, and intimately blended with, the atmosphere itself. If it does become so diffused, it can only subside to the floor of the apartment, where it is assumed to accumulate, by again separating from the air with which it has become blended. Now all that we at present know of the diffusion of gases leads us to the opinion, that, once intimately mixed up with the air of the room, it never separates again. The only way then in which we can account for the accumulation of the gas at the floor of the apartment (assuming it to be so accumulated) is by supposing the gas to be more rapidly generated than diffused. In the absence of all positive facts, we may safely conclude such a thing to be possible. In this case, then, the death of James Trickey might be justly attributed to the agency of carbonic acid, though the upper parts of the church did not contain enough of the gas to prove injurious to life.

The question, Does the gas accumulate in the lower parts of an apartment? has been examined by Devergie, with a view of throwing light upon an interesting case, that of Amouroux. (Annales d'Hygiène, vol. xvii. p. 228.)

He says, "the vapour of charcoal contains a large proportion of carbonic acid; and this gas being one and a half times heavier than the air, it ought constantly to tend to occupy the inferior layers of the atmosphere of the apartment in which the asphyxia takes place. Nevertheless, it would be a grave error to suppose that, on this account, the carbonic acid given off in an apartment during the com-

bustion of a focus (foyer) of charcoal, ought, in virtue of its specific gravity, to occupy the lowest part of the apartment." He then appeals to the well-known fact, that a lighter gas communicating with a heavier one beneath, through a small tube, mixes with it, and asserts, that if such mixture take place at an ordinary temperature, it would take place still more certainly at a higher temperature. He continues, " when charcoal burns, it gives off carbonic acid, enormously dilated by the high temperature at which it is produced; all the surrounding air is itself under the influence of a high temperature, so that, as long as the combustion lasts, ascending currents of pure carbonic acid are constantly formed, and descending currents of air more and more vitiated, but cooled down. If a layer of carbonic acid could form in the lowest part of the apartment, it would not be till after the entire combustion of the charcoal, and the establishment of an equilibrium of temperature in all the strata of the atmosphere; that is to say, at a period far removed from that at which asphyxia has already taken place." Devergie, however, was not satisfied with these reasonings on the subject, but submitted the question to experiment. The results are given in his own words:

" We have placed in an apartment two vessels proper for the collection of gases, one in the most elevated part, the other in the lowest part; this apartment had 166 cubic metres, and 89 centimetres of capacity. We burnt, in the evening, in this apartment, 8500 grammes of charcoal; we allowed the apartment to cool during the night, and the following morning, at 11 A.M., we emptied the upper vessel of each apparatus at the same time; we then rapidly introduced into each vessel a solution of potass, and immediately closed it; and at the end of two hours, we placed the fluid in an apparatus, furnished with a funneled tube (*tube à entonnoir*), and with another tube fitted to conduct the gas into a graduated tube; we then poured sulphuric acid into the straight tube, till the potash was saturated, and we obtained 150 cubic centimetres of carbonic acid from the fluid of the vessel placed in the lowest part of the apartment, whilst that of the vessel situated in the highest part only furnished 32 cubic centimetres of gas. A cat had been placed on the floor of the apartment; it uttered cries during an hour and a half, and next morning was found in a most decided state of cadaveric rigidity."*

There is another supposition, on which the fatal event in the case

* This question may be said to have been decided by an experiment of a different kind reported by M. Marye (De l'Asphyxie par la vapeur du Charbon).

" M***, who had held a high situation under the ancient government, and had lost it in consequence of the events of 1830, was thrown by his loss into a state of extreme melancholy. He placed a certain quantity of charcoal in his chamber, which he lighted, and fed the fire from time to time. He then placed himself on his bed; but finding after some hours that this method produced but a very slight indisposition, he abandoned his project. A few days after this attempt, he went to see some friends with whom he was on very intimate terms, and related this event as if it had happened to one of his friends, and he main-

of James Trickey may be explained, even more readily than that just discussed. It is that which supposes the gas to be diffused in larger quantity through the air, in immediate contact with the stove or choffer. We may imagine the carbonic acid to be diffused into the air immediately it is generated, and to fill the parts of the apartment close to its source, whether they be above it, around it, or beneath it. That a large quantity of carbonic acid is found in the neighbourhood of burning charcoal, may be ascertained by placing lime water in watch-glasses, in different positions, about it. It becomes rapidly coated with a film, of about equal thickness, in whatever position it is placed. This is the more probable explanation of the death of James Trickey, assuming that his death was due to the inhalation of carbonic acid. But the subject requires, and would well repay a careful investigation.

