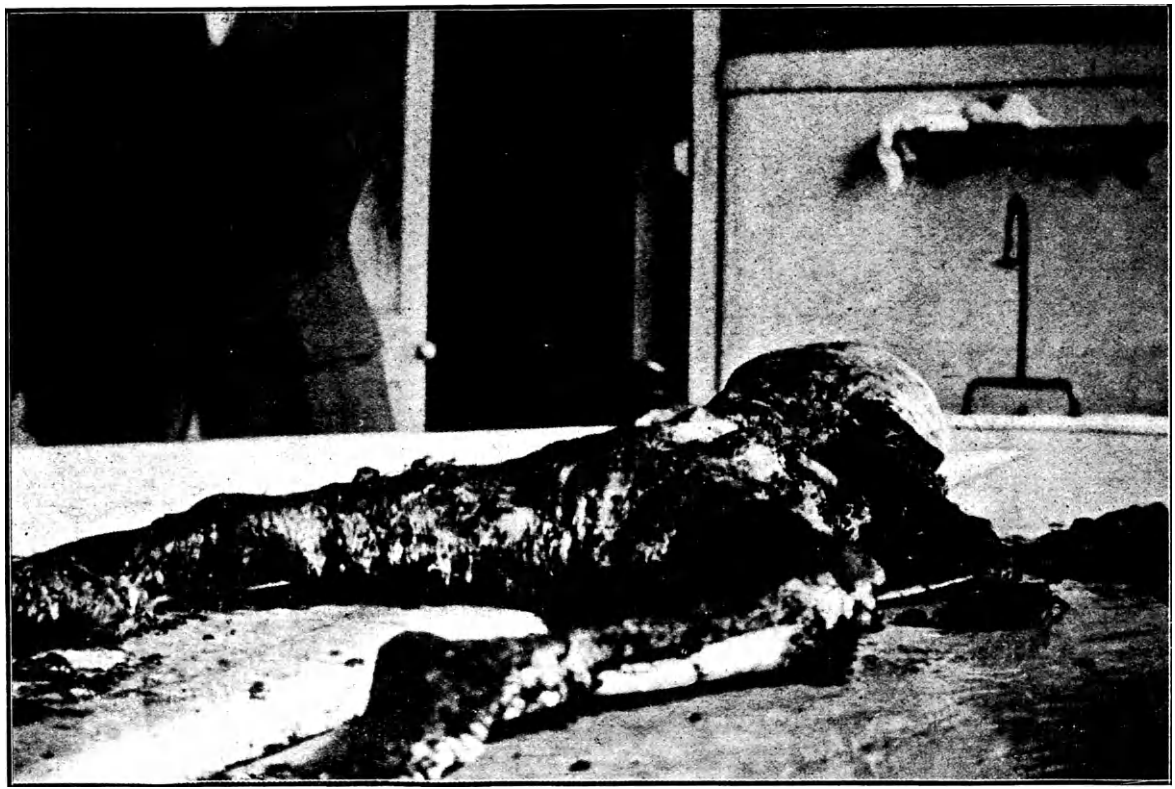

The saponified body of a female child (see page 113).

A TEXT-BOOK OF

MEDICAL JURISPRUDENCE AND TOXICOLOGY

BY

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WITH AN INTRODUCTION BY

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INTRODUCTION.

There are many textbooks on Medical Jurisprudence in the English language, and in this as in most of the branches of the medical curriculum the addition of yet another textbook requires some justification. As one of those at whose instigation Dr. Modi undertook the preparation of this volume, I feel a sense of responsibility which however is greatly lessened by the conviction that Dr. Modi has succeeded in producing a volume which should be of the greatest assistance to students for whom it is primarily intended. As an examiner in the subject I have been struck with the difficulties experienced by students in mastering from the larger textbooks the essential details of Medical Jurisprudence, and with the need of a book written in a clear and lucid manner, setting forth the subject in a way readily understood by the Indian student. That Dr. Modi has succeeded in producing a readable and attractive textbook I feel sure that its readers will agree. In this conviction I commend this volume to the attention of students, and also to that wider circle of readers who in the course of their professional duties are brought into contact with the practical side of the subject, in the full assurance that they will find much help from it. Dr. Modi's long experience as a teacher and as a medical jurist is a guarantee of the careful and practical nature of the teaching which he offers in this volume.

LUCKNOW. W. YOUNG.

5th April 1920.

PREFACE.

In accordance with the wishes of the Principal of the Agra Medical School and the Examiner in Medical Jurisprudence, this book has been written chiefly as a text-book for students reading in medical schools and colleges ; but in the hope that it may also prove useful to medical and legal practitioners I have tried to incorporate my practical experience as a medical jurist for about fifteen years and as a lecturer in this subject in the Agra Medical School for eleven years and since then in the Lucknow Medical College. I have as well given in the form of appendices copies of Government orders in relation to medico-legal work, and certain sections of the Indian Evidence Act, Criminal Procedure Code, Indian Penal Code, Lunacy Act, Poisons Act, etc., which have a direct bearing on legal medicine.

The students of medical schools and colleges while reading for their examinations may conveniently omit the text printed in smaller type, which not being included in their course, is meant only for practitioners.

I must admit my responsibility for the opinions expressed in the text, though in the preparation of this book I have freely consulted various text-books and periodicals, to the authors of which I acknowledge my grateful thanks. A list of these books has been appended at the end.

I have also to express sincere thanks to Dr. E. H. Hankin, M.A., Sc.D., Chemical Examiner and Bacteriologist to the Government of United Provinces, for his kindness in revising certain parts of the manuscript and for much valuable assistance and suggestions, especially in the section on Toxicology and to Lieutenant Colonel E. J. O'Meara, O. B. E., F. R. C. S., I. M. S., Principal, Agra Medical School, who has rendered every assistance to facilitate the completion of the book.

In conclusion I further desire to acknowledge my great indebtedness to Mr. H. M. Rogers, of Messrs. Butterworths' for assisting me in reading the proofs.

LUCKNOW.

J. P. MODI.

1920

MEDICAL JURISPRUDENCE AND TOXICOLOGY.

SECTION I.

MEDICAL JURISPRUDENCE.

CHAPTER I.

LEGAL PROCEDURE IN CRIMINAL COURTS.

Definition.—Medical Jurisprudence, Forensic Medicine Legal Medicine, and Judicial Medicine are all synonymous terms used for that branch of state medicine, which treats of the application of medical knowledge to the purposes of law, both civil and criminal. It does not include sanitation, hygiene or public health ; both this and medical jurisprudence being distinct branches of state medicine. Medical jurisprudence proper as distinguished from hygiene, embraces all questions which affect the civil or social rights of individuals and injuries to the person and bring the medical man into contact with the law ; while Toxicology deals with the diagnosis, symptoms and treatment of poisons, and the methods of detecting them.

In his professional career the medical man will have frequently to give evidence as a medical jurist in a court of law to prove the innocence or guilt of his fellow subjects, or to authenticate or disprove a criminal charge of assault, rape or murder brought against an individual. He must remember that as a medical jurist, his responsibility is very great, for, very often, he will find that his is the only reliable evidence on which depends the liberty or the life of a fellow

being. He has, therefore, to acquire the habit of making a careful note of all the facts observed by him, and to learn to draw conclusions correctly and logically after considering in detail the pros and cons of the case, instead of forming hasty judgments.

It has been repeatedly remarked by judges that members of the medical profession are not very careful in drawing up medico-legal reports and consequently cut a very poor figure as expert witnesses but the experience of medico-legal work in India leads one to believe that this carelessness complained of by the judges is not due to any wilful negligence on the part of medical men but it is due to want of sufficient data supplied by the Police, and also due to their want of practical knowledge of legal procedure in Criminal Courts owing to lack of opportunities afforded to students to be present in Courts when any cases of medico-legal interest are being tried. Again, in Medical Schools and Colleges great stress is laid on the theoretical teaching of this subject, but its practical side is altogether neglected. Medical Jurisprudence is a practical subject, and the class lectures have to be illustrated with practical examples, as far as possible, while the students ought to get ample opportunities to examine cases of injury and to witness medico-legal *post-mortems*.

To obviate this difficulty it is necessary to give first a brief account of the procedure adopted in a legal enquiry, and of the Criminal Courts of India before the subject proper is treated.

LEGAL PROCEDURE AT AN INQUEST.

Coroner's Inquest.—In the Presidency towns of Calcutta and Bombay the Coroner with the help of a jury holds an inquest or enquiry in cases of sudden, unnatural or suspicious deaths, or in cases of deaths occurring in a jail within the jurisdiction of the Coroner's Court. The Coroner is authorized to order the *post-mortem* examination of a

body to be made by any medical man, usually the Police Surgeon, whom he summons to his court to give evidence at the inquest. At such an inquest or enquiry he summons other witnesses, takes their evidence on oath, and then with the help of the jury finds a verdict as to the cause of death. If he finds a verdict of foul play against some person, he commits the suspected person to the High Court for trial. In the case, where there is enough evidence of suspicion of foul play, but the perpetrator of the crime is not identified, the Coroner's jury returns an open verdict against some person or persons unknown, and the matter is held in abeyance, until further enquiry throws some more light on the perpetration of the crime. (Vide Appendix viii).

Police Inquest.—In Muffasil towns, the officer usually of the rank of a sub-inspector of police in charge of a police-station, on receiving information of the accidental or unnatural death of any person, proceeds to the place, where the body of such a deceased person is lying and there, in the presence of two or more respectable inhabitants of the neighbourhood, holds enquiry and makes out a report regarding the apparent cause of death as judged from the appearances and surroundings of the body, describing the injuries which may be found on it, and stating in what manner, or by what weapon or instrument such injuries appear to have been inflicted. The report is then signed by the investigating police-officer, and by the persons present at the inquest. In case of suspected foul play or in case of doubt regarding the cause of death, the police officer forwards the dead body to the Civil Surgeon of the district for *post-mortem* examination, furnishing him with the descriptive roll and as full particulars as possible to enable him to find out the probable cause of death. In order to shirk responsibility the investigating officer is apt to send all dead bodies irrespective of the cause and manner of death to the Civil Surgeon for *post-mortem*

examinations. The Civil Surgeon, immediately after holding the *post-mortem* examination, has to give a statement as to the probable cause of death in police form No. 289 to the constable accompanying the dead body for communication to the investigating officer, and to send the full report in police form No. 33 (Appendix iv) later on to the Superintendent of police, who forwards it to the Sub-Divisional Officer or Magistrate concerned.

In cases of rape and other cognisable offences the individual is sent by the sub-inspector of police to the Civil Surgeon for medical examination along with his statement recorded in the vernacular; but in assaults of a non-cognisable crime the injured person may go direct to the Civil Surgeon, with the permission of the police officer, if he thinks it necessary, or else he goes and files an affidavit in the court of a magistrate who sends him to the Civil Surgeon with a forwarding letter, which the latter officer has to fill up (Vide Appendix IV).

Difficulties in the detection of Crime—The Civil Surgeon or the Medical Officer who is always ready to help justice being carried out, finds it, at times, very difficult to arrive at correct conclusions in medico-legal cases owing to the reasons stated below :—

(1) The investigating police officer on hearing of an incident, does not proceed at once to the place of occurrence, as he is already engaged in investigating another case or on account of some other reason, and consequently valuable time is lost in obtaining a clue to the crime.

(2) The police officer, even if he reaches the place in time, does not touch the dead body and scrutinize it for any marks of violence or identification on account of caste prejudices or some such scruples, but depends on the illiterate villagers present at the inquest, who may have some motive in concealing the real facts. To illustrate these remarks

I would cite a case that occurred in Agra District. The dead body of a woman was taken out from a well in Akbar's palace in Fatehpur Sikri, and was sent to the Agra Medical School for *post-mortem* examination with the police report that the woman was young, had thirty-two teeth and her hair was dark; while at an autopsy it was found that the woman was more than 60 years old, had no teeth, all the alveoli had been absorbed, and the plait of hair, that was lying loose owing to decomposition, was mostly of white colour.

(3) The report supplied by the police officer is, very often quite meagre, as, for want of power of observation and habits of accuracy he rushes through an inquest, and omits to note many points, which would, otherwise, help to prove the manner of death, or for want of the most elementary knowledge of medical jurisprudence, though this subject is taught in the police training school, he mistakes the marks of *post-mortem* staining for those of violence or omits to mention injuries even though they are many and thus unwittingly misleads the medical officer, specially if the body happens to be highly decomposed.

(4) The police officer is not to blame in all cases for, sometimes, he finds it very difficult to furnish the medical officer with really trustworthy information for his guidance inasmuch as, owing to the unwillingness of the relatives and neighbours to appear before the Magistrate, and give evidence on oath, or, owing to a false notion about the honour of the parties concerned, no one comes forward to volunteer a statement, even if he was present at the time of the perpetration of the crime.

(5) A lot of crime goes undetected owing to the prevailing custom of cremation or burial of bodies soon after death, and that too without any medical certificate. Besides, owing to tanks, lakes, canals, rivers, wells and jungles situated on the

outskirts of villages, there is a great facility for concealing the dead bodies, which are also likely to be eaten by dogs, jackals and birds of prey to an extent, which will render them difficult of recognition. In October 1918 I saw the body of a brahmin male, whose ears had been so nicely gnawed through by rats that they showed the appearances as if they had been cut away by a knife, unless examined very carefully.

(6) Owing to the climatic conditions in India the decomposition of bodies takes place much more rapidly than in Western countries, and this is a frequent occurrence in summer on account of the fact that a body has to be carried on the heads of *Chamars* for long distances, before it can be taken to the *sadr* station for autopsy ; for, in most districts the Civil Surgeon is the only officer authorized to hold *post-mortems.* As a precaution against decomposition, the police have been instructed to sprinkle wood-charcoal, and ferrous sulphate (*Kashish*) on the body, but this process does not, in any way, retard putrefaction ; on the contrary, it helps to disfigure the external wounds so much that their nature can be differentiated with great difficulty.

Owing to advanced putrefaction it is very trying and disgusting for a medical officer to hold a *post-mortem* examination, and there is a Government order that a medical officer may refuse, if he likes, to hold a *post-mortem* examination on a highly decomposed body but, in my opinion, he must always make a thorough examination as far as practicable so as to be able to find some clue to the cause and manner of death, if possible.

On account of districts being spread over a large area, it is impossible to avoid such difficulties ; hence it appears to be desirable for sub-assistant surgeons in charge of branch dispensaries to be authorized to hold *post-mortem* examinations ; and I do not see any reason why these officers should be debarred from holding autopsies seeing that they have to go

through a four years' course in a recognised medical school and have to pass two stiff examinations, before they are qualified to practise in medicine and surgery.

(7) To fabricate a false charge against an enemy it is usual for one party to kill an old man, and then to accuse the opposite party of murder, or some one disappears from the scene; after a time a decomposed body found lying on the outskirts of a village or dug up from a grave is claimed as the body of the absconding person, and a false charge of murder is laid at the door of an unwary enemy who though innocent, not infrequently makes a confession of guilt to avoid police torture, or when for other reasons he finds it difficult to escape the net of conspiracy spread around him.

CRIMINAL COURTS AND THEIR POWERS.

1. **Magistrates' Courts.**—These are called Courts of 3rd, 2nd and 1st Class Magistrates in Muffasil towns and Courts of Presidency Magistrates in presidency towns.

Third Class Magistrates are empowered to try only those offences for which, punishment is less than one year's imprisonment, and they cannot, for any single offence, sentence to imprisonment for more than one month, and inflict a fine of Rs. 50/-. They are not allowed to inflict a sentence of solitary confinement or whipping.

Second Class Magistrates are not ordinarily allowed to try any offence punishable with three years' imprisonment and cannot, for any single offence, sentence to more than six months' imprisonment, and a fine of Rs. 200/-. They may sentence to whipping if specially empowered by the Local government.

First Class and Presidency Magistrates are empowered to try all cases except those of grave offences, such as, murder, rape, unnatural offences, and causing miscarriage, in which

they record evidence in the presence of the accused, and after making up a *prima facie* case commit the accused, for trial to a Sessions Court, if there is sufficient ground for the establishment of the charge. Presidency Magistrates, on the other hand, commit the accused to take his trial at the High Court direct. They cannot inflict, for any single offence, a sentence of more than two years' imprisonment and a fine of Rs. 1000/-.

2. **The Sessions Court in each District Town.**— It is an Appellate Court and is called the Divisional Court in the Punjab and Burmah and the District Court in U. P. of Agra and Oudh. These Courts are empowered to try any offence, and to pass any sentence authorized by law but a death sentence passed by the Sessions Court has to be confirmed by the High Court, before it is executed. The trials before these Courts are usually conducted by the presiding judge with the assistance of two or more assessors except in some districts of Bombay and Bengal where a jury composed of men not less than three or more than nine, sits with the Judge in trying cases of murder, rape etc. It is not binding on the Judge to accept the verdict of the assessors. If he happens to differ from their verdict, he can pass a sentence without referring the fact to the High Court, but if he disagrees with the opinion of the jury or its majority he has to refer the case to the High Court.

3. **High Courts.**—These are the highest tribunals in the country for matters criminal and civil, and constituted by Parliamentary statutes. They are established at Allahabad, Bombay, Calcutta, Lahore, Madras and Patna, while they are represented by the Chief Court in Burmah and the Judicial Commissioner's Court in Oudh, the Central Provinces and Sind.

All these Courts are empowered to try any offence under the Penal Code and pass any sentence authorized by law.

In these Courts cases are tried before a Judge and a com-

mon or special jury of nine persons. A common jury is composed of persons, whose names appear in the general list of those liable to serve as jurors. Medical men, are, as a rule, exempted from serving on a jury (vide Appendix viii, Section 320). A special jury is composed of persons taken from a special list of about four hundred in presidency towns. A special jury is empannelled in trials pertaining to treason, or when a British-born subject is tried for murder, or when he claims to be tried before such a jury. The Judge ordinarily decides cases on the verdict of the jury, but if he does not concur with its verdict, he dismisses and summons another in its place; and orders a fresh trial to be held. If he again happens to differ from the verdict of the second jury, he has to send up the case for trial before the full bench of the Judges. The accused has also the power of challenging any one of the jury.

In the provinces of Oudh and Sind Europeans are under the jurisdiction of the High Courts of Allahabad and Bombay respectively. Again Europeans and British-born subjects are to be tried by European Magistrates only, if they prefer that treatment, and have to be committed to the High Court direct for trials of murders, etc., but not to the Sessions court. (Vide Appendix VIII.)

Subpoena.—A subpoena is a document commanding attendance under a penalty. When served on a witness to appear before a court, he must attend it punctually. Non-attendance may render him liable to a fine or imprisonment, unless some reasonable excuse is forthcoming.

In civil cases it is customary to offer a fee termed *conduct money* on serving the subpoena; if this is not done, the medical man can ignore the summons, if he so desires.

In criminal cases no fee is tendered at the time of service of the summons, but the independent medical practitioner can demand a fee at the time of giving evidence before

taking an oath; while, for a man in Government service, he can do so only in cases of non-cognizable crime, where Government is not a prosecuting party; however, he should not insist on the payment of the fee, if the presiding officer of the court is not willing to allow it. In that case he must give evidence, or else, he may find himself in the inconvenient position of being charged with contempt of Court.

When summoned on the same day to attend at two courts, civil and criminal, the medical witness should attend at the criminal court, and inform the civil court of his inability to do so on account of his presence in the criminal court, which has a preference over it. If summoned to courts, both civil or criminal, the witness should first attend at a court higher than the other. If, however, both courts happen to be of the same status, he should go to the court, from where he received the summons first, and inform the other court of the fact, or should attend after he has done with the first court.

Oath.—On being called into the witness-box the witness has to take an oath before he gives his evidence. It may be noted here that the medical witness, if he happens to be a gazetted officer, has not to stand in the witness-box, but is usually offered a chair on the dais by the side of the presiding officer. A Christian while taking an oath has to kiss the "book", but this is not right from a hygienic point of view and so he would be well advised to insist on taking it after the Scotch form, for which he should raise his right hand above his head, and say in a firm and loud tone "I swear by Almighty God, as I shall answer to God at the last day of Judgment, I will tell the truth, the whole truth, and nothing but the truth." A non-christian gives his evidence on solemn affirmation, and has to repeat, while standing "the evidence which I shall give before this court will be the truth, the whole truth, and nothing but the truth,

so help me God." In whatever form the oath is taken, it renders the witness liable to a trial for perjury, if he fails to say what he believes to be true. His evidence is then recorded in the following manner :—

(1) Examination-in-chief, (2) Cross-examination, (3) Re-examination, (4) Questions put by the Court, a juror, or an assessor.

(1) **Examination-in-chief.**—In Government prosecution cases the prosecuting inspector, as a rule, first examines the witness to elicit the principal facts concerning the case. If the witness is summoned by a private party, he is at first examined by the pleader of that party. But in both the cases no leading question is allowed.

(2) **Cross-examination.**—This is held by the defending pleader, who tries every possible means to weaken the evidence of the witness, thereby showing to the Court that the evidence in question is conflicting and worth nothing. In this examination leading questions are permissible, but the witness should be very cautious in answering them. He should not attempt to answer unless he clearly and completely understands them.

In some instances cross-examination acts as a double edged sword, which cuts both ways, i.e. it may damage the defence, as much as, nay, sometimes more than the prosecution, specially if the pleader is not familiar with medical science and if the witness happens to be well up in his subject, and at the same time, honest and straightforward.

(3) **Re-examination.**—The prosecuting inspector or the counsel, who conducted the examination-in-chief, has the right of re-examining the witness to explain away any discrepancies, that may have occurred during cross-examination ; but the witness should not introduce any new subject without the consent of the Judge or the opposing counsel, lest he should be liable to cross-examination on the new point thus introduced.

(4) **Questions put by the Court, Juror, or Assessor.**—The Judge, juror or assessor may question the witness at any stage to clear up doubtful points.

MEDICAL EVIDENCE.

Medical evidence given before a court of law is of two forms, viz; (1) documentary and (2) oral or parole.

(1) **Documentary Evidence.**—This includes

(*a*) Medical Certificates.

(*b*) Medico-legal Reports.

(*c*) Dying Declarations.

(*a*) **Medical Certificates.**—These are the simplest forms of documentary evidence, and generally refer to ill-health, unsoundness of mind, death, etc. These certificates should not be given lightly or carelessly, but with a due sense of responsibility for the opinion expressed in them.

In giving certificates of ill-health the medical man should mention the exact nature of the illness, and preferably should take, at the bottom of the certificate, the thumb-mark impression or signature of the individual to whom it refers.

He should remember that, on the occurrence of the death of a person, whom he has been attending during his last illness, he is legally bound to give a certificate stating, "to the best of his knowledge and belief," the cause of death, for which he is not allowed to charge a fee. The granting of such a certificate is not to be delayed, even if the fee for attending the patient during his life time is not paid. The medical man may, subsequently, sue the legal heirs of the deceased for recovery of the fee, if he so desires. However, he must decline to give a certificate, if he is not sure of the cause of death, or if he has the least suspicion of foul play. In such a case the proper course for him is to report at once to the police authorities, before the body is removed for cremation or burial.

Civil Surgeons and superior medical officers are, sometimes, called upon to countersign death certificates, but they should not do so without inspecting the dead body. From the non-observance of such a precaution it has, sometimes, happened that a medical officer has been placed in an awkward position in a court of law.

(*b*) **Medico-legal Reports.**—These are the forms of documents prepared by the medical officer in obedience to a demand by an authorized police officer or a Magistrate and are referred to chiefly in criminal cases relating to assault, rape, murder, poison, etc. These reports consist of two parts; viz., the facts observed on examination, and the opinion or the inference drawn from the facts.

These reports form the chief documents in judicial enquiries, and are likely to pass from the lower to the higher courts, as well as to be put into the hands of the pleaders, and so utmost care should be used in preparing them. No exaggerated terms, superlatives, or epithets expressing one's feelings should be used.

After noting the facts, the opinion should be expressed briefly and to the point. An injury case should be kept under observation, and the fact notified to the police, if it is not possible to form an opinion immediately after examining him; but a hasty opinion should not be formed, even if pressed by the police. (Vide Appendix I.)

The articles of clothing, weapons etc., sent for medical examination should be described with full particulars to facilitate their identification later on in Court. They should be labelled with the differentiating numbers or marks, and returned to the superintendent of police or Magistrate in a sealed cover, one's private seal being used; the signature of the person, usually the police constable, receiving them should be taken. Those articles, which are likely to be sent to the Chemical Examiner, should be kept under lock and key in the custody of the medical officer.

(*c*) **Dying Declarations.**—A dying declaration is a statement, verbal or written, made by a person since deceased, relating to the cause of his death or any circumstances resulting in his death. According to the Indian law it is admissible as evidence, whether the person making the statement was or was not under the impression that he was in actual danger of death; but it is essential that the declarant should be in a sound state of mind to make the statement; while according to the law of England he must believe that he is about to die and that his recovery is impossible, the presumption being that the person, during the last moments of life, would not tell anything but the truth.

The medical officer should at once take steps to have the statement of a person under his treatment recorded when he finds that he is in danger of death from criminal causes, or when he desires to make a confession.

For the manner of recording dying declarations and the procedure to be observed in recording them see Appendix I.

(2) **Oral Evidence.**—Oral evidence must in all cases be direct (see Appendix vii), that is to say, it must consist of an assertion by the person, who gives it that he directly perceived the facts to the existence of which he testifies. It is more important than documentary evidence, since a medical man has to prove on oath or affirmation documentary evidence supplied by him to the Court that, it is true and correct, and is in his own handwriting ; but the following are the exceptions :—

1. Dying declaration.
2. Printed opinions of experts.
3. Deposition of a medical witness taken in a lower court.
4. Chemical Examiner's report.
5. Evidence given by a witness in a previous judicial enquiry.

1. **Dying Declaration.**—This is accepted as legal evidence, but it ceases to have any legal force, if a person who has made the declaration does not die.

2. **Printed Opinions of Experts.**—Expert opinions printed in a text-book may be proved in Court by the production of that book, if its author is dead, or cannot be found, or has become incapable of giving evidence, or cannot be called as a witness without an amount of delay or expense which the Court regards as unreasonable.

3. **Deposition of a Medical Witness taken in a Lower Court.**—Evidence given by a medical witness in a lower court is accepted in a higher court, provided it is recorded and attested by a Magistrate in the presence of the accused, and a certificate written at the bottom of the deposition that the accused or his pleader was given full opportunity of examining and cross-examining the witness, whose evidence was taken in the presence of the accused. His evidence without this certificate is not accepted in a higher court ; hence the medical witness should himself see that the above certificate is written by the Magistrate at the foot of his deposition specially in those cases, which are likely to be sent up for trial before the Sessions Court, if he wants to avoid the trouble of being summoned there ; however he is liable to be summoned if the judge wishes to clear some point or if the accused insists on summoning him. (Vide Appendix VIII.)

4. **Chemical Examiner's Report.**—The Government Chemical Examiner or his assistant is exempted from attending at Court to prove on oath that the reports and documents upon matters forwarded to him for analysis or report are correct and signed by him. (Vide Appendix VIII.)

5. **Evidence given by a Witness in a Previous Judicial Enquiry.**—Evidence given by a witness in a previous judicial enquiry is admissible as evidence in a court,

if he is dead, or cannot be found, or if his attendance cannot be obtained within reasonable time and without undue expense, provided that the adverse party in the first proceeding was afforded an opportunity to cross-examine him. (Vide Appendix VIII).

KINDS OF WITNESSES.

Witnesses are of two kinds: common and expert.

A common witness is one who testifies to the facts observed by himself.

An expert witness is one who, on account of his professional training, is capable of deducing opinions and inferences from the facts observed by himself or noticed by others. Thus, it is apparent that a medical witness is both common and expert. He is a common witness, when he gives evidence as regards the variety, size and position of injuries, and is an expert witness, when he mentions the nature of these injuries as to whether they were caused during life or after death, whether they were accidental, suicidal or homicidal and so on. The medical witness should never express his opinion in Court, unless called upon to do so.

The medical man is bound to attend and give evidence in Court as a common witness, if legally summoned to do so. It is doubtful whether he can be punished for refusing to attend and give evidence merely as an expert. But the law of contempt is very elastic, and the neglect of a subpoena is always risky.

RULES FOR GIVING EVIDENCE.

The medical man, when summoned to Court as an expert witness must remember that he is there to tell the truth, and should, therefore, give his evidence irrespective of whether his evidence is likely to lead to conviction or acquittal of the accused.

He should speak slowly, distinctly and audibly to enable the Judge and the counsel to hear him and to take notes of his evidence.

He should use plain and simple language avoiding all technicalities, as the bench and the bar are not expected to be familiar with medical terms. It is no use showing his erudition by using these terms ; however, if he cannot help using any technical term, he should try to explain it.

He should avoid long discussions, and specially theoretical arguments. His answers should be brief and precise, and in the form of "yes or no". However, by so doing, if he finds that his meaning is not understood, he can explain his answer after obtaining permission from the Judge.

If he does not know or remember any particular point, he should not be ashamed to say so, and must not hazard a guess in a doubtful case.

He should remember that the lawyer has got practically speaking unlimited license and latitude in putting questions to the witness in cross-examination, and consequently he should never lose his temper, but should appear cool and dignified, even though questions of an irritable nature are put to him.

He may refresh his memory from his own report already forwarded to the Court, but should not do so from his private notes, unless they agreed word for word with the original and were written by him or certified to be correct if written by his assistant ; besides he should be prepared to have them put in as exhibits, if desired by the Judge or the counsel.

He should not quote the opinion of other medical men or quote from text-books concerning the case. He is supposed to express an opinion from his own knowledge and experience.

When the counsel quotes a passage from a text-book,

and asks the witness whether he agrees with it, he should, before replying, take the book, read the paragraph and the context, and then state whether he agrees or not ; for the counsel usually reads only that portion, which is favourable to his case, and the meaning may be completely altered if the whole passage were read. In spite of this precaution he should stick to his opinion if it is still his opinion, and if he finds that it differs from one expressed in the book. To avoid being surprised by such quotations however, it is advisable to study all the available literature on the subject, before going to give evidence in Court.

Professional Secrets.—The medical witness cannot claim any privilege in a Court of law as regards professional secrets communicated to him by his patients during their treatment. He should, on no account, volunteer these secrets, but should divulge them under a protest to show his sense of moral duty, when pressed by the Court to do so. Non-compliance of the order may render him liable to contempt of Court.

CHAPTER II.

PERSONAL IDENTITY.

Definition.—By identity is meant the determination of the individuality of a person.

The question of the identification of a living person is raised in criminal courts in connection with absconding soldiers and criminals, or persons accused of assault, rape, murder etc. It is also frequently raised in civil courts owing to fraudulent personation practised by people to secure unlawful possession of property or obtain the prolongation of a lapsed pension. Several cases of mistaken identity have been recorded.

The examination of a person for the purpose of identification should not be undertaken without obtaining his consent, and at the same time it should be explained to him that the facts noted might go in evidence against him. The law does not oblige any one to submit to examination against his will and thus furnish evidence against himself.

The identification of a dead body is required in cases of fires, explosions, railway accidents, foul play, etc.

In India the identification of a dead body in some cases becomes very difficult owing to its rapid decomposition in the hot season, and on account of it being damaged by wild animals when exposed on the outskirts of villages. However it is very essential that a dead body should be thoroughly identified and the proof of *corpus delicti* established before a sentence is passed in murder trials, as unclaimed decomposed bodies or portions of a dead body or even bones are sometimes brought forward to support

false charges, and in a country like India it is not difficult at all to obtain such bodies, since villagers are in the habit of cremating bodies very partially, or throwing them into shallow streams, rivulets or canals, or burying them in shallow graves whence carrion feeders may dig them out.

It will, thus, be seen that identification may be required of a living person, of a dead body, of fragmentary remains, or of bones only.

The following points are usually noted for the purpose of identification :—

1. Age.
2. Sex.
3. Race.
4. Complexion and features.
5. Hair.
6. Anthropometry.
7. Foot-prints.
8. Deformities.
9. Scars.
10. Tattoo-marks.
11. Occupation marks.
12. Handwriting.
13. Clothes and ornaments.
14. Speech and voice.
15. Gait.
16. Tricks of manner and habit.
17. Mental power, memory and education.
18. Amount of illumination required for identification.

1. AGE.

The principal means which enable one to form a fairly accurate opinion about the age of an individual are teeth, height and weight, ossification of bones and minor signs.

Teeth.—The estimation of age from the teeth with some amount of certainty is only possible up to 22 to 25 years of age; beyond that it is merely guess work.

There are two sets of teeth called *temporary* and *permanent.*

The temporary teeth are also called deciduous or milk-teeth and are twenty in number; four incisors, two canines, and four molars in each jaw. They appear in infancy, are shed in the course of a few years and are replaced by the permanent teeth, which are thirty-two in number, consisting of four incisors, two canines, four premolars or bicuspids, and six molars in each jaw.

The following table shows the average periods of eruption of the temporary and permanent teeth.

	Temporary.	Permanent.
Central Incisors	.....	7th to 8th year.
Lower Upper	6th to 7th month. 8th to 10th month.	
Lateral Incisors	.....	8th to 9th year.
Lower Upper	10th to 12th month. 7th to 9th month.	
Canines	17th month.	11th to 13th year.
Anterior Premolars or First Bicuspids	Absent.	10th year.
Posterior Premolars or Second Bicuspids	Absent.	10th to 12th year.
First Molars	14th month.	6th year.
Second Molars	22nd to 24th month.	12th to 14th year.
Third Molars or Wisdom Teeth	Absent.	17th to 25th year. very rarely at 14th year.

General Characteristics of Teeth.—In some rare cases the temporary teeth may either appear abnormally early or be present at birth, a condition probably due to hereditary syphilis. Their eruption may also be delayed for a considerable time on account of rickets. The permanent teeth are also not always regular in their appearance. In a few cases they may appear earlier than the average period. The notched and stunted upper central incisors of inherited syphilis, known as Hutchinson's teeth, are always permanent. Cases have been recorded in which a third eruption of the teeth occurred in advanced age.

The crowns of the temporary teeth are bluish white in color and are marked with a ridge or thick edge at their junction with the fangs; while the crowns of the permanent teeth are ivory white, but have no ridge. The anterior temporary teeth are vertical, and the permanent teeth are usually inclined a little forward.

Height and Weight.—The ratio between height and weight is too variable to depend upon for the estimation of age.

Ossification of Bones.—This is a very important criterion for the determination of age, as skiagraphy has now made it possible to determine even in the living persons the extent of ossification, and the union of epiphyses with the shafts of bones and of bones with each other.

I. Table showing the periods of life at which centres of Ossification appear in bones.

Years.	Bones in which centres of ossification appear.
1st year.	Fourth piece of the body of sternum; coracoid process of scapula; capitate (os magnum); hamate (unciform); head of femur; upper end of tibia; third or external cuneiform (tarsus).

I. Table showing the periods of life at which centres of Ossification appear in bones—continued.

Years.	Bones in which centres of ossification appear.
2nd year.	Lower end of radius; lower end of tibia and of fibula.
3rd year.	Greater tubercle (tuberosity) of humerus; patella; first (internal) cuneiform (tarsus); triangular (cuneiform).
4th year.	Upper end of fibula; greater (great) trochanter of femur; second (middle) cuneiform; navicular (scaphoid) of tarsus; head (lower extremity) of ulna.
5th year.	Lesser tubercle (tuberosity) of humerus; medial epicondyle (internal condyle) of humerus; lunate (semilunar), greater multangular (trapezium); upper end of radius.
6th year.	Navicular (scaphoid) of carpus.
7th or 8th year.	Lesser multangular (trapezoid).
10th year.	Olecranon of ulna.
12th year.	Pisiform.
13th to 14th year.	Lateral epicondyle (external condyle) of humerus; lesser (small) trochanter of femur.
18th to 20th year.	Sternal end of clavicle.

II. Table showing the periods when epiphyses unite with shafts and bones with each other.

Years.	Union of Epiphyses and Bones.
1st year.	Posterior and lateral fontanelles; symphasis of mandible (lower jaw).
2nd year.	Anterior fontanelle; commencement of obliteration of frontal suture except at lower part.

II. Table showing the periods when epiphyses unite with shafts and bones with each other—continued.

Years.	Union of Epiphyses and Bones.
7th or 8th year.	Inferior rami of ischium and pubis.
8th year.	Complete obliteration of frontal suture except at lower part which may persist throughout life.
9th year.	Meeting of ilium, ischium and pubis in acetabulum.
13th to 14th year.	The above united but separated by a Y-shaped cartilaginous portion.
15th year.	Coracoid process to scapula.
16th year.	Upper epiphysis of ulna.
16th or 17th year.	Lateral epicondyle and both portions of the articular surface with lower epiphysis of the humerus.
17th year.	Lesser (small) trochanter of femur.
17th to 18th year	Upper extremity of radius.
18th year.	Medial epicondyle with lower epiphysis of humerus; greater (great) trochanter of femur; Lower end of tibia; acetabulum (its component parts); two lower segments of sacral vertebræ.
19th year.	Epiphysis of head of femur.
20th year.	Epiphysis of head of humerus; lower epiphysis of radius, ulna and of fibula.
21st year.	Upper epiphysis of tibia; lower epiphysis of fibula.
24th year.	Epiphysis of upper end of fibula.
25th year.	Second and third pieces of sternum; epiphysis of clavicle (sternal end); lower epiphysis of femur; first and second sacral vertebræ.
40th year.	Manubrium with body of sternum.

In old age laryngeal and costal cartilages become ossified, and the skull and other flat bones tend to become thinner

from absorption of the diploë; these are, therefore, liable to fracture more easily through violence.

Minor Signs.—The growth of the hair on pubis and axillæ commences with the appearance of down from ten to thirteen years and becomes thicker as puberty approaches.

The development of the breasts in girls commences from twelve to thirteen years, but it is very vague and liable to be altered by loose habits and social environments.

Boys develop a deep voice between 16 and 18 years when Pomum Adami becomes more prominent.

The hair tends to become grey usually after forty years and silvery white in advanced, old age. The grey hair is sometimes seen among young people. Cases have occurred in which the hair changed to grey in a single night from grief, shock or some unaccountable reason.

Atheromatous arteries, and an opaque zone in the cornea, known as *arcus senilis*, are rarely seen before forty. Wrinkles on the face begin to appear after this age; but no reliance can be placed on these signs inasmuch as arcus senilis has been seen as early as twenty-eight, and wrinkles may not appear to a very late age, as they depend more or less on the nutrition of the body.

The ramus of the mandible (lower jaw) forms an obtuse angle in infancy, a right angle in adult life and again in old age an obtuse angle from loss of the teeth and absorption of the alveolar processes. The mental foramen opens midway between the upper and lower borders of the mandible in adult age, while it is closer to the upper (alveolar) border in old age.

The horoscope can form a very important piece of evidence in deciding the question of age, but every one knows how easy it is to produce a fictitious one.

Medico-legal Aspect of Age.—The following are the

cases in which a medical man is called upon to give his opinion as regards age :—

1. Criminal responsibility.
2. Marriage contract.
3. Kidnapping.
4. Rape.
5. Attainment of majority.
6. Eligibility for employment.
7. Infanticide.
8. Criminal abortion.

Criminal Responsibility.—Children under seven years of age are held incapable of committing any crime, and are, therefore, exempt from punishment. Children between seven and twelve in India and seven and fourteen in England are held responsible, if it is proved that they have attained such a degree of maturity as to be able to understand the criminal character of the act committed by them.

Marriage Contract.—In India there is no limit of age for contracting marriage ; but in England a girl under twelve and a boy under fourteen cannot contract marriage.

Kidnapping.—To constitute the offence of kidnapping the age of a girl should be under sixteen and that of a boy under fourteen.

Rape.—Sexual intercourse with a girl under twelve even with her consent constitutes rape. According to the English law a boy under fourteen is incapable of committing rape, but there is no such limit in India.

Attainment of Majority.—In accordance with the English law a person attains majority at twenty-one, when he enjoys the full privileges of an adult. Legally he is supposed to have attained majority a day previous to his twenty-first birth day. In India majority is reached at eighteen except in the case of ruling chiefs, or where the property is under a Court of Wards, when the English law is applicable. A minor

is incapable of selling his property, making a valid will or serving on a jury. A witness can give evidence in Court at any age, provided the Judge is satisfied that the witness understands the difference between the truth and the falsehood and the necessity of speaking the truth.

Eligibility for Employment.—Twenty-five is ordinarily the limit for entering into Government service. The Indian Factories Act of 1911 provides that no child shall be employed in any factory coming under its operation unless he is in possession of a certificate showing that he is not less than nine years of age, that no child between nine and fourteen shall be employed in any factory for more than seven hours in any one day and that no child shall be employed in any factory before half-past five o'clock in the morning or after seven o'clock in the evening.

Judicial Punishment.—Males above forty-five are exempt from whipping. Those under sixteen, who are liable to punishment for certain offences are called juvenile offenders. Under fifteen they may be sent to a reformatory, but must not be kept there beyond eighteen. Such offenders, if they have attained the age of fourteen may be placed under the charge of a trustworthy person.

Infanticide.—In cases of infanticide the question raised is whether a foetus had arrived at the age of viability, which is certain after the 210th day of intra-uterine life and may be after the 180th day, but it can never be capable of being reared under ordinary circumstances, if born earlier than the 180th day ; hence the charge of infanticide falls through, if a foetus is proved to be under the age of six months of intra-uterine life.

Criminal Abortion.—In criminal abortion it is necessary to find out whether a woman has passed the child-bearing period, lest it might be a false charge. It is also necessary to find out the age of the foetus from the characters of its development.

2. SEX.

The determination of the sex becomes necessary in cases relating to heirship, disposal of property, marriage, education, eligibility to vote, impotency, rape and allied subjects.

It is easy to determine the sex in normal cases from external inspection only, but it becomes difficult in malformed individuals called hermaphrodites, concealed sex, advanced decomposed bodies, and in the skeleton.

In some cases it may be impossible to affirm the sex during childhood owing to the non-descent of the testicles or such other reason. If so, a positive answer must be delayed until the child reaches puberty, when characters peculiar to each sex usually arise. The distinguishing characters essential to each sex are tabulated below :—

Male.	Female.
1. A testicle secreting spermatoza; the prostate, vesiculæ seminalis, penis, &c. being mere appendages.	1. A functionating ovary with ova; the uterus, fallopian tubes and vagina being appendages only. In the absence of an ovary, the presence of uterus or the opening of a cul-de-sac below the mouth of the urethra and in front of the rectum.
Additional confirmatory signs.	
2. Build, generally larger.	2. Build, generally smaller.
3. Shoulders broader than hips.	3. Hips broader than shoulders.
4. Pomum Adami, developed and prominent.	4. Pomum Adami, not developed.
5. Breasts, not developed, though may be so very rarely.	5. Breasts, developed.
6. Lineae Albicantes, not to be found except in very stout males or in the case of previously distended abdomen by disease.	6. Lineae Albicantes, found on abdomen, breasts and buttocks, as well as on thighs indicating previous pregnancy.
7. Pubic hair, thick and extending upwards to the navel.	7. Pubic hair, horizontal and covering mons veneris only.

Hermaphrodites.—These are individuals in whom the essential parts of the generative organs of both sexes are included. This abnormality occurs from a faulty development of the sexual organs in the embryo and is known as *hermaphrodism.* It is classified as *spurious* or *false* and *true.*

Spurious or False Hermaphrodism.—In this class of hermaphrodism there is a malformation of the external genital organs only. Thus, in *Androgyni* (womanly men) the penis may be very small and hypospadic or epispadic, the scrotum may be cleft in the middle, and the testicles may be undescended. In *Androgynæ* (manly women) the clitoris may be thickened and elongated, and the labia majora may be united.

True Hermaphrodism.—True hermaphrodism is that in which one or more portions of the generative apparatus of both sexes is represented in the same individual. In old times there was a false belief that this condition owing to the union of the sexes in the same individual led to self-reproduction ; but such a condition does not exist. Hermaphrodites are usually impotent and sterile.

True hermaphrodism has been classified into three distinct types ; viz ; lateral, transverse, and vertical or double.