The air of the apartment has been hitherto assumed to be still; but supposing a gentle draught to exist, it will alter the state of the case, for the carbonic acid will be blown in the direction of the draught, and a person inhaling the current of air will be exposed to increased danger. If the draught, however, be strong, it will clear the air of the carbonic acid which it contains, and free those who may happen to be in the current from all danger. This circumstance is illustrated by a case reported by Dr. Bird,* which also seems to place, beyond all reasonable doubt, the greater immediate accumulation of air in the proximity of the stove, than in the remoter parts of an apartment.

Carbonic acid gas, though it is the chief, is not the only, product of the combustion of charcoal or coal. In the case of burning charcoal, the gases given off vary according to the rapidity with which the fuel is consumed. According to Orfila, the gases given off from dimly burning charcoal are, in round numbers, in the following proportion: carbonic acid, 14 parts; atmospheric air, 20 parts; nitrogen, 52 parts; carburetted hydrogen, 14 parts. The products of vivid combustion, on the contrary, are: carbonic acid, 12; atmospheric

tained that the vapours of charcoal were not infallibly fatal. One of my friends, an apothecary, who happened to be present, and was one of M*** 's acquaintance, requested him to give some of the details; M*** then told him that his friend had placed himself on his bed, and that sufficient gas must have been given off to produce asphyxia, because a lighted candle had been extinguished. The apothecary then told him that the carbonic acid was much heavier than the air, and that it always occupies the lower strata; that the light placed below the level of the bed might have been in the atmosphere of carbonic acid, and have been consequently extinquished, and that his friend owed his safety to the circumstance of the gas not having passed that limit. The subject was changed, and during the rest of the evening was not resumed. Two days elapsed, and M*** was found dead in his chamber, seated in front of his bed, and a lighted candle on the night-table: he had put the fatal information which he had obtained in practice."—From a paper by Devergie, Annales d'Hygiène, vol. xxiii. p. 190.

* Guy's Hospital Reports, viii. p. 84.

air, 49 ; nitrogen, 39.* Well-burned charcoal yields little or no carburetted hydrogen, but a gas, not mentioned in this statement of M. Orfila, is given off in variable quantity, viz. carbonic oxide, a gas possessed, like carbonic acid, of poisonous properties.

Where, then, combustion goes on slowly, a much larger quantity of air is deprived of its oxygen than when combustion is vivid.

The gases given off in the smothered combustion of coal are of a much more compound nature than those produced from charcoal. In addition to carbonic acid, we may expect to find sulphurous acid gas, and the sulphuretted and carburetted hydrogen gases. These gases are also highly injurious to life.

Sulphuretted Hydrogen.—This gas ranks next in importance to carbonic acid. It is scarcely less generally diffused, but being of a most offensive odour it gives warning of its presence. Hence it happens, that death from this cause is not so frequent as from carbonic acid. It is an extremely active poison, for according to Thénard atmospheric air, which contains $\frac{1}{1500}$th of its volume will destroy a bird ; when it contains $\frac{1}{800}$th of its volume it will kill a dog; and $\frac{1}{250}$th proves fatal to a horse. Injected into the blood, it speedily destroys life ; introduced into any of the cavities of the body it also proves fatal; and it exerts its deadly influence even when applied to the skin.

Symptoms.—When the gas is breathed in a moderately diluted state, the symptoms produced are, giddiness, a sensation of tightness across the temples, and of oppression in the pit of the stomach, nausea, sudden weakness, and loss of sense and motion. Tetanus, delirium, and convulsions, a cold skin, an irregular and very frequent pulse, and laborious respiration, are occasionally present.

Post-mortem Appearances.—The body has a highly offensive odour, and undergoes very rapid decomposition. The muscles are dark, and insensible to the stimulus of galvanism. The large vessels and all the internal viscera are distended with black liquid blood.

The means to be adopted for resuscitation are removal to a pure air, the use of stimulants, and of *chlorine* gas, This latter acts as an antidote to the poison by removing the hydrogen.

The sulphuretted hydrogen gas rarely exists in a separate state as a poison ; it is most commonly met with combined with other gases in the soil of privies and common sewers.