Lateral.—In this type a testicle is developed on one side, and an ovary on the other.

Transverse.—In this type, male organs are developed externally and female organs internally, or the reverse.

Vertical or double.—In this type various combinations of the generative organs of both sexes are seen ; e.g.

1. Ovaries with combined male and female passages.
2. Testicles with combined male and female passages.
3. Ovaries and testicles co-existing on one or both sides.

In the case of a doubtful sex a very thorough examination should be made bimanually as well as by rectal palpation and an opinion should be given from the ana-

tomical condition and the habit of the individual predominating most.

Concealed Sex.—Criminals may try to conceal their sex by dress or by some other means to avoid detection, or some persons, e.g. eunuchs, dancers, etc., may do so from moral obliquity. These cases do not present any difficulty if they are stripped naked; but the most remarkable case of concealed sex is that of Colonel James Barry, Army Surgeon and Inspector of Hospitals, who successfully practised deception on the public until death at the age of eighty, when it was found that *he* was a female.

Individuals are mentioned possessing features representing no sex (sexlessness), but such a condition is very rare indeed. So far only one case reported by Tardieu has been described in Taylor's Jurisprudence.

Decomposed Bodies.—In the absence of all other evidence the presence of the uterus, which resists putrefaction for a considerable time, will decide the sex. In the case of mutilated remains the determination of the sex is only likely to be accurate from hairiness on the face, head or pubis, development of the breasts and lineae albicantes, if any of these parts are available.

Skeleton.—It should be borne in mind that it is not possible to determine the sex from a skeleton with a full amount of certainty in individuals who have not reached puberty, seeing that the sexual characteristics of the bones (apart from those of the pelvis) do not begin to manifest themselves until this period is attained.

The bones of the adult female are usually smaller and lighter than those of the male; and have less marked ridges and processes for muscle attachments.

The adult female skull is, as a rule, lighter and smaller, its cranial capacity being about ten per cent. less than that of the male. The glabella, zygomatic and superciliary arches,

mastoid processes, and the occipital protuberance are less prominent. The facial bones are more delicate and smaller specially the maxillae, mandible and the teeth contained in them.

The female thorax is shorter and wider than the male. The sternum is shorter and its upper margin is on a level with the lower part of the body of the third thoracic (dorsal) vertebra, while in the male it is on a level with the lower part of the body of the second. The ribs are thinner and have a greater curvature, and the costal arches are larger.

The pelvis affords the best marked and most reliable characters for distinguishing the sex, these being well marked as early as the fourth year.

The female pelvic cavity is shallower and wider, the sacrum is shorter, wider, and its upper part is less curved ; the obturator foramina are triangular in shape and smaller in size than in the male. The inferior aperture is larger and the coccyx more mobile. The ilia are less sloped and the anterior iliac spines are more widely separated. The superior aperture of the lesser pelvis is larger, more nearly circular, and its obliquity is greater. The ischial tuberosities and the acetabula are wider apart, and the former are more everted. The pubic symphasis is less deep, and the pubic arch is wider and more rounded than in the male, where it forms an angle rather than an arch.

The neck of the femur forms almost a right angle with its shaft in the male, while an obtuse angle in the female.

3. RACE.

The question of the determination of race arises in the identification of unknown or unclaimed dead bodies found in railway carriages, or lying in streets, roads, and fields in the

vicinity of villages, or recovered from wells, tanks, canals and rivers. This question also arises in seaport towns, where there is always a conglomeration of races.

The two important races of Hindus and Mahomedans in India can be recognised by noting the following chief points :—

Hindu Males.	Mahomedan Males.
1. Not circumcised.	1. Circumcised. (*N. B.* Jews are also circumcised.)
2. Sacred thread worn over left shoulder in high castes, *dwija* or twice-born.	2. No such sacred thread.
3. Necklace of beads (*Tulsi* or *Rudraksh*) round the neck.	3. No such necklace.
4. Marks on the forehead painted red, yellow (saffron colored) or white (Sandal wood), indicating different religious sects.	4. No such marks; but callosities on the centre of forehead, patella, tubesosity of left tibia and tip of left lateral (external) malleolus owing to special attitudes adopted during prayers.
5. Tuft of hair usually grown longer on middle of back of head below the crown.	5. No such tuft of hair. Head clean shaved specially among *Bohras*.
6. *Angarakha* or *Mirzai* when worn leaves an opening about 5″ or 6″ × 1″ along the right side of chest showing a brown sun-burnt mark, as nothing else is worn next to skin, especially among the villagers.	6. Similar sun-burnt mark on left side of chest on account of the *Angarakha* or *Mirzai* opening on that side.
7. Ear lobules usually pierced.	7. Ear lobules not pierced but left lobule may be pierced in a few cases.
8. Palms and fingers not stained with *henna*.	8. Palm of left hand and tip of little finger sometimes stained with *henna*.

Hindu Females.	Mahomedan Females.
1. Tatto-marks between eye-brows, below crease of elbow, on dorsum of hand, and on chest, specially among low castes.	1. No tatto-marks except among proselytised women.
2. Nose-ring aperture in left nostril ; in a few cases in septum as well.	2. Nose-ring aperture in septum only.
3. A few openings along helix for ear-rings.	3. Several openings along helix for ear-rings.
4. Vermilion painted in hair parting on head and red mark on centre of forehead in women having husbands alive.	4. No such paint.
5. Iron-wristlet worn on left wrist in Bengal and ivory *churis* in Bombay and several glass bangles in U. P.	5. No Iron-wristlet or *churis* worn but very few glass bangles.
N.B. These are only worn by women whose husbands are alive.	
6 Head shaved among high class (Brahmin) widows.	6. No shaving of head.
7. Toes wide apart as usually no shoes are worn, but silver ornaments called *Bichhawas* are carried on the toes.	7. Shoe marks probably with corns on toes.
8. Trousers not worn except by Punjabi women.	8. Trousers worn.

Parsi males wear a sacred thread (*Kashti*) round the waist and a *sadra* (muslin *kurta*) on the body. Parsi women in addition tie a *Mathabanu* (white piece of cloth) on the head.

Indian Christian males usually wear pants and short coats and their women put on skirts and cover their head with a white *Chadar*.

Race can also be determined from certain differences in the skeleton given below in a tabulated form.

Race.	Caucasian	Mongolian.	Negro.
	1. Skull.—rounded.	1. Square.	1. Narrow and elongated.
	2. Forehead.—raised.	2. Inclined.	2. Small and compressed.
	3. Face.—small proportionately.	3. Large and flattened, malar bones being prominent.	3. Malar bones and jaws projecting; teeth set obliquely.
	4. Upper extremities.—normal.	4. Small.	4. Long in proportion to body; forearm large in proportion to arm; hands small.
	5. Lower extremities.—normal.	5. Small.	5. Leg large in proportion to thigh; feet wide and flat, heel-bones projecting backwards.

The skull of an Indian is Caucasian with a few negroid characters. This fact must not be taken as any evidence of any racial affinity between Indians and the inhabitants of Africa.

The Cephalic Index.—The important test for determining race is the *cephalic index*, which is obtained by multiplying the maximum length of the skull from before backwards by 100 and dividing the result by the greatest breadth measured transversely. Skulls having the index between 70 and 74.25, as observed among the Aborigines and pure Aryans are called *Dolicho-cephalic* or long-headed; skulls

denoting 75 to 79.9 index are called *mesati-cephalic* and skulls with 80 to 84.9 index are termed *brachy-cephalic* or short-headed, as observed in the Mongolian race.

The Mongoloid Patch.—During the census of 1911 a dark blue patch was observed on the gluteal regions of infants among the Burmese ; the color in some cases varied from dark brown or reddish to pink ; but such a patch has been found among other races as well.

4. COMPLEXION AND FEATURES.

The complexion may be fair, wheat colored, dark, brown or sallow. The color may change from the residence in a tropical country. The features of an individual may resemble those of his supposed parents or relatives, or his photograph, but this is not always the case. Again there are some persons who can cleverly alter their features by changing the expression of their face, so as to evade detection. While examining photographs the chief point to note is the character of the angle, which the eye forms with a line drawn through the middle of the forehead or nose ; but the medical man should never risk an opinion on this point, as he should remember that he is not an expert in photography, whereas a photographer or an artist is better qualified to give an opinion on such a point.

The details of the features as regards the eyes, nose, ears, teeth and chin should be carefully noted. The ires of the Indians are generally dark brown, but in a few cases, especially the Punjabis they are grey. In some individuals the color of one iris may differ from the other. Coloboma or hiatus may be found, if an operation has been performed on the iris. The bridge of the nose may be narrow, flat or broad, and the nostrils may be distended or the reverse. The ears may be small or large in size. Their lobules may be free or adherent to the face. The teeth may be

artificial or natural or a few may be missing or worn out or may have been set irregularly or colored. The chin may be protruding or double owing to excessive fat.

Owing to decomposition, more often in summer, the features of a dead body become bloated beyond recognition. It has been suggested that the altered features due to decomposition may be restored to natural features by bathing them with chlorine, salt and hydrochloric acid, as well as by injecting them with chlorine, zinc chloride and ferric chloride; but this does not seem to be possible.

5. HAIR.

The hair forms an important means in establishing identification, as it resists putrefaction. The hair of the Indians is generally dark and fine. That of the Chinese and Japanese is coarse, while that of the Negroes is curly and woolly. It has been observed by Tidy that the hair grows even after death, but this growth is only apparent probably from shrinking of the skin, which takes place after death.

Change in Color.—To disguise identity the hair may be artificially darkened by dyes and cosmetics containing metallic salts of lead, bismuth, or silver, or rendered lighter by using chlorine, hydrogen peroxide, dilute nitric acid, or nitro-hydrochloric acid.

Detection of Color.—The coloring of the hair can be detected by examining the scalp, which will, as a rule, be found dyed, and the color of the hair will not be uniform, the roots being different in tint from the rest. Such hair is rough, brittle and lustreless. The coloring can also be found out by comparing the hair of the head with that of other parts of the body, such as pubis and armpits, which is usually not dyed, as it is not likely to be open to the gaze of the public. In doubtful cases the hair should be shaved or cropped closely and the color of the growth of

the new hair should be observed, while the person is kept in custody for a few days.

Chemical Examination.—To find out the mineral used for dyeing, some hair should be steeped or boiled in dilute hydrochloric, or nitric acid to dissolve out the metal and the appropriate tests should then be applied to the solution thus obtained.

Lastly it should be remembered that the change of color is effected by following certain trades. For instance the hair of ebony turners and copper smelters assumes a greenish hue, and that of indigo-workers becomes blue.

6. ANTHROPOMETRY.

This is a system chiefly used for the identification of habitual criminals. There are two methods by which this is carried out. One is called the *Bertillon System* or *Bertillonage*, and the other is called the *Galton System.*

Bertillon System.—This system is called Bertillonage from the name of its inventor, M. Alphonse Bertillon. It is based on the principle that after twenty-one years of age no change occurs in the dimensions of the skeleton during the rest of the life and that the ratio in the size of the different parts to one another varies considerably in different individuals.

It consists in taking the measurements of certain parts of the body and then classifying the individual. The measurements that are usually taken are the length of the head, the width of the head, the length of the left middle finger, the length of the left foot, the length of the left forearm and, in some cases, the width of the right ear.

Galton System.—This system consists in taking the impressions of the bulbs of the fingers and thumbs with printer's ink on an ordinary white paper which should not be too glossy, and then examining them with a magnifying lens. It is based on the principle that the individual peculiarities of

these impressions in the arrangement and distribution of ridges and furrows, which are for the most part classified as arches, whorls, loops and composites, are always constant and invariable throughout life from infancy to old age, and that no two impressions resemble each other.

This system was first used by Sir William Herschell, I.C.S., but the credit is given to Francis Galton for having systematised it for the identification of criminals. The system is so very perfect that it has been now adopted all over the civilized world. Very often persons have been convicted of a criminal charge from the only evidence of their finger impressions left on furniture or some articles, as in the Muttra murder case of 1901, where the murderer's thumb-impression was left on a brass *lotah*, which he had used in washing his hands after killing his victim.

In the case of criminals, emigrants, and persons in subordinate Government service—both civil and military—while preparing their service books and pension papers, impressions of all the ten fingers are taken, but for the purpose of identification while giving a medical certificate and for other civil purposes only thumb impressions are taken: the left thumb impression in the case of a man and the right thumb impression in the case of a female.

If in the case of unknown decomposed bodies decipherable prints cannot be obtained owing to the fingers being contracted and wrinkled, the skin should be removed from the bulbs of the fingers, should be packed separately in sealed envelopes marking on the outside the finger to which it belongs. These envelopes should then be sent to the Finger Print Bureau at Allahabad for opinion.

Faint and invisible impressions can be rendered clearer by dusting them with some impalpable powder as plumbago, or grey powder. They can then be photographed or enlarged.

Tamassia's Identification of Veins.—Tamassia has,

for the purpose of identification, made use of the fact of the peculiar distribution and arrangement of the veins on the dorsum of the hand remaining constant. The veins are rendered conspicuous by pressing the arm with a ligature and the dorsum of the hand is photographed.

7. FOOT PRINTS.

The impression of a foot or a boot left on the ground in the vicinity of the occurrence of a crime has led very often to the arrest of its perpetrator. To identify the foot print a fresh foot mark of the suspected person should be obtained and compared to the original one. It should be remembered that the foot-print varies in size according to whether the person is standing, walking or running. It is largest when standing and smallest when running. It is usually assumed that the impression left on sand is smaller than the foot or boot producing it, while the impression on mud, clay or earth is larger.

Casts of foot prints may be taken by smearing the prints with oil and pouring in liquid plaster of Paris, or by dusting them with solid paraffin, which may be melted by holding a hot iron over the prints. This process may be repeated until the cast obtained is sufficiently thick to be removed.

In some maternity hospitals the system of taking the impressions of foot prints of newly-born infants has lately been introduced to avoid the confusion of their being mixed or to prevent their deliberate substitution or changeling. These form a permanent record for future identification.

8. DEFORMITIES.

Deformities may be congenital or acquired. Congenital deformities, such as cleft-palate, hare-lip, supernumary fingers or mammæ, web-fingers or toes, birth-marks (nœvi) and

moles are hereditary in many cases, and known to occur through successive generations in the same family. Acquired deformities, such as malunited and ununited fractures are the results of previous injuries.

9. SCARS.

A scar or a cicatrix is a fibrous tissue covered by epithelium formed as a result of the healing process of a wound or injury, in which there has been a breach of continuity of substance. It has no hair follicles or sweat-glands, but it is slightly vascular owing to the presence of a few capillaries.

Character of Scars.—A scar generally assumes the shape of the wound causing it. A scar resulting from an incised wound, which has healed by first intention, is usually linear and straight. If it has healed by the formation of granulation tissue, the resulting scar will then be wider and thicker in the centre than at the periphery. Broad and irregular scars are caused by contused and lacerated wounds. Large, irregular scars, accompanied very often by keloid patches, are the result of extensive burns and scalds. The scars of gun-shot wounds are generally irregular and disc-shaped, and adhering to the underlying tissue. The scars as a result of leech-bites are triradiate. The scars due to syphilitic and tuberculous ulcers are irregular and thick in parts, while those due to vaccination and small-pox are pitted.

Appearance of Scars.—A scar appears in four or five days when the wound heals under a scab as in the case of a superficial cut on a finger or a shave-cut on the chin or cheek. In the case of a clean aseptic wound caused by a surgical operation, it usually appears in a fortnight, while in a suppurating wound it appears from two weeks to three months.

Disappearance of Scars.—Scars caused by the loss of substance in wounds healed by granulation tissue are always

permanent, but superficial linear scars involving only the epidermis or cuticle layer of the skin may disappear in the course of a few years. For instance, the scars caused by wet-cupping may disappear in three years. It is not possible to successfully remove a scar, but its size and shape can be altered by an operative procedure. A faint scar may be made more visible by rubbing the part, when the surrounding skin will be red, and the scar will appear of whitish colour. If necessary, it should be examined by the aid of a lens. While describing a scar for the purpose of identification, its shape, size and situation should be mentioned.

Age of Scars.—It is extremely difficult to tell the exact age of a scar ; hence the medical witness should be very cautious in answering this question. The most that he can say is that a recent scar is red in color, subsequently it becomes brown and lastly, on account of the obliteration of the capillaries due to their being affected by the growth of connective tissue, it appears white and glistening.

Growth of Scars.—Scars produced in childhood grow bigger in size with the natural development of the individual, specially if situated on the chest and limbs.

10. TATTOO-MARKS.

The practice of tattooing is prevalent all over the world, though more common among the lower order of society. Designs of all sorts varying from initials to those indicating emblems of moral depravity are not only found tattooed on the arm, forearm and chest but on the other parts of the body. While describing tattoo-marks, their design and situation should be carefully noted. It is possible to find the same design at the same situation in more than one individual, if the operator happens to be the same person. Complications, such as septic inflammation, erysipelas, abscess, gangrene and even syphilis have been known to have followed this operation.

Disappearance of Tattoo-marks.—Tattoo-marks may disappear spontaneously, but not within less than ten years, if the pigment used is vermilion or ultra-marine and if it has not penetrated deep into the skin. Even in these cases the pigment may be seen deposited in the neighbouring lymphatic glands, if examined after death. But the marks are indelible, if some such pigment as Indian ink, soot, gunpowder or charcoal has been used and has penetrated deep into the skin. These marks are so very permanent, that they may be recognized even in decomposed bodies after the skin has peeled off. A faded tattoo-mark may sometimes be rendered visible by friction and then examined with a magnifying lens in strong light.

Artificial Removal of Tattoo-marks.—These can be artificially removed by rubbing a solution of caustic potash or soda or a paste of lard and acetic acid or hydrochloric acid. They can also be effectively removed by raising a blister, by the application of an actual cautery, or by means of a papain-glycerine mixture, but all these methods will produce skin lesions resulting in the formation of permanent scars.

II. OCCUPATION MARKS.

These are helpful in identifying unknown dead bodies, as certain trades leave marks by which persons engaged in them may be identified. For example, horny and rough hands are observed among individuals employed in hard, manual labour. *Kahars* or dooly-bearers have usually horny callous marks on their shoulders. An Indian weighman, who has to weigh corn by lifting up a balance with heavy scales, gets a callosity, usually on the inner side of his right palm. A depression in the lower part of the sternum is found among shoe-makers due to constant pressure of the last against the bone. Tailors have marks of needle punctures on their left index finger, and a bursa on the lateral malleolus from the attitude of

sitting adopted while sewing. Photographers, dyers and chemists have generally their fingers stained with dyes or chemicals.

12. HANDWRITING.

The medical jurist is hardly called upon to give his opinion as regards the identification of handwriting, since there are experts in this line; though according to Lord Brompton, better known as Sir Henry Hawkins, these handwriting experts are not at all infallible, and their evidence is usually conflicting, and very often fallacious. Sometimes the medical man may have to examine a person to see if he is able to write, when a plea of mental incapacity or some paralytic affection is raised.

13. CLOTHES AND ORNAMENTS.

These do not form any essential piece of evidence in the identification of a living person as the individual can change them at will; but they are very valuable in establishing the identification of a dead body. It is, therefore, necessary to preserve them along with any articles, such as a watch, visiting card, diary etc., found on a dead body or lying in its vicinity for the purpose of future identification. The clothes should also be examined for the presence of rents or cuts or for seminal or blood stains in special cases.

14. SPEECH AND VOICE.

There are certain peculiarities of speech ; *e.g.*, stammering, stuttering, lisping, and nasal twang. These peculiarities become more evident when an individual is talking excitedly as in a quarrel. Speech is also affected in nervous diseases, as general paralysis of the insane and disseminated sclerosis. Defective speech depending on some organic defect of the mouth, as cleft-palate, can be cured by a surgical plastic operation, while functional stammering is curable without any operation.

To recognise a person from his voice is an every day occurrence, though it is too risky to rely on in criminal cases, seeing that many persons can alter their voice at will. The best example of these is the ventriloquist. The absence of the teeth, or the false teeth, or diphtheria may alter the voice. With the progress of science it may be presumed that the registering of voice by a gramophone disc will be used in the near future for the purpose of identification in Court.

15. GAIT.

An individual can be recognised even from a distance by watching his gait, but such evidence is far from conclusive, inasmuch as gait may be altered by an accident or disease specially of a nervous nature, as locomotor ataxy, hemiplegia, spastic paraplegia, etc. In civil suits the medical man may, sometimes, be requested to express his opinion if a particular individual is really lame or malingering, if he has filed a suit against his employer for the recovery of damages for an accident caused to him during his legitimate work.

16. TRICKS OF MANNER AND HABIT.

These are not infrequently found to be hereditary ; as an example left-handedness may be cited.

17. MENTAL POWER, MEMORY AND EDUCATION.

The consideration of these points for the identification of an individual is of great importance, especially in cases of imposture, as in the well-known Tichborne case.

18. AMOUNT OF ILLUMINATION REQUIRED FOR IDENTIFICATION.

In questions regarding the amount of light sufficient for recognition of the features for subsequent identification of the individual the following points should be bourne in mind.

1. A flash of lightning produces sufficient illumination for the identification of an individual.

2. According to Tidy the best known person cannot be recognised in the clearest moonlight beyond a distance of seventeen yards. Colonel Barry I.M.S. is of opinion that at distances greater than 12 yards, the stature or outline of the figure is alone available as a means of identification. To define the features even at a shorter distance is practically impossible by moonlight.

3. No definite statement can be made about artificial light. The best thing is to make actual experiments with the class of light used before an opinion is given.

4. In the absence of any other light the identification of a person is possible with the flash of light produced by a fire-arm, if the person is standing in close proximity of five to twenty paces, on one side of the line of fire, and if the powder is at the same time smoke-less ; though it is not possible to mark the different characters of the features beyond three paces. In such cases an experiment should be tried with the weapon and powder used before an opinion is given.

CHAPTER III.

POST-MORTEM EXAMINATION (AUTOPSY).

The object.—The object of the *Post-mortem* examination of a body is to establish its identity when not known, and to ascertain the probable time since death and the probable cause of death ; but in addition, the question of live birth and viability has to be determined in the case of the body of a newly-born infant.