It appears that feculent matter in a state of putrefaction gives rise to three principal gases, each of which may destroy life. They are sulphuretted hydrogen, hydrosulphuret of ammonia, and nitrogen. The first two are exceedingly deleterious, the latter merely acts by excluding the air. These three gases may exist separately or combined in the soil of privies. Sometimes it happens that no disagreeable smell whatever is given out, neither the nauseous odour of the sulphuretted hydrogen, nor the irritating and pungent odour of the hydrosulphuret

* Orfila Traité de Médecine Légale, iii. 516.

of the ammonia, but still the air is contaminated. In these cases the gases consist of carbonic acid and nitrogen, with a very small proportion of oxygen.

The symptoms and post-mortem appearances produced by the gases taken collectively will not differ much from those which are due to the inhalation of sulphuretted hydrogen alone. The rapidity with which the symptoms take place will depend on the degree of dilution or concentration of the gas. The most remarkable symptoms produced in those who have been suddenly and strongly affected and subsequently recovered, are, a feeling of violent pressure at the epigastrium, and round the head. Those who are employed in emptying the common sewers in Paris are frequently affected in this way, and they give to this form of asphyxia the name of *asphyxia* by *lead*—from the heavy leaden feel produced.

These gases may be readily recognized ; the sulphuretted hydrogen and hydro-sulphuret of ammonia by their smell, and by the discolouration they produce on paper dipped in a solution of a salt of lead. The presence of ammonia may be detected by holding in the gas a rod dipped in muriatic acid, when dense white fumes of muriate of ammonia will be formed.

Chlorine, as already stated, seems to be the best substance to employ for the purification of the air from these gases, as well as for the recovery of persons asphyxiated by them. It is the custom at Paris to introduce a pan of burning coals into the impure air ; this soon inflames the sulphuretted hydrogen and purifies the air. When the burning coals are lowered into the gas its presence is immediately recognized by the production of a luminous circle about the burning body.

Carburetted Hydrogen.—This is the chief constituent of the coal gas. It is not so powerful a poison as sulphuretted hydrogen, though when mixed with an equal bulk of air it cannot be breathed without producing very serious effects upon the system. If greatly diluted with air no bad effects follow the breathing of it, as is proved by the fact, that men who work in our coal mines are rarely incommoded by it. In coal gas, the carburetted hydrogen is mixed with varying proportions of free hydrogen, nitrogen, carbonic oxide, carbonic acid, sulphuretted hydrogen, and other gases of less importance.

Symptoms.—Very few cases of poisoning by this gas are recorded. From a case described by Devergie, it appears that, foam at the mouth, vomiting, violent convulsions, tetanic spasms, stertorous respiration, and injection of the countenance, with dilated pupil, are amongst the most prominent symptoms.

Post-mortem Appearances.—From two cases reported by Mr. Teale in the Guy's Hospital Reports,* it seems that the principal morbid appearances are the following :—Pallor of the integuments, and of the

* No. viii. p. 106.

internal tissues generally, with the exception of some portions of the mucous membrane; florid discolouration of the neck and back; light florid colour of the muscles; absence of all indications of venous congestion; fluidity of the blood, which is of a florid colour; infiltration of the lungs; injection and ecchymosis of the small intestines, and of the air passages. Rigidity rapidly supervenes.

The gas is discovered by its white flame, and the production of carbonic acid and water as the result of its combustion.

CHAPTER XXVIII.

NARCOTICO-ACRIDS.

Symptoms and post-mortem Appearances.—Poisoning by Belladonna, Stramonium, Tobacco, Hemlock, Monkshood, Colchicum, Digitalis, Nux Vomica, Camphor, and Alcohol.—Poisonous Fungi.

The class of narcotico-acrids, or narcotico-irritants, comprises a large number of active poisons derived from the vegetable kingdom, and resembling each other in combining an irritant with a narcotic action. The symptoms to which they give rise, like those produced by the metallic irritants, have merely that degree of resemblance, which justifies us in throwing them into the same group; but each plant, or group of plants, belonging to the same natural order, or owing its poisonous properties to a common principle, differs from other plants or groups to such an extent, as to lead to the formation of several subdivisions. That which is most strongly marked, is the one to which the nux vomica belongs, characterized by the tetanic spasms to which it gives rise.

The *symptoms* common to the entire class of the narcotico-acrids, are dryness of the throat, vomiting and purging, with giddiness, delirium, convulsions, palsy, and stupor. Great difference in degree and varieties in the combination of these elements are observed in different cases of poisoning by the same substance, or by different substances. Among the most characteristic symptoms of poisoning by the narcotico-acrids, may be mentioned delirium, which is only occasionally present in poisoning by the narcotics and irritants, but is comparatively rarely absent in poisoning by this class. The delirium is commonly of the violent kind, and is often attended with incoherence.