Rules.—The medico-legal *post-mortem* examination should never be undertaken unless there is a written order from the superintendent of police or the District Magistrate. Before commencing the examination, the medical officer should carefully read the police report on the appearance and situation of the body and the cause of death as far as could have been ascertained. This precaution is necessary specially in the case of a decomposed body, so as to enable him to examine particularly the organ or the part of the body most suspected for the evidence of death.

The examination should be conducted in daylight, and not in artificial light. It should also be as thorough and complete as circumstances permit. The three great cavities and the organs contained in them should all be carefully examined even though the apparent cause of death has been found in one of them, just to avoid unnecessary and sometimes unpleasant cross questions in court, inasmuch as evidence of factors contributory to the cause of death may be found in more than one organ.

Ordinarily the body is sent to the morgue but in exceptional cases the medical officer may be taken to the place, where the body is lying. In that case he should note the place and nature of the soil where he found the body, also its position specially as regards the hands and feet and the state of the clothes, if any. He should also note in cases of death from violence, the position of the body in reference to surrounding objects, such as sharp stones and the like, contact with which, it may be alleged, has produced the injury, also whether any blood stains are visible on such objects or anywhere near the corpse, and whether any weapons are lying near it. The ground in the vicinity should be carefully searched for the presence of footprints and the evidence of any struggle. In cases of

suspected death from poisoning, he should note whether any appearance as if of vomited matter, etc., is present in the neighbourhood of the body.

All the details observed by the medical officer should be carefully entered by himself in the *post-mortem* report or in a note-book, which can be used as evidence in a legal enquiry. If there is an assistant, the best plan is to dictate to him as the examination proceeds step by step, and then read, verify and attest them. It is not safe to trust to memory and to write the report later on after completing the examination. The notes and the report to be sent to Court must tally with each other There should be no discrepancy. Nothing should be erased ; and all alterations should be initialled.

The medical officer holding a *post-mortem* examination should be familiar with the normal and pathological appearances of the viscera. He should note the time of the arrival of the body at the morgue, the date and hour of the *post-mortem* examination and the name of the place where it was held. Very often necessary papers authorizing the medical officer to hold an autopsy are brought by the police long after the body has arrived. This dilatory method on the part of the police has very often led to the decomposition of the body in the *post-mortem* room even when it has arrived in a good condition. It is, therefore, safer to note the exact time of delivery of these papers. There should be no unnecessary delay in holding the *post-mortem* examination. It should be made as soon as the papers are brought, and the excuse of attending upon a midwifery case or any other similar reason should not prevent him from performing this most important, though too frequently unpleasant, duty.

No outsider should be allowed to be present at the autopsy.

Instruments.—The following instruments should be at hand before commencing the examination :—

1. Scalpel. 2. Large Section knife. 3. Dissecting forceps. 4. Scissors. 5. Saw. 6. Costotome. 7. Enterotome. 8. Blunt probe. 9. Blow pipe. 10. A pair of iron hooks. 11. Curved needles. 12. Strong twine. 13. Tape measure. 14. Small Scales. 15. Measuring and graduated glass. 16. China plates. 17. Basins to contain water. 18. Sponges. 19. A pair of thick India-rubber gloves with gauntlets or photographic gloves.

EXTERNAL EXAMINATION.

The following steps should be followed for the external examination :—

1. The body should be identified by the police constable and the *chaukidar*, who, as a rule, accompany the body. It may also be identified by a relative of the deceased if he has accompanied the body.

2. In the case of unknown bodies, a general appearance of the body describing the features, stature, age, sex, race, scars, tattoo-marks, etc., should be noted for the purpose of identification. The body should be photographed and the finger prints taken. The police should arrange for such a body to be photographed at once, before it gets decomposed. The photograph is worthless, after the features have become bloated and distorted from putrefaction ; but I have seen bodies photographed even after advanced putrefaction. At the request of the police the head may be preserved for future identification in methylated spirit and a little formalin in a large closely fitting jar or any other receptacle.

2. If the clothes are on the body, they should be carefully removed and examined for stains of mud, blood or semen, or burns caused by acids or fire, or cuts or rents caused by a cutting instrument during a struggle.

3. In the case of a cord or ligature round the neck, its exact position, manner and application of a knot or knots, and its material should be noted.

4. The probable age should be given from the presence of the teeth and other appearances. If, owing to rigor mortis, the jaw cannot be opened to count the teeth, the cheeks should be cut to expose them.

5. The time since death should be noted from the temperature of the body—whether it is cool or warm—rigor mortis, the stage of putrefaction, and even from the degree of digestion of the stomach contents which however only yields evidence of doubtful value.

6. The condition of the body, whether stout, emaciated, or decomposed, should be mentioned.

7. The natural orifices, viz., nose, mouth, ears, anus, urethra and vagina should be examined for the presence of foreign bodies or injuries.

8. The hands should be examined for any article, as hair, fragments of clothing or a weapon, grasped by them or the presence of mud or blood on them or under the nails,

9. The direction of blood smears and the signs of spouting of blood should be noted, if any.

10. The situation of *post-mortem* staining if present should be noted.

11. After washing the body a careful search for the presence of injuries or marks of violence should be made all over the body from head to foot, on the front as well as on the back. In the case of a female body the hair of the head should be removed to examine the scalp.

Contusions and abrasions, if any, should be described as regards their

length, breadth and their exact situations. Contusions should be incised to find out if they were inflicted before or after death and to differentiate them from suggilation.

Wounds, if present, should be described as regards their nature, size, direction and position. The condition of their edges should also be mentioned. The exact size ought to be noted with a measuring tape and some fixed bony points should be taken to describe their exact position. The nature of the weapon with which they appear to have been inflicted should be mentioned.

In the case of gunshot wounds the course and direction of the bullet should be ascertained by dissection rather than by the use of the probe, and the injured nerves and blood-vessels, if any are found, should be noted. If there is only one opening, a search should be made for the bullet, which must be preserved. It should be remembered that a bullet takes a very tortuous and erratic course in its passage through the body.

Ligature marks or finger marks, if present on the neck, should be noted.

In the case of burns, their position, extent and degree should be mentioned, as also the manner of their causation as to whether they were caused by fire, scalding fluids, corrosives or explosives.

Penetrating or deep wounds should not be investigated by means of a probe, until the body is opened.

12. All the bones should be carefully examined for the presence of fractures, and joints for dislocations. If any fracture is present, the soft parts overlying the fractured piece should be dissected and examined for laceration or ecchymosis. Lastly all the external injuries should be compared to those noted in the descriptive roll supplied by the police and any discrepancy should be mentioned in the report.

13. In the case of the body of a newly-born infant it is necessary to examine the lower epiphysis of the femur for the centre of ossification to prove its maturity. For this purpose, the knee joint should be opened by making an incision across its front and the lower end of the femur should be pushed through the wound. The epiphysial cartilage should now be sliced off in thin sections until a central pink spot is seen. The slicing of the cartilage should be continued till the greatest diameter of the ossified point is reached.

INTERNAL EXAMINATION.

If there be a fatal wound leading to one of the cavities, that cavity should be opened first, or else the head should be opened first, then the thorax and the abdomen. The spine and the cord should not ordinarily

be examined unless there is a suspicion of some injury to the vertebral column or the alleged cause of death is due to some spinal poison or some disease as tetanus. In that case they should be examined last of all.

HEAD.

A transverse incision across the vertex should be made from ear to ear and, after reflecting the flaps anteriorly up to the orbits and posteriorly up to the occipital protuberance, the inner surface of the scalp should be examined for extravasation of blood and the skull bones should be examined for evidence of any fracture or separation of sutures after the periosteum is denuded and the temporal muscles have been dissected off. In the case of doubt the skull should be tapped with a hammer ; it would elicit a ringing note if there is no fracture. To remove the skull cap a circular cut is then made with a saw round the cranium keeping close to the reflected flaps. Its inner surface should then be examined for fracture of the inner plate, or effusion of blood, which may be found on the dura mater. The dura master should be removed by cutting longitudinally along both the sides of its middle line noting any effusion of blood or serum, or the presence of pus. It would not be out of place to note here the distinction between meningitis and mere effusion of blood in the meninges. In the former the surface of the brain looks greasy and dull, but not so in the latter. The brain should now be removed by raising the anterior lobes with the fingers of the left hand and cutting through the various nerves at its base and the medulla as low down as possible. The brain should be placed in a large clean receptacle or dish and examined minutely on its upper as well as under surface (base) for the evidence of any injury, effusion of blood, inflammatory products, embolism of arteries, morbid growths or any disease of its tissue. The ventricles should also be examined. The average weight of the brain of the adult male is forty-nine ounces and a half, that of the female, forty-four ounces.

The dura mater should lastly be stripped from the base of the skull, to facilitate the examination for the presence of fractures.

THORAX.

Before examining the thorax, both the cavities, thorax and abdomen, should be opened by making a longitudinal incision from above the middle of the sternum to the pubic bone, keeping wide away from any wounds existing in its line. In infant bodies the incision should be carried

a little to the left of the umbilicus. The integument, fascia and muscles should now be reflected and examined for extravasation of blood in their inner surface. The abdominal cavity should be examined before the chest cavity is opened. The color and appearance of the abdominal viscera, as also the position of the diaphragm with respect to the ribs (especially in full term newly-born infant bodies) should be noted. It should also be noted if there is any collection of blood, serum, pus, or fæcal matter in the cavity.

After this preliminary, the examination of the thorax should be proceeded with. The ribs and sternum should first be examined for evidence of fracture and then the cavity of the thorax should be opened by dividing the ribs at their cartilages, and the sternum at the sterno-clavicular junctions with the costotome and lifting up the sternum separating it from the underlying parts without injuring them. The pleural cavities should be examined for the presence of adhesions, foreign bodies or fluid of a bloody or purulent nature. The pericardium should be opened and examined for any adhesions between its two surfaces or if there is any abnormal quantity of the fluid present in its cavity. Normally about a dram of bloody serum is found in the pericardial sac. The condition of the chambers of the heart should be examined by opening them in *situ*. The lungs and heart should be removed from the cavity and laid on the table. The lungs should be cut open for the evidence of disease, congestion, injury, Tardieu's spots, etc., and the bronchi should be examined for the presence of pent up expectoration, pus or any foreign body. The average weight of the right and left lungs of the adult male is twenty-four and twenty-one ounces respectively; while the right female lung weighs on an average seventeen ounces and the left, fifteen ounces. The heart should be opened and its chambers examined for the presence of a valvular disease, and the condition of the endocardium should be noted. The heart weighs on an average nine ounces. The aorta should be examined for aneurysm, or calcareous degeneration.

To examine the larynx, trachea and aesophagus an incision should be made from the chin to the upper part of the sternum after throwing the head well backward and placing a block of wood beneath the neck. After reflecting the soft parts on each side of the middle of the larynx, both the trachea and aesophagus should be removed and examined by cutting them open from their posterior surface. The interior of the aesophagus should be examined for the evidence of congestion, inflammation or ulceration of its mucous membrane, and the presence of a foreign body, tumour or stricture. The larynx and trachea should be examined for the

presence of froth, or a foreign body in their interior and their mucous membrane should be examined for congestion or inflammation.

ABDOMEN.

The peritoneum should be first examined for evidences of adhesions, congestion, inflammation, or exudation of lymph or pus. The abdominal and pelvic cavities should then be examined for the presence of a serous, bloody or purulent fluid. Now the abdominal organs should be removed and examined separately as below :—

Liver.—The surface of the liver should be examined as regards its smoothness or roughness. If there is any injury on the liver, its nature and dimensions should be noted as well as the size and weight of the liver. Normally the liver weighs from fifty to sixty ounces, and measures $12'' \times 7'' \times 3\frac{1}{2}''$. The organ should be cut open by deep incisions in several places, and the color, consistence and blood supply of its tissue should be carefully marked ; at the same time the presence of an abscess, new growth or amyloid degeneration should be observed.

The gall bladder should be opened and the presence or absence of bile stones and the character and the quantity of the bile should be noted.

Spleen.—The size, color and consistency of the organ should be noted, as well as the condition of its capsule. In the case of a rupture of the spleen, its size and position should be described, as well as the size and weight of the spleen. The normal spleen in the adult measures $5'' \times 3'' \times 1''$ and weighs from 5 to 7 ounces ; but its size and weight vary in individuals according to age under different conditions. Thus, it increases in size during and after digestion ; while it decreases in size and diminishes in weight in old age. Its relation to the body weight in the infant as well as in the adult is about the same ; it being 1 : 350 at birth, and 1 : 320 to 400 in the adult.

Kidneys.—The size, color and weight of the kidneys should be noted. Normally the size of a kidney is $4'' \times 2'' \times 1''$ and the weight varies from $4\frac{1}{2}$ to 5 ounces ; the left being heavier by about 2 drams than the right. Its capsule should be examined as to whether it is adherent or strips off easily. The kidney should be cut open and the internal cut surface should be examined for the presence of Bright's disease or amyloid degeneration ; the pelvis should be examined for calculi and evidence of inflammation.

Bladder.—The bladder should be examined for congestion, hæmorrhage, inflammation and ulceration of its mucous membrane. It may be opened in *situ* and its contents noted, but in a suspected case of poisoning

urine should be taken in a clean glass vessel for chemical analysis, if necessary.

Uterus.—In female bodies the uterus should always be examined for its size and shape. The normal size of the organ is $3'' \times 2'' \times 1''$ and weight, from one to one-and-a-half ounces ; but the size and weight vary considerably during pregnancy or when there is any tumour. The condition of its mucous membrane and the thickening of its wall should be examined after the uterus is opened longitudinally. During menstruation the mucous membrane is thickened, softer and of a darker color, and covered with blood and detritus. In old age it becomes atrophied, and paler and denser in texture. If the uterus contains a foetus, the age of its intra-uterine life should be noted. The ovaries and fallopian tubes should also be examined. The ovaries should be examined for corpora lutea.

In cases of suspected criminal abortion the uterus and its appendages should be preserved for chemical analysis, if thought necessary.

Intestines.—The intestines should be removed after ligaturing at both ends, and should be cut longitudinally to examine the inner surface for the presence of congestion, inflammation, erosions, ulcers, perforation or any other lesion. In cases of suspected poisoning the contents should be kept in separate vessels for chemical analysis, if necessary ; but, as a rule, the faecal matter has not to be sent to the Chemical Examiner. (Vide Appendix V ; rule 32 chapter II).

Stomach.—Under ordinary circumstances the stomach is examined by making a cut while in *situ*, for the contents as regards their quantity and quality, and the degree of their digestibility. But in suspected poisoning the stomach should be removed after tying a double ligature at both ends. It should then be opened in a thoroughly clean plate ; after emptying the contents its mucous surface should be carefully examined noting its appearance, and any suspicious particles found adherent thereto should be picked off with a pair of forceps and placed in a separate small phial for chemical analysis. The contents of the stomach should be also examined as regards their smell, color and character and for the presence of any foreign particles or lumps ; these, if present, should be felt between the thumb and the index finger as to their roughness or smoothness.

For the purposes of chemical analysis the following articles should be preserved in separate clean glass bottles.

1. The stomach and its contents.

2. A portion of the liver, not less than sixteen ounces in weight, or the whole liver if it weighs less than 16 ounces, one kidney, and the spleen.

If the spleen is very large, a portion only need be preserved.

If there is suspicion of a vegetable poison having been used, the following articles in addition should be preserved.

3. The upper part of the small intestine with its contents.

4. Any urine found in the bladder.

5. The heart and a portion of the brain if strychnia or nux vomica is suspected.

According to the revised rules by the U. P. Government the stomach and its contents are to be preserved in one bottle, and pieces of the liver, spleen, kidney and a small piece of the upper portion of the small intestine, in another bottle. These are to be preserved in rectified spirit except in the case of alcohol or phosphorus poisoning, when a saturated solution of common salt is to be employed, and, in addition, a handful of solid salt should be placed in the bottle. (Vide Appendix V.)

Spine and Spinal Cord.—The body should be turned over on the face with a block beneath the thorax and an incision made along the entire length of the vertebral column extending from the occiput to the lower end of the sacrum. After reflecting the integuments, dissecting away the muscles and noting extravasation of blood in the soft tissues, the laminae should be sawn through vertically on each side and the detached portions removed, when the dura mater would be exposed. After noting its appearance, the dura mater should be opened and an examination made for the presence of hæmorrhage, inflammation, suppuration or tumour. The cord should now be removed, laid on a table, cut transversely in several places, and examined for the evidences of hæmorrhages, softening and inflammatory lesions.

The vertebral column should be examined for the presence of fractures or dislocations after the cord has been removed.

As soon as the *post-mortem* examination is finished, the body should be thoroughly washed, the organs should be replaced into the cavities, the dissected flaps should be brought in apposition and well sutured with strong twine. It should then be covered with a cloth before it is returned to the relatives so as to avoid hurting their feelings. In the absence of the relatives the body should be returned to the police constable accompanying it, who should cremate or bury it according to the religious customs of the deceased, but should never throw it into a running stream or river as is often done.

The Cause of Death.—After completing the *post-mortem* examination, the medical officer should form an opinion as to the probable cause and manner of death, based on the appearances observed by him, and should immediately give in the vernacular the abstract of his opinion in the

police form no. 289 to the police constable accompanying the body for communication to the investigating officer.

If the opinion has been based on the *post-mortem* appearances, as well as on the statement of the police, he should mention the fact in his report. The report should be as complete as possible, but concise and clear ; and should be forwarded to the superintendent of police as soon as possible, but not later than two days.

Post-mortem reports drawn up by civil assistant surgeons have to be countersigned by civil surgeons ; but this appears to be unnecessary and meaningless, as responsibility still rests with civil assistant surgeons.

EXAMINATION OF DECOMPOSED BODIES.

The examination should be complete and should be held on the same lines as in ordinary *post-mortems*. To save hand work on decomposed bodies and thus to lessen the chances of septic poisoning a pair of hooks made of iron and steel 9″ long and 3″ bent in to form a handle is very convenient for hooking up the abdonimal and other incisions so as to keep the parts open and also for opening the pericardium and hooking up the heart, lungs and other organs.

In cases of external fatal injuries it is not difficult to find out the cause of death. Similarly in cases of strangulation and hanging the cord mark would be apparent, even if the skin had peeled off, as the skin on and round about the mark persists for sometime. Again in fracture of skull bones disorganised clotted blood may be found on the inner plate of the skull bones, or on the surface of the dura mater and on the brain in spite of its soft and pulpy nature if decomposition has not far advanced ; but the mere effusion of blood on the brain would not be enough to warrant a statement that the fracture was caused before or after death. In doubtful cases a guarded opinion should be given that the injuries found on the body, if inflicted during life, were sufficient to cause death and that they might have been caused by such and such a weapon.

Necessary viscera should always be preserved for chemical analysis in those cases, where the cause of death cannot be found owing to advanced decomposition.

EXAMINATION OF MUTILATED BODIES OR FRAGMENTS.

Mutilation of a body is not always the act of a criminal, who wants to destroy all traces of identity and thus gets greater facilities to dispose it off. In India animals such as jackals, dogs, vultures, etc., mutilate

the body in a very short time after death if exposed in the open. Besides, it is not an uncommon sight to notice the dead bodies of lunatics, *fakirs*, and pilgrims, lying on the road side or on the remote spots in the vicinity of villages, and attacked by birds of prey or dogs and other animals. If the village *chaukidar* happens to find such a mutilated body, he hurriedly runs to the police station to make a report about his wonderful discovery, and the remnants of the body are forwarded to the civil surgeon for *post-mortem* examination.

In such cases the medical examiner should first ascertain if the parts sent are human or not. This is only difficult when a piece of a muscle without the skin or a viscus is sent. Having determined that they are human he should try to elucidate the following points :—

1. All separate parts should be fitted together, and it should be determined whether they belonged to one and the same body.

2. The nature and character of the parts should be described, as also the color of the skin, if any.

3. The manner of separation as to whether they had been hacked, sawn through, cut cleanly, lacerated, or gnawed through by animals.

4. Sex can be determined, if the head or trunk is available, from the presence or absence of the hair and general conformation.

5. The probable age may be ascertained from the skull, teeth, color of the hair, trunk, size and degree of development of fragments, and ossification of bones.

6. Identification can be ascertained from tatto-marks, scars, color of the hair, deformities, recent and old fractures, etc.

7. The probable time since death may be ascertained from the condition of the parts.

8. The cause of death can be ascertained, if there is evidence of a fatal injury to some large blood vessel or some vital organ. For instance, a penetrating wound on the left side of the chest cutting the left ventricle was noticed on a mutilated body of a Hindu male packed in a steel trunk and found lying in a first class compartment of No. 6 down train of R. M. Railway at Agra Fort station on the 7th August 1909. The head, extremities, penis, and upper half of the lip had been severed from the trunk.

EXAMINATION OF BONES.

When a skeleton or isolated bones are sent for medical examination, the usual questions that a police officer puts to the medical officer are : (1) whether the bones are human or not ; (2) if human whether they

are male or female ; (3) whether they belong to one or more individuals ; (4) the stature of the individual to whom the bones belonged ; (5) the age of the individual, to whom the bones are alleged to belong ; (6) time of death ; (7) whether the bones have been cut, sawn or gnawed by animals or burnt ; (8) the probable cause of death.

The above questions may be answered by observing the following points :—

(1) The knowledge of human as well as comparative anatomy is necessary to find out whether the particular bones are human or not. The answer is quite easy when the bones are entire or when the skeleton is sent, but great caution should be used in giving a definite opinion, when a fragment of a bone is available without any characteristic features, such as, tuberosities, etc. Such fragments should be examined under the microscope or forwarded to an expert for his opinion.

(2) The sex can be determined from the distinguishing marks of the male and female bones. The determination is more accurate if the adult pelvis is forthcoming.

(3) The bones sent for examination should be assorted according to the side to which they belong and then it should be noted if there are bones of one kind more than necessary as required for one individual, or if there are bones of the same kind more than necessary on the same side.