The *post-mortem appearances* proper to this class are traces, more or less distinct, of inflammation in the alimentary canal, with fulness

of the vessels of the brain. They are not sufficiently well marked to be decisive as to the cause of death.

The poisons comprised in this class are very numerous, but the following alone demand especial notice: belladonna, stramonium, tobacco, hemlock, monkshood, colchicum, digitalis, nux vomica, camphor, and alcohol. The symptoms and morbid appearances due to these poisons will be briefly described, and the effects of the active principles on which they depend will be incidentally noticed.

Belladonna (*Atropa Belladonna, Deadly Nightshade*). The berries, leaves, and root of this plant have a poisonous property, which they owe to an alkaloid, called *atropia*. Cases of accidental poisoning from eating the dark berries are not uncommon. The symptoms which they produce are dryness of the throat, dilated pupil, and delirium, followed by coma. To these have been superadded, in single cases, slight convulsions, and tetanic spasms, loss of sight, and speechlessness. Nervous affections have, in some instances, continued for some time after the removal of the urgent symptoms. The poison is not so active as several included in this class. The symptoms do not make their appearance till the lapse of one or two hours, and delirium has not made its appearance till the end of five hours. Patients have recovered from very large doses of the poison. In one instance, related by Sir B. Brodie, an ounce was taken without fatal consequences. The treatment consists in the prompt removal of the poison from the stomach, and the after use of stimulants. When the poison has been taken in the crude form, fragments of the berries may be expected to be found in the stomach.

Stramonium (*Datura stramonium, Thorn Apple*). The fruits and seeds of this plant are poisonous, and have been taken accidentally, and administered intentionally. The symptoms produced by this poison may be inferred from a case communicated to Dr. Christison by Dr. Traill, in which eighteen or twenty grains of extract of stramonium were taken, by mistake, for extract of sarsaparilla. "The symptoms were, dryness of the throat immediately afterwards, then giddiness, dilated pupils, flushed face, glancing of the eyes, and incoherence, so that he seemed, to his friends, to be intoxicated; and subsequently there was incessant, unconnected talking, like that of demency. Emetics were given without effect, and little amendment was obtained from blood-letting, leeches to the temples, cold to the head, or purgatives. But after a glass of strong lemonade, vomiting took place, the symptoms began to recede, in ten hours he recognized those around him, and next day he was pretty well."*

Tobacco (*Nicotiana tabacum*). — Every part of this plant possesses a poisonous property. Severe or fatal symptoms have been produced by smoking the leaves, and by the use of the infusion as a clyster. The symptoms commonly produced are nausea, giddiness,

* Christison on Poisons, p. 769.

vomiting, and purging, great faintness, and a weak and irregular pulse. These symptoms are generally preceded by slight excitement of the circulation, with a quick, full pulse. The symptoms of depression, just described, are occasionally followed by stupor, stertorous breathing, and convulsions.

Tobacco is one of those poisons which has a marked effect on the circulation, as well as on the nervous system, the circulation being directly affected by the action of the poison on the heart, as well as remotely by the shock which the system sustains. Thus, an accelerated pulse is the most uniform effect of the smoking of tobacco, even in those accustomed to its use.

Hemlock (*Conium maculatum*).—The symptoms of poisoning by hemlock, as far as they can be gathered from a few recorded cases, are giddiness, headache, furious delirium, or profound stupor. In some instances the symptoms are nearly allied to those produced by opium; in others, they more resemble those due to the contents of the present chapter.

The Cicuta virosa, or Water-hemlock; the æthusa cynapium, or Fool's parsley, and the œnanthe crocata, or hemlock dropwort, are placed in the same group with the conium maculatum, and give rise to analogous symptoms. Accidental poisoning by these plants is not uncommon.

Monkshood (*Aconitum napellus*). — Every part of this plant is poisonous, but the extract of the leaves is the preparation in most common use. It is a very active poison, and may prove fatal in so short a space of time as an hour and a half or two hours. The symptoms are very strongly marked, consisting in a burning heat in the mouth, throat, gullet, and stomach; a sensation of swelling in the face, and of tingling over the entire body; restlessness, dimness of sight, and stupor, followed, after an interval, by vomiting, purging, swelling and tenderness of the stomach, cramps, convulsive twitchings, delirium, and tetanic spasms. After death, traces of severe inflammation have been found in the gullet, stomach, and intestines.