(4) To estimate the height of an individual an inch or an inch and a half for soft parts should be added to the length of the entire skeleton, if it is available. As a general rule the stature of an individual is said to be the length measured from the tip of the middle finger to the tip of its opposite fellow, when the arms are extended fully in a horizontal position. If only one arm is sent for examination, the height can be fairly ascertained by multiplying its length by two and adding twelve inches for the clavicles, and one and a half inches representing the width of the sternum. The length of the forearm measured from the tip of the olecranon process to the tip of the middle finger is also stated to be equal to five-nineteenths of the height of the body.

It is not possible to estimate the stature from single bones, with any degree of exactitude, but the following table would be useful to determine the height within an error of five inches :—

Table for calculating the height from bones :

a. Humerus = 19·54% of height.

b. Radius = 14·15% of height.

c. Femur=27·51 % of height.
d. Tibia=22·15 % of height.
e. Spine=36·8 % of height.

(5) The age can be determined with a certain amount of accuracy from the presence of the teeth in the mandible and the maxillae, as also from the formation of centres of ossification and the junction of epiphyses with shafts or of bones with one another. For this purpose it is better to tabulate the report as under so as to avoid any mistake.

Kind of bone.	Centre of ossification.	Junction of epiphysis with shaft.	Union of bones with one another.	Age.	Remarks.

Lastly the approximate age should be given considering all these points.

The weight of the bones may help one to give an opinion as regards age though not with any certainty; however, when the bones of an alleged adult are forwarded by the police and the medical man finds them to be those of a boy or a child, it is much safer to weigh them to avoid future complications, as some cases have happened in which medical men were put to some inconvenience owing to their not having done so.

The specific gravity of a bone, which forms the densest part in the human body, is two. The average weight of an Indian male skeleton, specially that of a Punjabi is ten pounds and six ounces, which is about the same as that of a European male skeleton; while that of an Indian female (Punjabi) weighs six pounds and two ounces, which is less than that of a European female skeleton, which weighs eight pounds and thirteen ounces. Children attain half the adult weight at about 12 in the case of boys and under 11 in the case of girls.

(6) It is extremely difficult to tell the precise time of death from examining the bones, but a guess may be made by noting the existence of fractures, odour, the condition of the soft parts and ligaments attached to them. In the case of a fracture the time may be judged with a certain degree of accuracy by examining the callus after dissecting it longitudinally. The odour emitted by the bones of recent deaths is quite characteristic and offensive. It should be remembered that the dogs, jackals, and ants denude the bones free of soft tissues and even ligaments in a very short time, but their peculiar odour will be still evident and will be different from that of the bones cleaned by decomposition in the earth.

The bones begin to decompose, after all the soft parts have dis-

appeared from three to ten years, which is the usual period taken up by bodies, when laid in coffins ; but this period is much shorter in India, where most of the bodies are buried without any such protection.

The changes due to decomposition occurring in the bones are accompanied by the loss of organic matter and weight. Such bones become dark or dark brown in color, and may be fragile. It is extremely difficult to assign the time when these changes occur, but it depends on the nature of the soil, the manner of burial (with or without coffin), and the age of the individual (more rapidly in young persons).

(7) The bones, particularly the ends of the long bones should be examined very minutely and carefully to find out if they have been cut by sharp cutting instruments, or sawn, or gnawed through by animals and the medulla eaten away. Sometimes inexperienced police officers mistake the gnawing of bones by animals for cuts by sharp instruments, and then try to suggest all kinds of absurd theories to maintain their point.

Their nutrient canals should be examined for the presence of red arsenic or some other stain to ascertain if the bones came from a desecting room, for, the pleader in a city where there is a medical school or college may raise a question as to whether they did not come from a dissecting room. To avoid such a possibility it is necessary for the authorities to see that all the remaining parts are thoroughly incinerated after the dissection is over.

(8) It is almost impossible to infer the cause of death from a bone or bones unless there is evidence of fractures which would, under normal conditions, prove fatal, e.g., fractures of skull bones or of the upper cervical vertebrae or a deep cut into any of these bones suggesting the use of a heavy cutting instrument, as a *gandasa*, or fracture of several ribs. Disease of the bones, such as caries or necrosis should also be noted, if present.

The bones should not be returned to the police after medical examination, but should be retained and kept in one's own custody with a view to producing them in Court, if required.

Burnt Bones.—In some instances burnt bones and ashes are forwarded to the medical officer for inspection, when the police come to suspect some foul play after the body is partially or completely burnt. A bone, when burnt in the open, is white in appearance, and black or ash grey when burnt in a closed fire. A burnt bone preserves its shape, but falls to powder when pressed between the fingers. It is said that it will be reduced to charcoal if treated with hydrochloric acid, but

this is not necessarily true. If so much burnt that organic matter is destroyed, no charcoal will be left on adding acid.

In cases of suspected poisoning with some mineral, all the available ashes and burnt bones should be sent to the Chemical Examiner. It is reported that he has been able to detect arsenic and antimony in large pieces of bone mixed with ashes in some cases despite the volatility of these poisons.

CHAPTER IV.

EXHUMATION.

It becomes necessary to exhume bodies from graves, when a suspicion of poisoning or some foul play arises sometime after death or it may be only for the purpose of identification. In India such a procedure is very rare owing to the custom of cremating the dead bodies among the Hindus, who constitute the larger proportion of the population.

Rules for Exhumation.—Under the written order of the District Magistrate, the body should be exhumed in the early morning by the medical officer in the presence of a police officer. Before ordering the digging of the grave he should examine the plan of the graveyard to fix the exact situation of the grave, if any plan is available. After proceeding to the place the name plate, if any, should be identified and the undertaker should be asked to identify the stone if it is a *pucca* (masonry-built) grave. The grave should now be ordered to be dug up and the earth from above and below the body in the direction of the flow of the sub-soil water, or some fluid if found in the coffin (which latter should also be identified by the undertaker) should be preserved in a dry clean glass bottle for chemical analysis.

The coffin or the body (if the coffin has decayed or is not used) should be raised from the grave and identified by as many persons as possible, chiefly, relatives, friends or servants who might have been present at the time of preparing and dressing the body for burial.

Examination.—If the interment has been recent, the *post-mortem* examination should be conducted in the usual manner either in the open near the graveyard but screened off from public gaze, or at the mortuary. But, in the case of bodies, which have lain underground for a sufficiently long time to undergo putrefaction, an attempt should be made to determine the sex, stature and marks of identification. The hair found on the body should be preserved in a dry clean glass bottle for subsequent identification and chemical analysis. All the cavities should be examined and as many viscera as can be obtained should be each preserved separately in dry, clean, wide-mouthed glass jars or bottles without

exposing them unnecessarily to the air, and a sufficient quantity of preservative should be added. The viscera should not be brought in contact with any metal. These bottles or jars should then be closed with well-fitting glass stoppers covered with skin, preferably, chamois leather, and delivered sealed to the Chemical Examiner on the same day if he lives in the same town, or they should be forwarded to him by a passenger train without the least delay. In the case of suspected metallic poisoning, long bones such as the femur, should be preserved and sent to the Chemical Examiner. Search should also be made for recent or old injuries, such as fractures.

Disinfectants.—Disinfectants should not be sprinkled on the body but may be sprinkled on the ground in the neighbourhood of the body. To avoid inhaling offensive gases, the medical officer should use for the mouth a gauze mask dipped in a solution of permanganate and should wear thick India rubber gloves with gauntlets or photographic gloves, which are now always kept in every public mortuary in the United Provinces of Agra and Oudh. He should also stand on the windward side of the body.

The time of Exhumation.—In England no time limit is fixed for the disinterment of a body; but in Scotland twenty years is the limit fixed as no suspected person can be prosecuted for the perpetration of a crime after the lapse of that period. In France this period is reduced to ten years and is raised to thirty years in Germany.

Report.—A verbatim report made by Major (now Lieut. Colonel) E. J. O'Meara F. R. C. S., I. M. S., Principal, Agra Medical School and Civil Surgeon, Agra, on the exhumation of the body of the late Mr. Fulham which was exhumed about fourteen months after death is given below with a view to illustrate as to how it should be made out in the case of exhumations :—

"On an order of the District Magistrate of Agra dated 6-12-12 I proceeded to the Cantonment Cemetery of Agra at 8-45 A.M. on Sunday the 6th December 1912, accompanied by Mr. Williamson, Superintendent of Police, and Dr. Modi, L. R. C. P. & S. (Edin.), Lecturer on Medical Jurisprudence, Agra Medical School.

The grave was identified by the Rev. Canon Menzies from the key to the Cantonment Cemetery plan as Book R. No. 129 non-masonry. A stone marked "No. 129 Mr. E. M. Fulham" stood at the head of the grave.

After $3\frac{1}{4}$ hours the coffiin was raised ; it was then identified by Chiranji Lal of Messrs. Suntoke and Co., the undertakers as having been made by that firm. There was no name plate. Samples of earth for examination

by the Chemical Examiner were taken from above and below the coffin and in the direction of the flow of the subsoil water. The coffin was then placed in a shell on a hearse under the charge of Police Sergeant Charlewood to the *post-mortem* room of the Thomson Hospital.

On arrival at the *post-mortem* room at about 2 P.M., the coffin was taken out of the shell, opened by the undertaker Chiranji Lal in the presence of——

Mr. H. Williamson, Superintendent of Police.

Mr. Emery, Merchant, Meerut.

Mr. Sarkies, Military Accounts Department, Meerut.

Dr. Modi.

Dr. Vyas.

Gur Bux bearer to the late Mr. E. M. Fulham, and myself.

The coffin was much eaten by white ants and decayed but was intact with the exception of the lid which had given way down the centre of the coffin containing a quantity of earth. A sample of this earth was taken for despatch to the Chemical Examiner. On removal of this earth, the grave clothing, a white shirt, white drawers, and black socks were identified by Gur Bux the late Mr. Fulham's bearer as having been the clothes in which the body had been dressed for burial.

1. Sex, identified as male from the scrotum ; there was no penis.

2. Stature, about 5 feet 5 to 6 inches, the remains in the coffin being $5'\text{-}3\frac{1}{2}''$.

3. Weight, during life approximately 10 stone. It was impossible to distinguish race, age, scars, birth, tattoo or thumb marks. There were no peculiarities of nails, no injuries having permanent results or fractures that could be ascertained. Mr. Emery and Mr. Sarkies stated that Mr. Fulham had a withered left arm. This could not be definitely made out as the measurement of the lower third of the left arm was only $\frac{1}{4}''$ less than the right and there was only $\frac{3}{4}''$ difference in the measurement of the upper-third of forearm.

The hair lying in the coffin and attached to the back of the head was identified by Mr. Emery, Sarkies and Gur Bux as being the same color as that of Mr. Fulham. The upper and lower jaw were preserved for further identification of the teeth, if necessary. The body was in a peculiar condition of decomposition, there was no skin or subcutaneous tissue left, a piece of white cloth adhered to the face, but all the soft parts and eyes were gone leaving the bones bare. The hair lay in a mass at the head of the coffin with some attached to the back of the head. There was a quantity of light colored hair round the pubis. The muscles were very

well preserved and of a dark red color. The parieties were intact. On opening the chest the heart was found in a comparatively good state of preservation ; the lungs had entirely disappeared. The diaphragm was extremely well preserved and immediately below, there was a mass of an organ in the position of the stomach. The liver was easily distinguishable. The mass of another organ was removed from the position of the spleen and another mass from the position of the left kidney. The intestines were well preserved but it was impossible to separate the small from the large intestines. There was no sign of the urinary bladder.

The following were sent to the Chemical Examiner :—

(1) Earth taken from above the coffin.
(2) Earth taken from below the coffin.
(3) Earth taken from within the coffin.
(4) Hair from head.
(5) Hair from pubis.
(6) Heart.
(7) Stomach.
(8) Liver, spleen and left kidney.
(9) Intestines.
(10) Two femurs.

Articles upto 9 were packed in standard pattern boxes and article 10 was packed in a big glass jar.

All the regulations for the despatch of articles to the Chemical Examiner were complied with, with the exception that* no preservative fluid was used and the viscera were taken direct from the body and placed in tightly fitting stoppered bottles which were specially prepared. As an additional precaution glass stoppers were covered with Chamois leather. The *post-mortem* was finished at 3-45 P. M., and all the boxes were sealed by 4-25 P. M. The boxes were taken by Dr. Modi himself to the Chemical Examiner and were acknowledged to have been received by that officer at 5 P. M.

*** Lieut.-Colonel O'Meara did not add preservative in this case (1) because the viscera were so fully decomposed that no further rapid decomposition could occur and (2) because he was able to send them direct to the Chemical Examiner's Office. In all cases in which these conditions do not exist preservative should be added.**

CHAPTER V.

EXAMINATION OF BLOOD AND SEMINAL STAINS, AND OF HAIR.

The stains that have usually to be determined in medico-legal practice are those of blood and semen.

BLOOD-STAINS.

These may be found on the body or the clothing of the suspected assailant or on the person or the clothes of the victim, as well as, on weapons, mud, stone, leather, or any piece of furniture.

When any articles requiring medical examination are brought by the police, it is the first duty of the medical officer to see that the articles tally with the description supplied by the police. If the description is not given, he should, while writing his report, describe very minutely all the features of the articles, *e.g.*, the size, color and consistence of the clothing, as well as the number and situation of the stains present. After completing the examination, he should label each article separately, and pack them in a sealed packet to be handed over to the police constable from whom a receipt should be obtained. This precaution is necessary so as to enable him to identify them subsequently in Court.

The points that are usually required of the medical jurist to determine regarding the stains on an article sent for examination in cases of alleged wounds, rape and unnatural offences are—

1. If the stains are due to blood or any other substance.
2. If they are due to human blood.

Examination of Blood-stains.—The examination of blood-stains may be carried out by five methods—*Physical*, *Chemical*, *Microscopical*, *Spectroscopical*, and *Biological*.

Physical Examination.—It is said that the physical examination is conducted with a view to determine the age of the stain and to ascertain whether the stain is arterial, venous or menstrual, whether it is from an assailant or victim, and whether it was shed before or after death.

The blood-stains can be easily determined from their naked eye appearances, if recently effused and spread over a large surface, but a difficulty arises when they are small and old or on a colored and fouled fabric. In that case they should be examined with the aid of a magnifying lens.

It is very difficult for a medical man, even if of much experience, to offer an opinion as to the age of blood-stains. It is a fact that medical men in India do sometimes make far too definite statements in this matter. A young inexperienced doctor is apt to make such a statement under the impression that the court would think him a fool if he did not give a definite opinion as regards the age of a stain, but he should remember that it is practically impossible to say more than that the stains are fresh or not fresh.

The appearances of the stain as to whether they are fresh or not depend on the color and nature of the material. Recent stains on a white cloth are red in color but, owing to the formation of methæmoglobin, become reddish brown in less than twenty-four hours, specially in warm weather. Recent stains on dark colored materials are more visible in artificial light than in daylight. Old and dry stains have a starchy feel on cloth composed of a thin fabric, such as, cotton, silk, or linen ; but they mat together the fibres of woollen articles, which have usually a thick fabric.

Stains of recently effused blood on a hard substance, such as iron, steel or a stone, have a dark shining appearance ; while

dry and old ones have often a cracked or fissured look. Recent stains are also more soluble in water than old ones in which hæmoglobin gets converted in hæmatin, which is insoluble. Again blood effused during life, when dry, can be peeled off in scales owing to the presence of fibrin in its coagulum, but is liable to break up into a powder, if shed after death.

It is not at all essential from a medico-legal point of view to find out whether the blood effused is arterial or venous, as it rarely happens for an artery or a vein to be cut singly in wounds. The recently arterial blood is bright red in color ; while the venous blood is dark red, but assumes a bright red hue when exposed to air for some time ; besides the arterial blood is seen in the form of jets or sprays, which have an appearance of elongated, pear-shaped marks which may be compared to the signs of exclamation.

The jets may be projected to a distance of three to four feet, if effused from a large artery. Arterial blood is always shed during life, as blood-pressure in arteries falls to zero after death.

It is not possible to say from the appearances of stains, whether they are of menstrual blood ; however, it is well to remember that menstrual blood is very often acid in reaction owing to the presence of vaginal secretion and may, during the first two days, show under the microscope, squamous epithelium from the vagina, and occasionally columnar cells from the uterus. It must be noted here that failure to find such things may be due to many adventitious causes such as want of experience in the observer or decomposition, but such failure is no proof that the blood is not menstrual. It is not correct to suppose that menstrual blood does not clot. Similarly it is not possible to recognise a child's blood. At birth it forms a thinner and softer clot and some of the red corpuscles may be found neucleated.

That the blood-stains belong to an assailant or a victim can

be determined only from circumstantial evidence by examining an article of clothing. If the stains are on the inner side of a garment, it is very probable that it belongs to a victim but, if on the outside, they may belong to the assailant, but not necessarily so, as the stains would be found on the outside of a garment worn by a man who receives a blow on the head, while standing. Again the assailant may not show any stains of blood, if he is so standing as to avoid splashing from the outflow of blood, while inflicting an injury. Besides, he may have changed the clothes or may have washed them, but the stains are always visible though faintly, if washing is done hurriedly or carelessly. They are more easily washed in cold water than in warm water.

In this connection it may be mentioned that the accused person may, in defence, attribute the presence of a few blood stains on his garment to the stains left by the crushing of blood-sucking insects, such as, mosquitoes, bugs and fleas, which is not an uncommon occurrence in India. Similarly an investigating police officer may mistake the insect-stains caused by the splashing of the cow's tail on the wall of a cow-shed for human blood-stains and may suspect murder where there is none. Owing to the similarity in their appearances it is not possible to distinguish them with the naked eye. It has been suggested that portions of the insects, as well as their eggs are often found in insect-stains, if seen under the microscope; but this view has not been confirmed by the investigations of Colonel Sutherland I. M. S., who urges further observations on this point.

Chemical Examination.—There are so many pitfalls in chemically testing for blood by one who is not experienced that the undermentioned test should only be used when an immediate answer is required and that in all other cases the stained articles should be sent to the Chemical Examiner.

Guiacum Test (Van Deen's or Day's Test).—

The usual procedure for the application of this test is to moisten a piece of a white blotting or filter paper and press it with gentle rubbing on a small portion of the whole stain. After a little while, the paper acquires a brownish stain which, on the addition of a drop of a freshly prepared tincture of guiacum, assumes a cherry-red color which, in turn, becomes saphire blue within half a minute of the addition of a drop of old turpentine, ozonic ether or an aqueous solution of hydrogen peroxide. This is a very delicate test revealing the presence of fresh blood in a solution of 1 : 5,000 or 1 : 6,000, but very old stains may not give any reaction, though hæmatin readily responds to it. It is valuable as a negative test, for, if the stain does not respond, it is probably not blood. However Colonel Sutherland is of opinion that the test has very little value medico-legally seeing that it produces the same reaction with saliva, sweat, bile, milk, gluten and sodium chloride.

Microscopic Examination.—Several solvents have been recommended to dissolve out the blood-stain for the extraction of red blood corpuscles for the microscopic examination, but the best for this purpose is Vibert's fluid, which is obtained by mixing two grammes of sodium chloride and half a gramme of mercuric chloride in a hundred cubic centimetres of distilled water. A small piece of the stained cloth should be cut out and placed in a watch glass with 2 drops of Vibert's fluid to be soaked for half an hour. It should then be teased out and examined under high power.

If a piece of wood is sent for examination, a thin piece should be sliced off with a clean sharp knife and suspended in the solvent for some hours unless the wood happens to contain tannic acid, when a two per cent. solution of hydrochloric acid should be used. The same procedure should be adopted in the case of leather.

In the case of stains on weapons, stone, plaster, mud, or earth, they should be scraped with a knife, and dissolved in

a watch glass or test-tube. In investigating blood stains on a knife it very often happens that there may not be any stains on the blade or the handle but only on the joint. It is, therefore, necessary in such a case to remove the pivots and examine the joint.

A drop of the solution thus obtained placed on a slide and viewed under the high power of the microscope may reveal the presence of red blood corpuscles or erythrocytes which are circular, biconcave, non-neucleated discs in the case of all mammalia except in camels, in whom the red corpuscles are oval and biconvex. They are oval, biconvex and neucleated in birds, reptiles, amphibia and fishes.

These corpuscles are detected by one with considerable experience in microscopic work, and that too only when the stain is quite fresh, say, about twenty-four hours old, and when a small fragment of a clot is available. In old stains the corpuscles become disintegrated, irregular and much shrunken in appearance and are, therefore, unrecognisable. Again it is not easy to find them by any means in blood stains dried during the hot weather in India.

Hæmin Crystals.—A small crystal of sodium chloride and a few drops of glacial acetic acid placed on a minute fragment of the stain, or added to a drop of the solution of the stain, on a glass slide and evaporated to dryness, will show under the high power of the microscope dark brown or yellowish red rhombic crystals of hæmin or hæmatin hydrochloride, if blood is present. These crystals are known as *Teichmann's crystals.* Similar crystals may be obtained from indigo-dyed fabrics without the presence of blood. Hence in a case of doubt a drop of hydrogen peroxide should be added to the crystals which, if of hæmatin, will give off the bubbles of oxygen gas. This test is very good but tricky, and is not always successful.

Spectroscopic Examination.—The spectroscopic

examination is the most delicate and reliable for determining the presence of blood in both recent and old stains, and is always employed by chemical examiners.

A recent blood stain gives a solution of *oxyhaemoglobin* which, when examined by means of a spectroscope, shows two absorption bands between Frauenhofer's lines D and E in the yellow-green in the solar spectrum. In an old stain oxyhæmoglobin gets converted into *methaemoglobin* owing to its exposure to air. Its spectrum shows one band in the red orange between lines C and D, and two thinner and fainter bands between D and E.

If a portion of the stain be moistened with a drop of a ten per cent. solution of potassium cyanide, treated with ammonium sulphide and then examined on a glass slide under low power, a cherry red colour due to the formation of *cyanhaemochromogen* will be seen if it is due to blood. If the same is seen by the aid of a microspectroscope, two characteristic bands of cyanhæmochromogen but nearer the red will be visible. This is a most delicate test and should always be employed. Dr. Hankin has elaborated the technique for this test which does away with the use of the microspectroscope.

In India these spectra are quite enough. It is unnecessary to examine any more spectra of acid or alkaline hæmatin, hæmatoporphyrin, etc.