Colchicum (*Colchicum autumnale, Meadow-saffron*).—This plant, too, is poisonous in all its parts. The symptoms present in a case related by Mr. Fereday* where two ounces of the wine of the seeds were taken by mistake, were acute pain, commencing in an hour and a half after swallowing the poison, followed by retching, vomiting, and tenesmus, feeble pulse, great anxiety, and, after a longer interval, incessant coffee-coloured vomiting, suppression of urine, excessive debility, and feeble respiration, and, for a short period before death, profuse, dark, watery purging. There were no convulsions, and the patient remained sensible to the last.

Similar symptoms are produced by other plants containing the same active principle (Veratria). The veratrum album, or white

* London Med. Gaz. x. p. 160.

hellebore, is among the most active of these, and gives rise to symptoms nearly allied to those just described.

DIGITALIS (*Digitalis purpurea*, *Foxglove*).—This plant is among the most important in this group, from its frequent use in medicine, and the familiar property which it possesses of accumulating in the system, so that small doses, often repeated, may produce poisonous effects. The effects of the poison are also more enduring, and pass off more slowly than those of the other poisons belonging to this class. The symptoms produced by a large dose of the preparations of this substance are nausea, headache, giddiness, dryness of the mouth and throat, slight salivation, great debility, vomiting, purging, and colic pains, a small, frequent, and irregular pulse, followed, after the lapse of some hours, by dimness of vision, a feeling of distention in the eyeballs, convulsions, delirium, and coma.

The effects of the accumulation of small doses of the poison given medicinally, are nausea, giddiness, restlessness, heat of skin, throbbing in the temples, great debility, accompanied sometimes with diarrhœa, salivation, and profuse sweating.

NUX VOMICA; STRYCHNIA.—The alkaloid strychnia is contained in several plants belonging to the species *strychnos*, of which the strychnos nux vomica, the bean of St. Ignatius, and the plant yielding the Upas Tieuté are the best known.

Nux vomica, which is the poison in most common use, is found in the form of a light brown kernel, of a flattened round shape, with radiating fibres externally, and with a fine downy covering. The powder is of the colour and appearance of powdered liquorice, and has an intensely bitter taste. Strychnia, its active principle, may be extracted by alcohol, and it is by means of this that the poison itself may be identified.

Strychnia has the following properties:—1. Its crystals are lengthened octahedrons. 2. It is very insoluble in hot or cold water, sparingly soluble in alcohol, but very soluble in ether and the dilute acids. 3. Its solution has an intensely bitter taste. 4. It is turned of a deep red colour by strong nitric acid, but there is no evolution of nitrous acid vapours, as is the case with morphia. This substance is further distinguished from morphia by the absence of effect with permuriate of iron, and with iodic acid and starch.

Nux vomica in organic liquids.—The process for the detection of this poison in the contents of the stomach, or for the separation of the alkaloid from the powder itself, is as follows: We boil in water acidulated with sulphuric acid, filter, neutralize the filtered liquid with carbonate of lime, and evaporate to dryness. The residue is then to be acted on by successive portions of alcohol, and evaporated to the consistence of a thin syrup. On standing two or three days crystals of strychnia will sometimes be deposited. The extract is reddened by nitric acid.

Symptoms.—An intensely bitter taste, followed in a few minutes by

burning in the mouth and throat, pain and heat in the stomach, a sensation of weariness and stiffness in the limbs, followed by frequent fits of tetanus, which affect both the limbs and trunk of the body. The spasmodic contraction of the muscles of the chest causes a suspension of respiration, and consequent fatal asphyxia. To these tetanic spasms, which form the characteristic feature of the action of the poisons of which strychnia is the active principle, are added, in cases which are not rapidly fatal, intense thirst, vomiting, diarrhœa, and severe colic pains.

The post-mortem appearances are not more characteristic than those proper to the other poisons belonging to this group. Some turgescence of the vessels of the brain, and traces of inflammation in the alimentary canal have been found.

The *smallest quantity* required to destroy life. The smallest quantity of the alcoholic extract which has proved fatal is three grains, of the powder thirty grains in two doses. Recovery has taken place after very large doses of the poison. The poison has proved fatal in as short a space of time as *one hour*. The fatal event may, however, be postponed for three or four days.

Treatment.—This consists in the prompt removal of the poison from the stomach by the use of the stomach-pump, or of emetics. The extract of the Cannabis Indica has been lately recommended by Mr. W. Ley as a powerful sedative.* It may be given after the stomach has been freely evacuated.

Camphor.—This is not a very active poison, and appears to produce so slight a degree of irritation as scarcely to deserve a place among the narcotico-acrids. The symptoms occasioned by a large dose, such as half a drachm or two scruples, are giddiness, confusion, loss of memory, and incoherence, with heat of skin and hurried pulse, followed by profuse sweating, a feeling of intoxication, and furious delirium, and these symptoms by sleep, from which the patient awakes much exhausted. It has not yet produced fatal effects.

In the case of a child, already referred to, who had taken half an ounce of camphorated oil instead of castor oil, the symptoms were those of an epileptic fit from which the child speedily and entirely recovered on discharging the poison from its stomach.

Alcohol.—Fatal effects have often followed the drinking of large quantities of spirituous liquors. The symptoms are too familiar to need description. Death itself is preceded by complete insensibility, and all the symptoms of an apoplectic seizure, the insensibility either following upon the usual symptoms of intoxication, or coming on suddenly without any warning. The post-mortem appearances correspond with the symptoms observed during life, consisting either of mere distention of the vessels of the brain, with effusion of serum, or of effusion of blood. In addition to these appearances in the brain, inflam-

* Prov. Med. Journal, Aug. 1842, and March, 1843.

mation of the mucous membrane of the stomach is of common occurrence. The odour of spirits in the contents of the stomach, or in the serum effused in the brain, or in other fluids of the body, often serves to reveal the cause of death; but this only happens when the fatal event takes place soon after the swallowing of the poison.

From the cases which have been put on record it appears that death may take place in so short a period as half an hour. The average period is stated at from twelve to eighteen hours. The smallest quantity which has proved fatal is three ounces of brandy in a boy seven years of age.*

The poison may be detected by submitting the contents of the stomach to distillation.

The treatment will consist in the speedy removal of the poison by the stomach-pump.

POISONOUS FUNGI.—The symptoms produced by these substances are illustrated by the following case: A man, ten minutes after eating a considerable number of the Agaricus campanulatus, by mistake for the Agaricus campestris, was suddenly attacked with dimness of vision, giddiness, debility, trembling, and loss of recollection. In a short time he recovered so far as to be able to go in search of assistance. But he had hardly walked two-hundred-and-fifty yards when his memory again failed him, and he lost his way. His countenance expressed anxiety, he reeled about, and could hardly articulate. The pulse was slow and feeble. He soon became so drowsy that he could be kept awake only by constant dragging. Vomiting was then produced by means of the sulphate of zinc, the drowsiness gradually went off, and next day he complained merely of languor and weakness.† It appears from other cases, that the symptoms are sometimes those of irritant, at others of narcotic poisoning. In most instances the two classes of symptoms are combined.

* This case is referred to by Mr. Taylor. Manual, p. 277.

† London, Med. and Phys. Journal, xxxvi. p. 451; and Christison on Poisons. p. 820.

APPENDIX.

GENERAL REMARKS ON CHEMICAL ANALYSIS.

WITH TABLES OF ELIMINATION.

THE object of these few remarks on chemical analysis, and of the tables by which they are accompanied, is to render such assistance as the nature of the case admits, to those who are not in the constant habit of performing chemical manipulations, but may yet be called upon to ascertain the nature of a substance submitted to examination. The practised chemist needs no such assistance as is here provided. Like the scholar who has long since mastered the elements of grammar, and reads and writes without its assistance, he has no need of books to point out the steps of an analysis, or to instruct him in the nature of a decomposition. The unpractised chemist, on the other hand, like the unripe scholar, must avail himself of the assistance of books which describe at length, and with the necessary minuteness, the processes by which he may discover the nature of an unknown substance, or completely identify one to the nature of which he has merely a clue. Among the means which have been devised for the assistance of the inexperienced in processes of analysis, tables are the most useful, and in the form of a list of bases with columns of reactions headed by the tests arranged without order or method, are very commonly met with. These tables have always appeared to the author to be open to the serious objection of affording little or no real assistance in performing any process of analysis for the detection of an unknown substance. They are not in themselves the representatives of any train of reasoning, nor of the process by which the practical chemist arrives at his results. They present in a condensed form the principal reactions of the principal bases, and this is all that they do. Strongly impressed with this defect in existing tables, the author has attempted to construct one or two tables which, as he hopes, will be found more practically useful.