Biological Examination.—This is helpful in ascertaining whether a particular stain is from human blood or not.

Precipitin Test.—This test is based on the principle that a substance of an albuminous nature, when inoculated into the blood of an animal, produces antibodies in the blood serum of that animal, which will cause a precipitate with the substance introduced. The organic substance thus introduced is called the *antigen* and the antibody capable of forming a precipitate is called *precipitin.* In 1901 Uhlenhuth

made use of this fact in detecting human blood, but its applicability to Indian conditions is due to the researches of Colonel Sutherland I. M. S., Imperial Serelogist, India.

Thus it will be seen that the antiserum obtained from a fowl or rabbit previously inoculated subcutaneously or into its peritoneal cavity or venous system with defibrinated human blood causes a precipitate with a solution of human blood and no other.

This test has to be applied after the stain has been proved to be of blood inasmuch as, the antiserum will give reaction with other albuminous substances, such as mucus, pus, semen and milk. The reaction should be completed within twenty minutes.

Blood stains which have been washed or mixed with mercuric chloride (1 in 1,000), potassium permanganate, calcium chloride, copper sulphate, iron sulphate, zinc chloride and sodium bisulphide will not react to this test, but old and putrefied stains, or stains mixed with mud or earth often respond very well to it.

The precipitin test is ample for forensic cases in which it has to be determined whether the blood stains are due to human blood or not; but one, who is not very conversant with the technique of the test and has not a well-equipped laboratory at one's command is not justified in trying it and giving a decisive opinion. It is, therefore, essential that in such cases the medical jurist should only reply that the suspected stain appears to be like that of blood and should request the police or Court to send it to the Imperial Serologist, Calcutta, if it is required to find out whether the stain is of human blood. (Vide Appendix V.)

The following tests, though they are not likely to be used in India, have been mentioned below as they have been described in most of the text-books.

Deutch's Hæmolytic Test.—This is based on the theory that the

blood of an animal produces hæmolytic action when injected into the circulation of another, which is not of the same species. The test is carried out by injecting defibrinated human blood into the circulation of a rabbit at short intervals until its serum shows hæmolytic power. The serum obtained from a rabbit so treated is mixed with an extract of the suspected stain. If the union of the two results in hæmolysis of the erythrocytes, it is inferred that the stain is of human blood.

This test is only possible when red corpuscles are entire and unbroken ; and hence it is valuable only for very fresh stains, which is a rarity in medico-legal practice.

Complement-Fixation Test.—This is applied on the principle that the serum of an animal receiving injections of washed erythrocytes of another species develops in time the power of rapidly dissolving the erythrocytes of that other species, if they are brought in contact with the serum in a test-tube. This test can only be relied on as corroborative evidence. Professor Powell of Bombay has lately carried out this test satisfactorily.

Anaphylaxis Test.—This is based on the fact that when some albumen is injected subcutaneously or into the circulation of an animal, such as a guinea-pig, that animal becomes hypersensitive to this albumen. The test is applied in the following manner :—

The suspected stain is dissolved into a normal salt solution and is then divided into seven equal parts. Each of the six parts is injected into the peritoneal cavity of six guinea-pigs previously sensitized with injections of 1/100 c. c. of serum of horse, sheep, dog, cat, pig, and man, and the seventh part is injected into an untreated guinea-pig. If, owing to shock, there is no change in the fall of the temperature of any of the guinea-pigs except one previously treated with human serum, it is presumed that the stain is of human blood.

SUBSTANCES RESEMBLING BLOOD-STAINS.

Substances, which resemble blood-stains are rust-stains on iron or steel weapons, and on linen, and stains from fruits, vegetable, and mineral or aniline dyes.

Rust-stains.—Rust-stains on knives and steel weapons often look like dried blood-stains, but they seldom have a dark and glazed appearance and do not fall off in scales, when

the other side of the blade is heated. Similarly rust-stains on linen (iron-moulds) may present an appearance like old dried blood-stains, but these stains do not stiffen the cloth or make it glossy. Rust-stains are insoluble in water, and are usually blackened by ammonium sulphide. Again a beautiful port wine colour is obtained on adding sulpho-cyanide of potassium after (ferrous) iron has been reduced to the ferric state on the addition of nitric acid.

Fruit-stains.—Fruit-stains on clothing, which resemble blood are very often produced from mulberry, currants, gooseberries, jams, etc. ; they are changed to a greenish color on the addition of ammonia and are bleached by chlorine water, which has practically no effect on blood. Knives, which are used to cut acid fruits, not unfrequently, present stains having a strong resemblance to blood stains. These stains are due to the formation of *citrate* and *malate of iron*, which is soluble in water, and give rise to Prussian blue, if a drop of hydrochloric acid and potassium ferrocyanide solution be added. They do not react to guiacum test, and do not show red-blood corpuscles under the microscope, but present vegetable cells and detritus.

Vegetable Stains.—These are produced by henna, catechu contained in betel-leaves *(pan)*, madder, tobacco and the barks of some trees, such as, *babool.* Most of these contain tannin, which will blacken the solution of the stain, if a drop of tincture of ferri perchloride is added to it. The addition of ammonia will change the color to green, crimson or bluish black, and dilute mineral acids will heighten the original color ; while chlorine water will bleach it. If viewed with the spectroscope no bands are seen as in blood stains.

Mineral Stains.—These are mostly due to the oxide or some salt of iron or lead. After dissolving with hydrochloric acid, the solution may be tested for iron or lead.

Aniline Stains.—These are produced by certain aniline

dyes and resemble blood stains. They are changed to a yellow color, when treated with nitric acid, while blood pigment is not visibly affected.

Spots of grease, tar and pitch, especially when on dark fabrics, may resemble blood. They are insoluble in water or in acids, but dissolve in naphtha, turpentine, or xylol. When a clean white filter paper is pressed on any of these spots with a hot iron, the paper absorbs the material and is stained.

SEMINAL STAINS.

The question of detecting seminal stains arises in cases of rape or unnatural offence. They may be found on the person of an individual, on the articles of clothing, or on muddy or stony ground. They may also be found mixed with mucus, urine, pus or fæces.

Examination of Seminal Stains.—The examination of seminal stains may be carried out by the following methods :—

1. Physical.
2. Microscopical.
3. Chemical.
4. Biological.

Physical Examination.—The semen when fresh is a viscid albuminous fluid of pale whitish or yellowish color, possessing a peculiar odour, and containing spermatozoa. Soon after secretion it coagulates on account of fibrin contained in its fluid portion. Stains made by it have a greyish white or faint yellow color which changes to deep yellow or fawn, when held near a flame. But many other stains have the same characters. In fact seminal stains, when once dried, have no reliable distinctive characters, when looked at by the naked eye. Hence it is most important for the medical man or the police when taking off the accused's *dhoti* or other clothing to

mark the part liable to have come into contact with the issuing semen.

Microscopic Examination.—The chief purpose of examining the stain under the microscope is to detect the presence of spermatozoa. The fresh specimen of semen is diluted in a salt solution and examined with high power after a thin layer of the solution is placed on a slide under a cover-glass. A drop of mucus from the vagina can be taken and placed directly on a slide to ascertain whether spermatozoa are present or not. Several solvents, such as, a solution of hydrochloric acid 1 in 40, or glycerine ten per cent., have been suggested for obtaining suspensions of spermatozoa from dried stains on fabric, but they are all useless under practical conditions. To suit the climatic conditions of Upper India Dr. Hankin has elaborated a method for detecting seminal stains. He first of all boils the stained fabric in a tannin solution before he dissolves it in a solution of potassium cyanide so as to render the spermatozoa capable of removal. The fabric is then placed on the slide, teased and stained with carbol fuchsin, when it is examined with a medium power lens.

The following are the various steps of the process.

(1) "Cut out the suspected stains from the articles of clothing, etc. The cut-out pieces should be about a centimetre square. In the case of *dhoties*, the chances of success in detection are greatly increased if the supposed seminal stains have been marked by the police at the time of taking off the garment.

(2) Place the cut-out stains in a test-tube, and label the latter.

(3) Add sufficient acid tannin solution to cover the stains. This solution contains tannin 0.5 per cent., and sulphuric acid 0.2 per cent.

(4) Place the test-tube in a small beaker of boiling water. Keep it in the boiling water for exactly five minutes. In timing the different stages of this test, it is convenient to place a watch on the table and to make a mark on its glass with a glass pencil.

(5) Take the stains out of the test-tube. A piece of wire bent at the end to a small hook is convenient for the purpose. If the liquid

in the test-tube remains transparent on cooling, it may safely be concluded that the stains are not seminal. If, as is more usually the case, the liquid becomes turbid on cooling, the stains may either be seminal or due to some other kind of organic matter.

(6) Place the stains on a piece of clean filter paper to remove superfluous moisture. Fresh and clean filter paper must always be used. It is not advisable to keep a large piece of blotting paper on the table and to use it for different articles.

(7) Place the stains for half a minute in glycerine ammonia solution. This solution contains glycerine 5 per cent., and strong ammonia solution $\frac{1}{4}$ per cent. The object of this treatment is to remove or neutralize the excess of tannin solution. If this is not done the stained specimens will contain too much colored background.

(8) Remove the stains and put them on filter paper.

(9) Transfer the stains to a small glass dish containing acid bichromate solution. Leave them in this solution for five minutes. This solution should contain one per thousand of potassium bichromate and two per thousand of sulphuric acid. This solution does not keep well, especially at a high temperature. Therefore, in the hot weather, it is advisable that it should be freshly made up. The action of the bichromate solution is to make the spermatozoa stain deeply when they are afterwards treated with carbol fuchsin.

(10) Place the stains on filter paper till superfluous liquid drains off.

(11) Transfer the stains to a solution of 2 per cent. potassium cyanide. The action of this solution is to loosen the spermatozoa. If the action continues too long the spermatozoa may be dissolved.

(12) Take out the stains after the lapse of three minutes. Mop off the excess of cyanide solution with blotting paper. Place the stains in a glass dish containing distilled water.

(13) Place each stain separately on a slide. Mop off excess of water. Hold the stained fabric at one end with a pair of forceps, and scrape the surface with a knife. Sufficient water should be left to form a drop in which the scrapings are suspended. This drop is spread out on the slide. This treatment does not readily break up the spermatozoa. If the heads are found separate from the tails, this is because decomposition had commenced before the stain had dried.

(14) The slides, immediately after preparation, are dried preferably in a current of air while lying on the top of a water bath. This rapid drying is convenient but not indispensable.

(15) The films on the slides are fixed by pouring over them a mixture of equal parts of alcohol and ether.

(16) The films are stained by means of carbol fuchsin, which is allowed to act for five minutes at air temperature. For this and the preceding stages it is convenient for several slides to be held at the same time in a special clip, so that they can be treated together.

(17) The slides are well washed with water. They are then washed for a few seconds with rectified spirit. The spirit is immediately and rapidly mopped off with filter paper, and the slide is at once dried.

(18) The slides are examined with a medium power lens (e. g. 3 millimetres). The spermatozoa should be readily visible, both the heads and the tails being stained, and, as a rule, stained deeply."

The human spermatozoa are minute filamentous bodies varying from $\frac{1}{800}$th to $\frac{1}{1,000}$th of an inch in length, and consisting of a head, a middle piece or body and a tail. The head is oval and flattened, or, in some cases pointed, having a length of $\frac{1}{9,000}$th of an inch, and a breadth of $\frac{1}{10,000}$th of an inch. The middle piece or body has about the same length as the head and is traversed by an axial filament and a spiral fibril wound round the sheath of the axial filament. The tail has a length varying from $\frac{1}{5,000}$th to $\frac{1}{4,000}$th of an inch tapering to a point at its end and has a vibratile ciliary motion which gives spermatozoa their mobile power. Spermatozoa retain their activity in the alkaline mucus of the vagina and cervix for seven to fourteen days after emission. They lose their activity in the mediums of acids, strong alkalies, metallic salts, alcohol and chloroform, or when heated above 50°C ; but they retain their form for a long time and can, therefore, be identified in stains of five to eighteen years' standing, if they have not undergone decomposition which renders the spermatozoa unrecognizable. Decomposition occurs in less than twenty-four hours at temperatures obtaining in India. Hence it is necessary to dry the clothes suspected to bear seminal stains at air temperature, before they are wrapped up and sent for medical examination.

To give a definite opinion it is necessary that one or two entire spermatozoa must be detected. One must not rely on a detached piece of the head or tail.

The spermatozoa can scarcely be mistaken for an organism called *Trichomonas Vaginæ* found in the vaginal mucus. This has a globular head, much larger than the head of the spermatozoa, with one or more flagellums and a granular interior, but has a shorter tail.

The presence of spermatozoa in the suspected stain is a positive indication of it being due to semen, but their absence is not a negative proof, inasmuch as they are not found in the semen of very young boys and old men. They may also be absent from the semen of young men suffering from chronic disease, such as epididymitis, or from exhaustion owing to excessive sexual intercourse or onanism.

Chemical Examination.—The solution of a seminal stain is treated with a mixture containing iodine 2.54 parts, potassium iodide 1.65 parts, and distilled water 30 parts. A drop of this mixture is placed on a slide, and examined under the microscope, when dark brown rhombic crystals of iodo-spermin similar to hæmin crystals are found ; these are soluble in water, alcohol, acids, and alkalies. This test is known as *Florence's test*, as it was first introduced by Dr. Florence of Lyons. He regarded this as a specific test for human semen, but his opinion has not been upheld by others.

Biological Examination.—The precipitin test as proposed by Dr. Farnum is applied in the same way as in blood examination. The *antigen* used is semen or testicular emulsion ; five to ten c.c. of this is injected into the peritoneal cavity of a rabbit from five to eight times at intervals of six to eight days. The serum of this rabbit's blood gives a precipitate only with human semen.

HAIR.

The detection of hairs upon weapons, blood-stains, or upon the clothing or person of the assailant or victim forms not unfrequently a very important chain in the evidence of cases of alleged assault, murder, rape, and unnatural offences. The examination of the hair also becomes very necessary in identification, particularly, when, unknown bodies or fragmentary remains have been sent for medical inspection.

While examining hairs the following points have to be determined.

1. The nature of hairs.
2. The source of hairs.
3. The character of hairs showing the manner of extraction.

1. **The Nature of Hairs.**—Human hairs have to be distinguished from those of lower animals, as also from fibres of cotton, linen, silk and wool. For this purpose hairs should be washed in water, alcohol, ether and oil of cloves successively, and mounted in Canada balsam, and then should be examined under the microscope.

Under the microscope the human hair is seen covered with a thin cortical layer of very fine imbricated scales, and a medullary portion of different shades of colour, and frequently containing a narrow axial band of spheroidal cells.

Distinction between human and lower animal Hairs.—To distinguish between the hairs of human beings and those of lower animals the microscopic features represented by the cuticle, medulla and cortex should be observed.

In animal hairs the imbricated scales of the cuticle are very large, and marked with step-like or wavy projections. The medulla of the human hair is narrow and in some cases absent ; while in animals the medulla is often conspicuous

and, when seen under low power, is found to contain round or oval, and prominent cuboidal epithelial cells. The cortex forms the bulk of the shaft in the human hair, and is, as a rule, four to ten times as broad as the medulla ; while in the lower animals the cortex is rarely more than twice as broad as the medulla, and often presents only a thin shell enclosing the medullary cells.

Before giving a decisive opinion it is advisable to compare under the microscope the specimen of the hair sent for medical examination with a sample taken from the same part of the individual or animal from where it is alleged to have been derived.

Fibres.—Cotton fibres are flattened bands having spiral twists. Linen fibres are round and transparent, and possess jointed markings at unequal distances. Silk fibres are cylindrical, and have no markings on the surface. They refract light powerfully, and hence exhibit well-defined boundary lines.

2. **The Source of Hairs.**—In order to ascertain whether the hairs sent belong to the assailant or victim, it is necessary to determine the source from which they have been derived. This can be done mostly from observing their length, thickness, and form.

The hair from the female head is thinner and much longer than that of the male head. Hairs of the beard and moustache are very thick. Some men do allow the hair of the head and beard to grow, but they are seldom found longer than twelve inches. The hairs of the pubis, axillae and chest are stouter, curly, and one to three inches in length. The hairs of the pubis and axillae also show split ends. The hairs of the eyebrows, eye-lashes and nostrils taper to a point and are $\frac{1}{4}$ to $\frac{1}{8}$ inch long. Hairs of the body surface are generally fine, short, and do not have medulla, nor pigment cells.

3. **The Character of Hairs showing the manner of Extraction.**—When examined under the microscope the hairs cut by sharp weapons will not show the roots, and the cut ends will exhibit a more or less regular section. Recently cut hairs show a sharply cut edge with projecting cuticle and a few loose fibres. After a week the end becomes square, smooth, and rounded, but blunt. After three to four months the end becomes elongated, but not similar to the original uncut end, and the medulla is always absent from such ends.

The roots should be examined to determine whether a hair has fallen out, or pulled forcibly. The root of a hair that has fallen out spontaneously is round and solid, but atrophic, while the root of a hair that has been extracted forcibly, has a hollow, concave surface, which covered the papilla of the corium.

CHAPTER VI.

DEATH IN ITS MEDICO-LEGAL ASPECT.

Definition.—Death is classified as *somatic* or *systemic* and *molecular*. *Somatic* death is that state of the body in which there is a complete cessation of the functions of the heart, lungs, and brain, which maintain life and health, and are, therefore, called "the tripod of life". *Molecular* death means the death of the tissues and cells individually, which takes place some time after the stoppage of the vital functions, and is accompanied by cooling of the body, whose temperature is reduced to an equilibrium with the external world.

MODES OF DEATH.

In all kinds of death, whether natural or accidental, there are three primary modes of death ; viz.,

1. Syncope.
2. Asphyxia.
3. Coma.

SYNCOPE.

In this, death occurs from the stoppage of the heart's action, the causes of which are as follow :—

1. Anæmia due to sudden and excessive hæmorrhage from wounds of the large bloodvessels, or of internal organs, such as, lungs, spleen, etc., or bursting of an aneurysm or a varicose vein.

2. Asthenia from deficient power of the heart muscle as in a fatty degeneration of the heart, aortic regurgitation and certain poisons.

3. Shock inhibiting the action of the heart from sudden fright, blows on the head or on the epigastrium, drinking a large quantity of cold water when in a heated condition, extensive injuries to the spine or other parts of the body, or from the sudden evacuation of fluids from the body.

4. Exhausting diseases.

Symptoms.—These are pallor of the face and the lips, dimness of vision, dilated pupils, cold perspirations, feeling of sinking and impending death, great restlessness, air hunger, noises in the ears, gasping respirations, nausea and possibly vomiting. The pulse is slow, weak and fluttering in anæmia, and rapid in asthenia. Slight delirium, insensibility and convulsions precede death. In collapse the patient retains consciousness, though the condition is attended by failure of the heart's action.

Post-mortem Appearances.—The heart is contracted and the chambers are empty, when death has occurred from anæmia, but both the chambers are found to contain blood in the case of death resulting from asthenia. The lungs, the brain and the abdonimal organs are usually found pale.

ASPHYXIA.

Death is said to have taken place from asphyxia, when the respiratory function stops, before the heart ceases to act.

Causes.—1. Mechanical obstruction to the air passages, e.g., foreign bodies, exudations, tumours, suffocation and drowning by blocking their lumen from within; strangulation and hanging by their compression from without; and spasm of the glottis from mechanical irritation and irritant gases.

2. Absence of sufficient oxygen, as in high altitudes or the presence of inert gases in the atmosphere.

3. Stoppage of movements of the chest resulting from the exhaustion of the respiratory muscles due to cold or debility ; paralysis of the respiratory muscles from disease or injury of the medulla or phrenic or pneumogastric nerves, mechanical pressure on the chest or the abdomen, and tonic spasm due to tetanus or strychnia poisoning.

4. Collapse of the lungs from penetrating wounds of the thorax, and diseases, such as, pleurisy with effusion, empyema, or pneumothorax.

5. Non-entrance of blood into the lungs, as in embolism plugging the pulmonary artery.

Symptoms.—These are divided into three stages: (1) The stage of exaggerated breathing, (2) the stage of convulsions, and (3) the stage of exhaustion.

In the first stage the face bears an anxious look, and the patient complains of heaviness in the head and ringing in the ears. The lips are livid, the eyes are prominent, and respirations are deep, hurried and laboured, the extraordinary muscles of respirations being called into play.

In the second stage the expiratory muscles of respiration become more active with spasmodic movements, which are followed by convulsions of nearly all the muscles of the body. At the same time there is a relaxation of the sphincters.

In the third stage the respiratory centres are paralysed. The muscles become flaccid, there is insensibility, the reflexes are lost, and the pupils are widely dilated. Prolonged sighing inspirations occur at longer and longer intervals until they cease altogether, and death ensues. The pulse is scarcely perceptible, but the heart may continue to beat for some seconds after respirations have quite ceased.

The three stages last for about five minutes before death takes place.

Post-Mortem Appearances.—External.—The face is either calm and pale in slow asphyxia, or distorted, congested and blue in cases of sudden asphyxia. The lips and nails are livid. Cadaveric lividity is more marked. The tongue is protruded in most cases, and frothy and bloody mucus comes from the mouth and nostrils. Rigor mortis is slow to commence, but may be rapid in some cases.

Internal.—The mucous membrane of the trachea and larynx is cinnabar red due to its injection and contains froth. The lungs are dark and purple in color, and gorged with dark venous blood ; on being cut they exude frothy dark fluid blood. The air-cells are distended or even ruptured due to emphysema. The right cavity of the heart is full, containing dark-colored, imperfectly clotted blood, and so are the pulmonary artery and the venæ cavæ. The left cavity, the aorta and the pulmonary veins are empty. In many cases, both sides of the heart are found full, if examined soon after death, but, after rigor mortis has set in, the heart is found contracted and empty, or the tension in the abdomen presses on the inferior vena cava, and drives blood up into the heart. Similarly the lungs are found heavier with blood collected in the dependant parts, if examined some time after death ; or the tension in the abdomen or contraction of the heart muscle will drive more blood into the lungs, irrespective of the cause of death.