When a substance is submitted to analysis it is either in entire ignorance of its nature, or some clue has been afforded to it. In some instances, indeed, there is from the first the highest probability of its being what it is stated to be, and the process of analysis, instead of being one of cautious elimination is merely one of comparatively easy verification. This latter alternative generally finds place in medico-legal inquiries, in which the previous symptoms or morbid appearances, or both together, have revealed the nature of the poison almost beyond a doubt. Tables of elimination, therefore, would appear to be but rarely required for medico-legal purposes, and might seem to be uncalled for, considering how rarely they must have to be applied. Irrespective, however, of their occasional use in actual processes of analysis, it is believed that they cannot fail to render much assistance to the medical pupil by placing side by side the chief of those reactions of the several bases or acids which resemble each other, by which means the memory cannot fail to be greatly assisted, and the subject of the tests for poisons to be rendered much more easy of comprehension. The class of poisons in which this assistance is most required and most easily rendered is the inorganic, consisting of the bases and of the acids in combination with them. Two tables, accordingly, have been prepared, of which Table I. displays the reactions of the principal bases derived from the inorganic kingdom, and Table II. those of the acids most frequently found in combination with them. Some of the rarer substances belonging to both classes have been omitted, but all of either which are likely to be used as poisons find a place in the tables.

In explaining the use of these tables of elimination it is necessary to premise that the arrangement of the bases or acids, the subjects of analysis, is entirely determined by the effect of the reagents upon them; and that the reagents themselves are only supposed to be applied where the columns are filled up. It will be seen that in order to put the table into the most compact form, one test has been substituted for another in the same column. This substitution is indicated by a double line, and is obvious at the first glance.

The mode of using the tables will be readily seen by the aid of an example. An unknown substance in solution submitted to analysis yields with sulphuretted hydrogen a black precipitate; it is, therefore, one of the seven included in the bracket (gold, copper, silver, protoxide of mercury, lead, bismuth, or peroxide of mercury). The same substance yields with hydro-sulphuret of ammonia the same precipitate. Liquor ammoniæ added to another portion of the same substance yields a white precipitate; the solution, therefore, contains lead, bismuth, or peroxide of mercury. Liq. potassæ gives with another portion of the solution a yellow precipitate. This proves the unknown substance to have been a salt of the peroxide of mercury. Having ascertained, in this manner, the nature of the substance submitted to analysis, it only remains to identify it more completely by

the use of its characteristic tests, which may be found in any chemical work, or in the tables in common use. The substance submitted to analysis, if in the solid state, and soluble, is supposed to be dissolved in distilled water previous to the application of the tests; if insoluble it must be dissolved in nitric or muriatic acid; it has seemed unnecessary, therefore, to give tables of elimination for the solid poisons. The coloured poisons, indeed, are readily distinguished without the aid of such tables, and most of the colourless poisons must be dissolved before they can be effectually discriminated. All, then, that can be necessary in addition to the table of bases is a short table shewing the effect of heat on the principal white poisons. The heat is supposed to be applied with a spirit-lamp on a fragment of platinum foil.

Volatilized unchanged	Arsenious acid, corrosive sublimate, calomel, white precipitate.
Volatilized and decomposed	Proto-nitrate, pernitrate, and bicyanide of mercury.
Fixed . . .	Arsenic acid, carbonate and sulphate of lead, carbonate and sulphate of baryta.
Fused . . .	Chloride of lead, chloride of tin, nitrate of silver.
Carbonized . .	Acetate and sub-acetate of lead, tartar emetic.
Changed to a yellow colour	Carbonate of lead, oxide and carbonate of zinc.

The degree of solubility of the colourless poisons in water, may furnish an additional clue. This is displayed in the following table:

Soluble	Corrosive sublimate, arsenic acid, nitrate, pernitrate, and bicyanide of mercury, tartar emetic, acetate, sub-acetate, nitrate, and chloride of lead, chloride of tin, sulphate of zinc, and nitrate of silver.
Insoluble or very sparingly soluble	Arsenious acid (sparingly), calomel, white precipitate, sulphate and carbonate of lead, oxide and carbonate of zinc, subnitrate of bismuth, carbonate of baryta.

Having ascertained the nature of a liquid submitted to analysis, it is often desirable to determine its quantity. For this purpose, a measured portion of the liquid must be set apart, and treated by some reagent which gives with the poison contained in it a precipitate that can be conveniently washed and dried, and weighed. What this precipitate is in the case of the several poisons is mentioned under the head of "quantitative analysis," together with the number of grains of the poison contained in one hundred parts of the precipitate. The

calculation by which the quantity of the poison contained in the liquid submitted to analysis is ascertained, is the same in all cases, so that it will be sufficient in this place to give a single illustration.

From a measured quantity of liquid containing sulphuric acid, we obtain, on the addition of nitrate of baryta, a precipitate which, being boiled in nitric acid, washed, and dried, weighs 12 grains. On reference to any chemical work we find that 100 grains of dried sulphate of baryta corresponds to $41\frac{1}{2}$ grains of common oil of vitriol. The following simple proportion, then, leads at once to the quantity of the poison contained in 12 grains, and consequently in the liquid from which it was procured, and in that of which the liquid is a part.

$$100 : 41\tfrac{1}{2} :: 12 : x$$

x being the unkown quantity of the acid contained in 12 grains of the precipitate.

$$\text{Therefore } x = \frac{12 \times 41\frac{1}{2}}{100} = \frac{498}{100} = 4{\cdot}98 \text{ grains.}$$

If the liquid from which this precipitate was obtained formed the half of the entire liquid submitted to analysis the quantity of the acid contained in the whole will be 9·96 grains.

Bases.	Sulphuretted Hydrogen.	Hydro-sulphuret of Ammonia.	Carbonate of Potash.	Chloride of Platinum.	Liquor Potassæ.	Dilute Sulphuric Acid.	Oxalic Acid added to a dilute solution.
Soda	0	0	0	0			
Potash	0	0	0	Yellow			
Ammonia	0	0	0	Yellow	Ammoniacal odour		
Baryta	0	0	White			White	0
Strontia	0	0	White			White	Crystals
Lime	0	0	White			Crystals	White
Magnesia	0	0	White			0	0
			Liquor Ammoniæ.				
Alumina	0	White	White				
Zinc	0	White	White*				
Manganese	0	Flesh-red					
Cobalt	0	Black	Pink solution				
Nickel	0	Black	Blue solution				
Protoxide of Iron	0	Black	White then Green then Red-brown				
Peroxide of Iron	White	Black	Red				
Gold	Black	Brown*	Yellow*				
Copper	Black	Black	Blue solution				
Silver	Black	Black	Brown*				
Protoxide of Mercury	Black	Black	Black				
Lead	Black	Black	White		White	White	
Bismuth	Black	Black	White		White	0	
Peroxide of Mercury	White then Black	Black	White		Yellow		
Protoxide of Tin	Brown	Brown*					
Peroxide of Tin	Yellow	Yellow*	White				
Arsenic	Yellow	Yellow*	0				
Cadmium	Yellow	Yellow					
Antimony	Orange-red						

* Soluble in excess of the Precipitant.

TABLE II.

Salts of Acids.	Chloride of Barium.	Muriatic Acid added to the Precipitate.	Nitrate of Silver.	Nitric Acid added to the Precipitate.	Heat* applied to the Precipitate.	
Muriatic .	0		White	Insol.	Fuses	
Hydrocyanic .	0		White	Insol.	Purple Flame of Cyanogen	Chloride of Potassium and Muriatic Acid
Tartaric .	0		White	Sol.	Chars, leaving pure Silver	White
Citric .	0		White	Sol.	Chars, leaving pure Silver	0
Acetic .	0		0			
Nitric .	0		0			
Hydriodic	0		Buff	Insol.		
Hydro-sulphuric .	0		Black			
Oxalic .	White	Sol.	White	Insol.	Detonates	Sulphuretted Hydrogen
Boracic .	White	Sol.	White	Sol.		
Arsenious	White	Sol.	Yellow	Sol.		Yellow
Phosphoric	White	Sol.	Yellow	Sol.	Fuses	0
Arsenic .	White	Sol.	Red			
Carbonic .	White	Sol. with effervescence				
Sulphuric	White	Insol.				

* The precipitate must be introduced into a test-tube drawn out at the open end into a fine point, and any gas which issues must be inflamed. The cyanide of silver yields cyanogen, distinguished by its purple flame.

The acetic, nitric, and hydriodic acids, may be readily distinguished by the fumes given out on the addition of strong sulphuric acid to a concentrated solution of their respective salts.

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