The brain and the abdominal organs are found congested. Numerous small petechial hæmorrhages or ecchymoses, known as, *Tardieu's spots*, are seen under the serous membranes of various organs due to the rupture of the capillaries caused by the intramuscular pressure. These are usually round, dark and well-defined varying in size from a pin's head to a small lentil. They are found under the pleuræ, pericardium, thymus, meninges of the brain and cord, conjunctivæ, and even under the skin of the face and neck. They are sometimes seen in deaths occurring from scurvy or purpura.

COMA.

It means insensibility resulting in death from some cause preventing the action of the brain.

Causes.—1. Compression of the brain resulting from injuries or diseases of the brain or its membranes, such as concussion, effusion of blood on, or in, the brain substance due to depressed fractures of skull bones, inflammation, abscess or new growth of the brain, or embolism and thrombosis.

2. Poisons having specific action on the brain and nervous system, such as, opium, alcohol, ptomaines, carbolic acid, etc.

3. Poisons acting on the brain after they are generated in the body in certain diseases of the liver and kidneys, *e.g.* cholæmia, acetonæmia, uræmia, etc.

Symptoms.—First of all there is a condition of stupor from which the patient may be roused temporarily for a few seconds or more. In this condition the reflexes are usually present, or are exaggerated, and the patient may be able to swallow fluids. It is followed by complete unconsciousness from which the patient cannot be roused. In some cases sudden insensibility supervenes without an initial stage of stupor. During the comatose condition the reflexes are lost, the sphincters are relaxed, and the pupils are dilated or contracted, and insensible to light. The skin is generally covered with cold perspiration, and the temperature is subnormal or normal except in the lesions of Pons Varolii, when it is high. The pulse is usually full and bounding, but slow. The breathing is slow, irregular and stertorous. Mucus collecting in the air passages causes the sound which is known as "the death rattle".

Post-Mortem Appearances.—Injuries of the skull bones or of the brain and consequent effusion of blood into the cranial cavity may be present. The brain and its membranes are found congested. Hæmorrhages within the cranium due to disease are found within the membranes

or in the brain substance, but, when due to injury, are commonly found in clots between the skull bones and the membranes, or on the surface of the brain. The right side of the heart is usually full and the left empty. The lungs and the venous system are gorged with blood, but not so much as in asphyxia.

SUDDEN DEATH

Sudden or unexpected death occurs from unnatural causes, such as violence or poison, as well as, from natural causes. Unnatural deaths have always to be investigated by the police, but, very often, natural deaths form the basis of medico-legal investigations, if they have occurred suddenly and under suspicious circumstances. In such cases medical men should not certify to the cause of death without holding a *post-mortem* examination even if there is a strong evidence of disease.

Causes.—The natural causes producing sudden death are :—

1. Diseases of the heart, especially fatty degeneration, angina pectoris, aortic regurgitation, rupture of the heart or of its valves, and diseases of the pericardium.

2. Diseases of the blood-vessels, especially, arterio-selerosis, thrombosis, embolism and rupture of aneurysms or variocose veins.

3. Cerebral and cerebellar apoplexy caused by bursting of intracranial aneurysms even in children and young persons. Chronic alcoholism and syphilis largely predispose to this condition.

4. Certain diseases of the respiratory organs producing asphyxia, such as, œdema of the glottis, membranous deposit in the larynx or tachea, or tumour pressing on the trachea, spasm of the vocal cords, air embolism, pneumo-thorax, hæmo-thorax, pleuritic effusion, hæmoptysis in the course of pulmonary tuberculosis, œdema of the lungs, asthma and whooping cough.

5. Rupture of chronic ulcers of the stomach, duodenum, or other parts of the alimentary canal.

6. Hæmorrhage into the peritoneal cavity due to rupture of the uterus or of a sac of extra-uterine gestation, uterine hæmatocele, and ovarian apoplexy.

7. Rupture of the over-distended urinary or gall bladder, enlarged spleen, or some other abdominal viscus.

8. Acute hæmorrhagic pancreatitis.

9. Certain diseases, such as, Addison's disease, diabetes and epilepsy ; laryngismus stridulus and status lymphaticus occurring in young persons usually during the first stage of chloroform inhalation.

10. Nervous influences leaving no *post-mortem* signs ; e. g., vaginal examination, vaginal and uterine douching, passing of a uterine sound, squeezing of the testicles, large quantities of alcohol or water drunk at a time when the body is overheated, mental emotions, shock, and fright.

11. Zymotic diseases, such as, cholera and influenza.

SIGNS OF DEATH.

The signs of death are—

1. Entire and continuous cessation of circulation and respiration.

2. Changes in the eye.

3. Changes in the skin.

4. Cooling of the body.

5. Cadaveric lividity, hypostasis, suggilation or *post-mortem* staining.

6. Cadaveric changes in the muscles.

7. Putrefaction or decomposition.

8. Saponification.

9. Mummification.

I. ENTIRE AND CONTINUOUS CESSATION OF CIRCULATION AND RESPIRATION.

Ordinarily these signs are considered sufficient to determine that death has actually taken place, but these alone should not be relied on as absolute signs to avoid premature burial or cremation, inasmuch as persons like hibernating animals have been known to be resuscitated to life after having remained for some time in a condition, in which the action of the heart and lungs were in abeyance and the muscles stiff and motionless. This state of *suspended animation* lasting from a few seconds to half an hour or more may be found in cases of trance, *yog*, catalepsy, hysteria, as well as in cholera, sunstroke, concussion, drowning, hanging, tetanus, convulsions, chloroform poisoning and the so-called still-born infants.

A careful examination of the heart and lungs with the stethoscope lasting for five minutes, and repeated at short intervals if necessary, will enable an opinion to be formed as to whether the circulatory and respiratory functions have ceased or not. In a case of doubt this may be supplemented by the under-mentioned tests.

The tests to determine the stoppage of circulation are—

a. Magnus's Test.—This consists in tying a ligature round the base of a finger, but not too tightly so as to occlude the arterial circulation. The finger remains white, if circulation has stopped, otherwise it becomes blue and swollen beyond the ligature.

b. Monte Verde's Test.—The subcutaneous injection of ammonia causes a dirty-brown stain indicating dissolution.

c. Cloquet's Needle Test.—A bright needle plunged into the biceps muscle and left there for ten seconds shows on withdrawal no signs of oxidation, if circulation has stopped.

d. Diaphanous Test.—During life the web of the fingers appears red and translucent, if the hand with the fingers abducted is held against a strong light, artificial or natural, while it appears yellow after death. The hand may, however, appear red in carbon monoxide poisoning, and yellow in anæmia or syncope.

e. Icard's Test.—The hypodermic injection of a solution of fluorescin renders the neighbouring skin deep yellow, if circulation is going on, but produces no change, if it has stopped. The solution of fluorescin is obtained by dissolving 1 gramme of resorcin-phthalein, and 1 gramme of sodium bicarbonate in 8 c. c. of water.

f. On the application and withdrawal of pressure to the finger nail, it does not assume alternately a white and pink color as in life.

g. The application of heat to the skin will not produce a true blister with a red line of demarcation, if circulation has stopped.

h. If a small artery is cut, there will be no jerky flow of blood, if circulation has stopped.

The tests to determine the stoppage of respiration are—

a. The surface of a cold bright looking glass held in front of the open mouth and nostrils becomes dim due to the condensation of watery vapour, if respiration is still going on, but not otherwise. This test is useful in cold climates.

b. There will be no movement of a feather held in front of the mouth and nostrils, if respiration has stopped, but this is not a reliable test as the slightest draught of air or nervousness on the part of an observer will move it.

c. Winslow's Test.—There will be no movement of an image formed by reflecting artificial or sun light on the surface of water or mercury contained in a saucer and placed on the chest or abdomen, if respiration has ceased. Similarly water

will not be spilt from a vessel filled to the brim and placed on the chest or abdomen, if respiration has stopped.

2. CHANGES IN THE EYE.

Soon after death the eye loses its lustre. The cornea loses its reflex action and becomes opaque, and looks like dimmed glass. Such a condition may be present before death in uræmia, narcotic poisoning, and cholera, while the cornea may retain its transparency after death caused by hydrocyanic acid, or carbon monoxide poisoning. The pupils are dilated and are insensible to light, but react to atropine or eserine probably for an hour after death, but not longer. The fundus of the eye, if examined with the ophthalmoscope, is seen to have a yellowish-white colour instead of the rosy tint of life.

3. CHANGES IN THE SKIN.

After death the skin of the whole body assumes a pale, and ashy-white appearance, and loses its elasticity; hence the incised wounds will not gape, if caused after death. But the edges of the ulcers and wounds caused during life retain their red or blue color after death, and so do ecchymoses. Further the icteric hue produced in jaundice or phosphorus poisoning, and tattoomarks are not at all affected by this change.

4. COOLING OF THE BODY.

After death the body commences to lose the animal heat and gradually attains the same temperature as that of its surrounding objects. The rate of the lowering in temperature is almost proportional to the difference between that of the body and the surrounding air. The average rate of heat that the body loses in temperate regions is 4°F. during the first

three hours and then about one degree per hour. Thus, the body takes fifteen to twenty hours to reach the temperature of the surrounding air, but much less time in a country like India. However, this period may be influenced by such causes, as, age, condition of the body, manner of death, and surroundings of the body.

Age.—Middle-aged bodies cool more slowly than the bodies of infants and old people.

Condition of the Body.– Fat and well nourished bodies retain heat longer than lean and weakly bodies.

Manner of Death.—Cooling of the body is more rapid in deaths occurring from hæmorrhage, starvation, chronic wasting diseases, and strychnia poisoning than in deaths from acute fever, or when death has occurred suddenly in a previously healthy person; whereas the body keeps warm for a long time, when death has resulted from lightning or suffocation.

Surroundings of the Body.—A dead body cools more slowly when kept in a small room with still air than when kept in a large room with access of cold draughts of air from outside. Similarly a body covered with clothes and lying in bed, or in a cesspool or dung-heap cools less rapidly than a naked body lying on a stone flag; while a body immersed in water, especially in running water, cools more rapidly than when exposed to the air. Cooling is delayed when the temperature of the atmospheric air or water is high.

Post-Mortem Caloricity.—This term is applied to a rise of temperature observed in bodies dying from cholera, small-pox, yellow fever, rheumatism, cerebro-spinal meningitis, liver abscess, peritonitis, Bright's disease, injuries to the nervous system, tetanus, and alcohol and strychnia poisoning. This *post-mortem* rise of temperature is due to the action of micro-organisms in the still living fluids and tissues of the body, and to the chemical changes going on there.

5. CADAVERIC LIVIDITY, HYPOSTASIS, SUGGILATION OR POST-MORTEM STAINING.

This is a discoloration of the skin due to the accumulation of the fluid blood in the capillaries, and small veins of the most dependant parts of the body according to its position, as the body after death like all other inert matter obeys the law of gravitation. If the body is lying on the back, the staining will be seen on the back part of the head, ears, neck, trunk, and extremities, except on those parts, which actually come into contact with the substance on which the body is lying, and which bear its weight. Similarly it is not seen on those parts which have been compressed by tight clothing or tight wrapping of a sheet, but occurs as stripes or bands called *vibices*, which often resemble the marks produced by flogging. Again a white band on the neck produced by a tight collar may look like a mark of strangulation.

Post-mortem staining appears from four to twelve hours after death, and consists of small irregular patches on the skin, having a coppery red or purple color. At first they are single, and scattered on the surface, but later increase in size, and unite together forming a large uniform area of discoloration. These patches will disappear, and new ones will form on the dependant parts on altering the position of the body, if the blood is still fluid, but they will remain permanent, and no more will form, if the position is changed after blood has coagulated.

Rarely hypostatic congestion resembling *post-mortem* lividity may be seen a few hours before death in cases of cholera, plague, uræmia, morphia poisoning, typhus, and asphyxia.

Post-mortem lividity or staining has often been mistaken for a bruise produced by violence during life, and consequently innocent persons have been prosecuted for murder,

but acquitted afterwards, when the charge could not be proved. The following are the points by which they can be differentiated :—

1. *Post-mortem* staining is situated on an extensive area of the most dependant parts of the body, and usually involves the superficial layers of the true skin ; a bruise may occur anywhere on the body, usually takes the shape of the weapon used, is limited in area, and generally affects the deeper tissues.

2. *Post-mortem* staining does not appear elevated above the surface, but has sharply defined edges ; a bruise appears raised above the level of the surface, and its edges are not sharply defined.

3. The color of the *post-mortem* staining is uniform ; it may become green, when the body begins to putrefy ; whereas a bruise exhibits the usual changes of color, especially if a few days old.

4. In the case of *post-mortem* staining there will be no abrasion of the cuticle, but it may be abraded in the case of a bruise.

5. *Post-mortem* staining, on being cut, does not show any effusion of coagulated or liquid blood into the subcutaneous tissues ; a bruise, on the other hand, shows the infiltration of the tissues either with coagulated or liquid blood.

Along with the appearance of the external *post-mortem* staining internal hypostasis also takes place in the dependant portions of the visceral organs except in the heart.

The hypostasis in internal organs, such as the brain, lungs, stomach, kidneys and intestines, has to be distinguished from congestion or inflammation of those organs.

The Difference between Post-mortem Staining and Congestion in an Organ.—The *post-mortem* staining in an organ is irregular, and occurs on a dependant part ; the redness caused by congestion is generally uniform and all

over the organ. The mucous membrane in *post-mortem* staining is dull and lustreless, but not so in congestion.

In *post-mortem staining* inflammatory exudations or constriction will not be seen, and areas of redness alternating with pale areas will be found, if a hollow viscus is stretched out, and held in front of the light.

6 CADAVÊRIC CHANGES IN THE MUSCLES.

After death the muscular tissues of the body pass through three stages : (1) Primary relaxation or flaccidity, (2) Cadaveric rigidity or rigor mortis, (3) Secondary relaxation.

(1) **Primary Relaxation or Flaccidity.**—Soon after death the whole muscular system commences to relax except in those cases, where the muscles have been in a contracted condition before death ; hence we notice that the lower jaw of a dead body falls, the eyelids lose their tension, the extremities become soft and flabby, and the joints are flexible. But the muscles are contractile, and react to external stimuli, mechanical or electrical, owing to their retaining molecular life after somatic death.

This stage lasts from three to seven hours, but the average is three hours. One hour and fifty-one minutes is the average period of duration in Bengal as found by Mackenzie.

(2) **Cadaveric Rigidity or Rigor Mortis.**—This phenomenon comes on immediately after the muscles have lost the power of contractility, and is due probably to the coagulation of myosin in the muscles by the formation of lactic acid, which is no longer removed from the system on account of the molecular death. It is, in no way, connected with the nervous system, and occurs whilst the body is cooling. On account of the setting in of rigor mortis all the muscles of the body become stiff, hard, opaque and contracted, but they do not alter the position of the body or the limb. A

joint rendered stiff and rigid after death, if flexed forcibly by mechanical violence, will remain supple and flaccid, but will not return to its original position after the force is withdrawn ; whereas a joint contracted during life in cases of hysteria or catalepsy will return to the same condition after the force is taken away.

Rigor mortis first appears in the involuntary muscles, and then in the voluntary. In the heart it appears, as a rule, within an hour after death, and may be mistaken for hypertrophy, while its relaxation, for dilatation. The left chambers are affected more than the right. *Post-mortem* delivery may occur owing to the contraction of uterine muscular fibres.

In the voluntary muscles rigor mortis follows a definite course. It first occurs in the muscles of the eyelids, next in the muscles of the back of the neck and lower jaw, then in those of the front of the neck, face, chest and upper extremities, and lastly extends downwards in the muscles of the abdomen and lower extremities. It passes off in the same sequence.

Time of Onset.—This varies greatly in different cases ; but the average period of its onset may be regarded as four to ten hours after death in temperate climates, and it may take two to three hours to develop. In India it usually commences in one to two hours after death, and takes one to two hours to develop.

Duration.—In temperate regions the average period of its duration is twenty-four to forty-eight hours, though it may last several days (nine days according to Casper, and three weeks according to Taylor). In India according to the investigations of Mackenzie the average duration is nineteen hours and twelve minutes, the shortest period being three hours, and the longest forty hours. When rigor mortis sets in early, it passes off quickly, and *vice versa*.

Circumstances modifying the Onset and Duration of Rigor Mortis.—*a. Age.*—Rigor mortis never occurs in the immature fœtus under seven months of intra-uterine life. In healthy adult bodies its occurrence is slow, but well marked, while it is feeble and rapid in the bodies of children and old people.

b. Muscular Condition.—The onset is slower, and the duration longer, in those cases where the muscles have been healthy and at rest before death than in those cases, where muscles have been feeble and exhausted, and thus have lost a greater degree of muscular irritability.

c. Manner of Death.—Rigor mortis sets in early, and disappears soon in the case of deaths causing great exhaustion and wasting of the muscles, as in cholera, plague, typhus, typhoid, phthisis, cancer, uræmia and chronic Bright's disease. Its onset is delayed in deaths occurring from pneumonia, apoplexy, asphyxia and nervous diseases causing paralysis of the muscles. In strychnia poisoning the onset is rapid, but the duration is longer.

d. Atmospheric Conditions.—Rigor mortis commences slowly, but lasts for a long time in dry, cold air ; on the other hand, its commencement is rapid, and duration short, in warm moist air. It comes on rapidly, and disappears late in bodies immersed in cold water.

Heat-Stiffening.—The phenomenon, known as heat-stiffening is observed in the increased stiffness of the muscles in a body exposed to a temperature of 75°C. after rigor mortis has already been fully established. This is due to the coagulation of other albuminates besides myosin, which coagulates ordinarily at a lower temperature, say, 50°C.

Cadaveric Spasm or Instantaneous Rigor Mortis.—This is a phenomenon in which the muscles, that have been in a state of contraction during life, become stiff and rigid immediately after death without passing into an initial

stage of relaxation ; hence the attitude of the body adopted at the time of death is maintained for several hours afterwards. It is due to the fact that the last voluntary muscular contraction of life does not stop after death, but is continuous with an act of cadaveric rigidity and, thus occurs in cases, in which there has been great muscular exertion and mental excitement before death, as observed among soldiers killed on a battle field. It is also found in sudden asphyxial deaths, and in deaths due to the irritation of the medulla. It is quite different from cadaveric rigidity or rigor mortis. In the case of cadaveric spasm, a weapon held in the hand before death is firmly grasped, and can only be removed with difficulty ; whereas in cadaveric rigidity the weapon placed in the hand before rigor mortis has set in is not grasped, but drops down from the hand on the slightest touch, even if it was bandaged in the hand before the onset of rigor mortis.

Medico-legally the condition of cadaveric spasm is very important, inasmuch as the finding of a weapon, hair, pieces of clothing, etc., firmly grasped by the fingers of a dead body may lead to the detection of a case being suicidal or homicidal. However the weapon, as a rule, drops down from the hand of a suicide, unless it is very light, and becomes glued down by the clotting of effused blood.

(3) **Secondary Relaxation.**—With the disappearance of rigor mortis, the muscles become soft and flaccid, but do not respond to a mechanical or electrical stimulus as in the first stage of relaxation. This is probably due to myosin being dissolved by the excessive production of acid during the stage of rigor mortis.

7. PUTREFACTION OR DECOMPOSITION.

This is absolutely a certain sign of death. It is a slow process and effected by the action of ferments produced by

living saprophytic micro-organisms, commonly known as *bacterium termo*, which resolve the complex organised tissues of the body into simpler, inorganic compounds These micro-organisms are both ærobic and anærobic and, during life, are found in large numbers in the alimentary canal but, within a short time after death, are found scattered in all the tissues, organs and even in the blood. Outside the body they are present in the upper layer of the soil up to the depth of one to one-and-a-half feet.

External Phenomena.—It is said that putrefaction follows the disappearance of rigor mortis, but this is not always the case; since in Northern India during the hot months from April to October it commences before rigor mortis has completely passed off from the lower extremities. This fact has been observed by me in a large number of dead bodies in Agra and Lucknow. India being a vast continent, the climatic conditions vary so much in the different parts of the country, that it is impossible to give the exact time when the putrefactive processes develop in a dead body.

The two characteristic features of putrefaction are the *colour changes*, and the *development of foul-smelling gases.*

Colour Changes.—The first external evidence of putrefaction in a body exposed to the air is the formation of greenish discoloration of the abdominal skin over the iliac fossæ. This discoloration is due to the conversion of hæmoglobin of the blood pigment into sulphmethæmoglobin by the action of sulphuretted hydrogen diffusing from the intestine into the tissues, and occurs from one to three days in winter, and six to twelve hours in summer. This patch of green discoloration is more evident on a fair skin than on a dark one. About the same time the eyeball becomes soft and yielding, the cornea white and milky and is either flattened or compressed. Later on the eye collapses and the cornea becomes concave.

From twelve to eighteen hours after death the green coloration spreads over the entire abdomen and the external genitals. Green patches also make their appearance successively on the chest, neck, face, legs and arms. These patches are at first separate and distinct but, later on coalesce together, and the whole skin of the body appears discolored.

Soon after the discoloration of the skin has commenced, the superficial veins, chiefly of the extremities, look very prominent like purplish red or green streaks owing to the decomposed blood setting free the coloring matter of the red blood corpuscles, which stains the walls of the blood vessels and infiltrates into the tissues, which also appear colored. The clotted blood becomes fluid ; hence the position of the *post-mortem* staining is altered, and the fluid blood collects into the serous cavities, such as the pleuræ and pericardium.

Development of Foul-smelling Gases.—Side by side with the appearance of the greenish patch on the abdomen the body begins to emit nauseating and unpleasant smell owing to the gradual development of gases of decomposition, some of which are sulphuretted hydrogen, marsh gas, carbon dioxide, ammonia and phosphoretted hydrogen.

From twelve to eighteen hours after death these gases collect in the intestine ; consequently the abdomen swells up, and a quantity of frothy blood is forced from the mouth and nostrils. The stomach contents may also escape from the mouth and nostrils. The sphincters relax, and the urine and fæces escape.

From eighteen to thirty-six or forty-eight hours after death the gases collect in the tissues, cavities and hollow viscera under considerable pressure with the result that the features become bloated and distorted, the eyes are forced out of their sockets, the tongue is protruded between the teeth, and the lips become swollen and everted. Ultimately the features become obliterated and unrecognizable. The

abdomen becomes greatly distended; hence on opening the cavity the gas escapes with a loud explosive noise. The penis and scrotum become enormously swollen. The cellular tissues are inflated throughout, so that the whole body appears stouter and older than it actually is.

Owing to the formation of these gases under the skin blisters containing a reddish colored fluid form on the various parts of the body. When these burst, the cuticle being softened peels off easily. Bruises and ecchymoses are unrecognizable when the cuticle is denuded. The wounds either caused before or after death begin to bleed once more owing to the pressure of gas within the heart and blood-vessels. The wounds also become so altered in appearance that it is difficult to form an opinion as to whether they were caused before or after death, unless the presence of clotted blood can be distinctly made out.

The flies are attracted to the body, and lay their eggs especially in the open wounds and natural orifices. The eggs hatch out very rapidly in four to eighteen hours into maggots, which crawl into the interior of the body, and help in destroying the soft tissues. Sometimes the maggots appear even before death, if the person has ulcers on him.

From forty-eight to seventy-two hours the rectum and uterus protrude. The gravid uterus may expel its contents. The hair becomes loose, and is easily pulled out. The nails are also loose, and easily detached.

From three to five days or more the sutures of the skull specially of the children and young persons are separated, the bones loosened, and the liquefied brain runs out. The teeth become loose in their sockets, and may fall off.

The next stage of putrefaction is known as *colliquative putrefaction*, which begins from five to ten days or more after death. During this stage the walls of the abdomen become softened, and burst open protruding the stomach and in-

testine. The thorax, especially in children, bursts. The diaphragm is pushed upwards.

If the putrefactive processes still go on, the tissues become soft, loose and are converted into a thick semifluid black mass. They ultimately separate from the bones, and fall of. The bones are consequently exposed, and the orbits are empty. The cartilages and ligaments are similarly softened, and ultimately the bones are destroyed, so that after some years no trace of the body is left. The time taken up by these changes varies considerably with the temperature and the medium in which the body lies.

The conclusions arrived at by Mackenzie from his observations on dead bodies in Calcutta are given below in a tabulated form.

	Average		Minimum		Maximum	
	hr.	m.	hr.	m.	hr.	m.
Muscular irritability. ...	1	51	0	30	4	30
Onset of rigor mortis. ...	1	56	0	40	7	0
Duration of rigor mortis. ...	19	12	3	0	40	0
Green discoloration. ...	26	4	7	10	41	0
Eggs of flies.	25	57	3	20	41	30
Maggots.	39	43	24	18	76	0
Formation of bullae. ...	49	34	35	0	72	0
Evolution of gases. ...	18	17	5	30	34	30

Table showing the chronological sequence of the putrefactive changes occurring in the temperate regions.

Putrefactive Changes	Time
1. Greenish coloration over the iliac fossae. The eyeball soft and yielding.	1 to 3 days after death.

Putrefactive Changes	Time
2. Green coloration spreading over the whole abdomen, external genitals and other parts of the body. Frothy blood from mouth and nostrils.	3 to 5 days after death.
3. Abdomen distended with gas. Cornea fallen in and concave. Purplish red streaks of veins prominent on the extremities. Sphincters relaxed. Nails firm.	8 to 10 days after death.
4. Body greenish brown. Blisters forming all over the body. Skin peels off. Features unrecognizable. Scrotum distended. Body swollen up owing to distension. Maggots on the body. Nails and hair loose and easily detached.	14 to 20 days after death.
5 Soft parts changed into a thick semifluid black mass. Skull, abdomen and thorax burst. Bones exposed. Orbits empty.	2 to 5 months after death.

Internal Phenomena.—The changes of discoloration similar to those described in the external phenomena of putrefaction are observed in the various visceral organs, such as the liver, spleen and kidneys, but the color is usually dark red changing to black instead of a greenish color. This discoloration should not be mistaken for the greenish yellow or black coloration imparted to the neighbouring organs by the bile soaking through the gall bladder. The viscera subsequently become greasy and softened, so that it is difficult to remove them entire.

The rate of putrefaction in the internal organs varies greatly owing to the differences in their structure as regards firmness, density and moisture. From his long experience

Casper has drawn up the following table showing the order in which the internal organs putrefy :—

Those which putrefy soon	Those which putrefy late
1. The Larynx and Trachea.	9. The Heart.
2. The Brain of Infants.	10. The Lungs.
3. The Stomach.	11. The Kidneys.
4. The Intestines.	12. The Bladder.
5. The Spleen.	13. The Œsophagus.
6. The Omentum and Mesentery.	14. The Pancreas.
7. The liver.	15. The Diaphragm.
8. The Adult Brain.	16. The Blood vessels.
	17. The Uterus.

The Larynx and Trachea.—The decomposition of these organs coincides almost with the appearance of the greenish coloration over the abdomen. They appear first brownish-red, and later become greenish and softened.

The Brain of Infants.—Owing to the thinness of skull bones and the presence of fontanelle the brain of infants very rapidly becomes soft and pulpy, and later turns into a black liquid mass.

The Stomach.—The stomach putrefies from four to six days in winter, and from twenty-four to thirty-six hours in summer. As a consequence of putrefaction dark-red patches are seen on the posterior wall, and gradually extend over the whole interior. These patches may be mistaken for the effects of irritant poisoning ; but the redness due to putrefaction involves the whole thickness of the stomach wall, while redness caused by irritant poisoning affects only the mucous membrane. Afterwards the blebs form on the inner walls,

which become softened, dark brown and ultimately change into a dark pultaceous mass.

Post-mortem digestion of the stomach is frequently observed. This auto-digestion usually occurs at its posterior wall, by which the mucous and submucous coats are destroyed, and a perforation results. This has to be differentiated from the gastric ulcer due to disease. In a perforation due to *post-mortem* auto-digestion the edges are not abrupt and sharply cut, and the margins are thinner than the surrounding portion of the healthy organ. In the diseased ulcer the edges are sharply cut and funnel shaped, and the margins are, as a rule, thickened. The mucous membrane in the case of auto-digestion is soft and pulpy, though it cannot be removed by peeling; whereas it can be easily peeled off from near its edges in the case of ulcer. In auto-digestion the mucous membrane and the muscle are both equally affected, and look soft and slimy, whereas in ulcer the muscle is not so much involved as the mucous membrane. Besides, in *ante-mortem* perforations there will be the signs of peritonitis and adhesions, but not so in *post-mortem* perforations.

The Intestines.—The putrefaction of these organs follows that of the stomach. The intestines rapidly inflate with the formation of gases in their interior, and the mucous membrane undergoes exactly the same changes as observed in the stomach.

The Spleen.—In some cases it decomposes earlier than the stomach and intestines, especially if it is diseased and enlarged, or if death has occurred from an acute infectious disease. It becomes soft, pulpy, greenish-steel in color, and within two to three days it becomes reduced to a diffluent mass.

The Omentum and Mesentery.—These withstand putrefaction for a long time, if they are free from fat; but decompose sooner, if loaded with fat. In that case they appear greyish green, and dry.

The Liver.—The convex surface first shows the signs of putrefaction. It soon becomes grey, and afterwards green in color. Later on the substance becomes soft and bloodless, and lastly coal-black. It putrefies earlier in newly-born children. The gall-bladder is long recognizable owing to its resisting action against putrefaction.

The Adult Brain.—The putrefaction first begins at its base, and then proceeds to the upper surface. It is hastened, if any injury to the brain or skull is present. The brain becomes soft and pulpy within twenty-four to forty-eight hours, and becomes a liquid mass from three to four days in summer.

The Heart.—The heart putrefies much later than the stomach, intestines, and liver. The organ first becomes soft and flabby, and the cavity appears dilated, which is usually empty containing a few gas bubbles. The organ itself can be recognized for several months.

The Lungs.—These organs putrefy at about the same time as the heart or a little earlier in a few cases. The first sign of putrescence in the lungs is the formation of gaseous bullæ under the pleural membranes. These are first small and scattered over the various parts of the lungs, and later on they coalesce together. Their color then changes to dark black and green. The lungs lastly become soft, and collapse, and finally become completely destroyed.

The Kidneys.—The kidneys become brown and greenish, but retain their consistence for long, so that diseases, such as nephritis and cancer, can be detected for a long time after death.

The Bladder.—This organ stands putrefaction for a long time, but the urine in the bladder may contain albumin owing to the transudation of serum albumin and globulin from the blood.

The Œsophagus.—It withstands putrefaction for a very long time, and may be recognized long after the stomach has entirely disappeared.

The Uterus.—This is the last organ to putrefy. It can be recognised even upto six or nine months after death.

The Aorta.—The aorta resists putrefaction, and can be recognised after a burial of even fourteen months.

Putrefaction in Water.—The rate of putrefaction of a body in water is more reliable than that of a body exposed to the air or interred, as the temperature of the water is more uniform, and the body is protected from the air, as long as it remains submerged in water. Ordinarily a body takes twice as much time in water as in air to undergo the same degree of putrefaction. Putrefaction is retarded when a body is lying in deep water, and is well protected by clothing. It is accelerated, when once a body has been removed from water, as the tissues have imbibed much fluid. In such a body decomposition is so rapid, that the changes occurring in twenty-four hours' exposure to the air will be more marked than those ordinarily resulting from a fortnight's further submersion.

The color changes of decomposition are first noticed over the face on the eyelids and ears instead of on the abdomen as in ordinary putrefaction. These changes then gradually spread downwards from the chest to the upper extremities, and lastly from the abdomen to the lower limbs.

The following table shows the putrefactive changes occurring at different periods of time in a body submerged in water :—

Putrefactive Changes	Time
1. Very little change if water is cold. Rigor mortis may persist.	First four or five days.
2. The skin of the hands and feet becomes sodden and bleached. The face appears softened and has a faded white color.	From five to seven days.

Putrefactive Changes	Time
3. Face swollen and red. Greenish discoloration on eyelids, lips, neck and sternum. Skin of hands and feet wrinkled. Upper surface of brain greenish in color.	One to two weeks.
4. Skin wrinkled. Scrotum and penis distended with gas. Nails and hair still intact. Lungs emphysematous and cover the heart.	Four weeks.
5. Abdomen distended, skin of hands and feet come off with nails like a glove.	Six to eight weeks.

The above table applies to bodies immersed during winter in temperate regions. Bodies immersed in summer undergo the same changes from three to five or six times as rapidly as in winter, or even more quickly than that.

If fish and crabs happen to be present in water, they destroy the soft parts, and expose the bones in a very short time. On the 2nd June 1919, a boy about twelve years of age was drowned in the Gomti. On the fourth, when the body was recovered, almost all the soft parts had disappeared leaving the bones bare.

Floatation of a Body.—The gases of decomposition developed within the submerged body cause it to rise to the surface, unless it is entangled in weeds, ropes, or any other impediment. In India the body comes to the surface within twenty-four hours in summer, and two to three days or more (rarely more than a week) in winter. In England the body floats in ten to fourteen days in summer, and in six to eight weeks in winter. The power of floatation of a decomposing body is so great, that it may come to the surface in spite of it being weighted with a heavy stone. The period of floatation depends

on the age, sex, condition of the body, season of the year and water.

Age.—The bodies of newly born infants, if fully developed, and well nourished, float rapidly.

Sex.—Females float sooner than males. The bodies of women float with the abdomen upwards, while the bodies of men usually float with the back and buttocks upwards.

Condition of the Body.—Fatty bodies float quicker than lean and thin bodies, as fat has a less specific gravity. Bodies wearing loose clothes will soon come to the surface.

Season of the Year.—The moist, hot air of summer is favourable to putrefaction ; hence dead bodies float quicker in summer than in winter.

Water.—Dead bodies float in shallow and stagnant water of a pond sooner than in the deep water of a running stream, as the water of a pond being warmer from the action of the sun's rays favours putrefaction.

Circumstances modifying Putrefaction.—These may be divided into external and internal.

External Circumstances.—These are warmth, moisture, air, and the manner of burial.

Warmth.—Putrefaction commences at a temperature about 50°F., and is most favoured between 70° and 100°F. It is altogether arrested below 32°F., and above 212°F. A higher temperature accompanied by dry air generally retards putrefaction.

Moisture.—This is very essential for the occurrence of putrefaction, as the micro-organisms, which are the causative agents of decomposition, thrive well in both heat and moisture. Hence the organs which contain water decompose more rapidly than dry ones.

Air.—The presence of air promotes, and its absence retards putrefaction. Closely fitting clothes to the body will retard decomposition by excluding the air. Similarly bodies

placed in air-tight, lead or zinc coffins resist putrefactive processes for a long period. Moist air favours putrefaction by diminishing evaporation, while dry air retards it. In the same way still air helps putrefaction, and air in motion prevents it. Putrefaction is also delayed in bodies completely submerged in water to the entire exclusion of air, and it has been ascertained that at the same temperature the putrefactive changes observed in a body exposed to the air for one week will almost correspond to those in a body submerged in water for two weeks, or buried in a deep grave for eight weeks.

The manner of Burial.—Putrefaction is hastened in a body buried in a damp, marshy, clayey soil, or in a shallow grave, where the body will be exposed to the constant changes of temperature. It will also be hastened in the case of a body buried without clothes or coffin in a porous soil impregnated with organic matter. Putrefaction is, however, retarded, if a body is buried in a dry, sandy or gravelly soil on high ground, or in a grave deeper than six feet, and also if the body is well covered with clothes and placed in a tightly fitting coffin. Lime and charcoal, when sprinkled on the body, do not hasten or retard putrefaction, but act as deodorizers to some extent, as they have the power of absorbing gases emanating during decomposition.

Internal Circumstances.—These are age, sex, condition of the body, and the cause of death.

Age.—The bodies of children putrefy more rapidly than those of young adults. The bodies of old people do not decompose rapidly probably owing to a less amount of moisture.

Sex.—Sex has no influence on putrefaction, but the bodies of females dying soon after child-birth decompose rapidly, especially if death has been due to septicæmia.

Condition of the Body.—Fat and flabby bodies putrefy more quickly than the thin and emaciated ones. Those parts

of the body which are the seats of bruises, wounds or fractures, or which have been mutilated, decompose very early.

Cause of Death.—In sudden, accidental or violent deaths bodies decompose more rapidly than in deaths resulting from disease. Putrefaction is hastened in the case of deaths occurring from infectious fevers, such as typhoid, anthrax, pneumonia, phthisis and pyæmia, as also from deaths due to suffocation by smoke, coal gas, hydrogen sulphide or sewer gas, and certain poisons, e.g., hydrocyanic acid and opium. On the other hand putrefaction is retarded in bodies dying from poisoning from alcohol, chloroform, strychnia, arsenic, antimony, zinc chloride, phosphorus and sulphuric acid, and from chronic diseases except in the case of dropsy.

8. SAPONIFICATION.

Under certain conditions the progress of putrefaction in a dead body is checked, and is replaced by saponification, which is known as *adipocere* from its resemblance to both fat (adeps) and wax (cera).

Adipocere is physically a waxy-looking substance having a pure white or a faint yellowish color. It cuts soft, and melts at a flame, or burns with a feebly luminant flame giving off a dull cheese-like, but by no means, a disagreeable smell. Its specific gravity being less than water, it floats when placed in the latter. It is soluble in ether and alcohol and, on heating with caustic potash, evolves ammonia. It is more or less permanent, lasting for several years, but becomes hard, brittle and yellow, when exposed to the air. On chemical analysis it is found to be an ammoniacal soap. The ammonia which is evolved from the decomposing nitrogenous compounds of the body unites with stearic, oleic and palmitic acids of the fatty tissues of the body. In some cases calcium forms the basis of soap instead of ammonia. The subcutaneous fat and

bone marrow are the first portions of the body which undergo this change. They are then followed by the changes in the breasts and buttocks, and then in the kidneys and other organs.

The conditions favourable to produce saponification are—

1. Fat.—The bodies of children, which usually contain fat, are more apt to be saponified than those of grown-up persons.

2. Water.—This is necessary for saponification, so that the process takes place in bodies immersed in water. It occurs more rapidly in running than in stagnant water.

3. Cesspools.—Bodies are saponified when thrown in cesspools to the exclusion of air.

4. Soil.—Saponification occurs in bodies buried in damp, clayey soils, especially when piled one upon the other.

Time of Saponification.—The time required for saponification varies according to the climate. In Europe it ranges from three months to one year, though the change may occur in five weeks, or may be delayed to three years. It is more rapid, when a body is submerged in water, than when it is buried in the earth In India according to the investigations of Mackenzie it occurs within three to fifteen days after death. The body of a female child removed from a well was brought to the Lucknow Medical College mortuary on the 26th January 1919. It had been saponified within about fifteen days of death. Its photo is given on the frontispiece.

9. MUMMIFICATION.

The term mummification, is applied to a peculiar desiccation of a dead body, whereby its soft parts shrivel up, but retain the natural appearance and even the features of the body. The skin is dry, leathery and rusty brown in color, and adheres closely to the bones. The odour is more like that of old cheese than that of a decomposed body. The inter-

nal organs either disappear altogether, or blend together and get transformed into a thick mass of a dark-brown dry substance, from which they cannot be separately distinguished.

Mummification occurs in the case of bodies buried in shallow graves in dry sandy soils of Rajputana, Sind and Baluchistan, where the evaporation of the body fluids is more rapid owing to the hot, dry winds prevailing in the summer season. It is observed also in the bodies kept perched up on trees, or rafters of a roof, as also when kept closed in steel trunks. Arsenical or antimony poisoning is said to favour the process of mummification in dry, warm climates.

Time of mummification.—The time taken by a dead body to mummify is not exactly known, but it may be regarded as varying from three months to a year or two.

The artificial method of mummifying or embalming dead bodies was known to the ancient Egyptians, and specimens of their mummies are to be found in a very well preserved condition in the British Museum of London after thousands of years. At present it is resorted to in the medical schools and colleges to preserve dead bodies for the purpose of dissection by injecting solutions of arsenic, lead sulphide and potassium carbonate into the femoral artery or into the aorta. The process has sometimes to be adopted, when dead bodies have to be taken from one country to another for burial, and when the time taken in transit is so much as would ordinarily lead to putrefaction.

TIME OF DEATH

It is very important from a medico-legal point of view that a medical jurist should always be prepared to give an opinion as to the probable time which elapsed after death, when a body is brought to him for *post-mortem* examination. The points to be noted in ascertaining the time are the warmth or cooling of the body, the absence or presence of

cadaveric hypostasis, rigor mortis and the progress of decomposition. All these points have been discussed at full length, but it must be remembered that the conditions producing these changes vary so much in each individual case, that only an approximate time of death can be given.

In addition to these, the time of death can be ascertained with some possibility from the degree of digestion of the stomach contents, and from the condition of the bladder and intestines as regards their contents.

It has been ascertained by physiologists that a mixed diet containing more of animal food and less of vegetable food as ordinarily taken by a European, leaves the stomach in four to five hours after it is completely digested ; but it must be borne in mind that a vegetable diet containing mostly farinaceous food, as it is usually taken by an Indian, does not leave the stomach completely within six to seven hours after its ingestion. Besides, the power of digestibility remains in abeyance in disease, as well as in coma, and at the same time the fact of *post-mortem* digestion should not be lost sight of, while determining the time of death.

In some cases the time of death may be calculated by examining whether the bladder or intestines are empty or not. Thus, in the case of murder of an individual having taken place in bed at night, one can say that the individual had lived for some time after going to bed, if the bladder was found full of urine, since people usually empty their bladder before going to bed. Similarly one can give an opinion that the death occurred some time after he had got up in the morning, if the large intestine was found empty of fæcal matter.

PRESUMPTION OF DEATH

The question of presumption of death arises at the time of inheritance of property or in obtaining insurance money,

when a particular person has gone abroad, and has not been heard of for a considerable time, or when he is alleged to have been dead, and the body is not forthcoming. The Indian law presumes that a person is alive, if he is proved to have been alive within the last thirty years, unless his friends and relatives have not heard from him for seven years. (Vide Appendix VII, sections 107, 108 I.E.A.) The law, however, does not presume anything as to the time of death. It has to be proved by evidence.

PRESUMPTION OF SURVIVORSHIP

The question of survivorship arises in the distribution of property, when several persons, naturally heirs of each other, lose their lives in a common disaster. In such cases the English law does not lay down any rule and hence, the courts are influenced in establishing the survivorship from the facts and evidence, where available. In the absence of such evidence, the following conditions should be taken into consideration in determining the question of survivorship with a reasonable certainty :—

Injury.—Wounds, even if small and insignificant, inflicted on the vital organs or main blood vessels, are likely to produce death much earlier than injuries, even though extensive, inflicted on those parts of the body, which are not vital.

Age.—The adults have got the power of resistance against a common danger more than the young and old, and it is, therefore, presumed that the former will survive the latter, but much will depend on the mode of death.

Sex.—The males being stronger are presumed to survive longer than the females but, when there is a question of physical endurance, females will live longer than males, as the former can withstand the severe physical strains better than the latter.

Constitution.—The vigorous and healthy individuals are ordinarily presumed to live longer than the weak and debilitated from disease.

Mode of Death.—The following modes of death should be particularly discussed :—

Drowning.—Females may be presumed to survive longer than men, as the former are more likely to faint from dread, which delays asphyxia. However, in cases where there has been a struggle for life, men being stronger will probably survive women, and those who know swimming will live longer than those who do not.

Suffocation.—In a common accident occurring from the falling of the debris of a fallen roof or so, persons who have least injuries, and who are nearer the surface and consequently not buried deep under the debris, are presumed to have died last.

Asphyxia from want of Oxygen or from Irrespirable Gases.—Women consume less oxygen and are, therefore, supposed to live longer than men in an atmosphere containing a less amount of oxygen. Again an individual will be required to consume more oxygen, if he were to make a muscular effort to escape the danger, and hence he will be more liable to the danger than one who is inactive, and does not make any exertion.

Starvation.—Fatty persons have got a better chance of outliving the lean, as they can live on their fat for some time. Again one deprived of food alone will live longer than one deprived of both food and water, as water alone enables a person to live for many days. In the case of children, adults and old people exposed to starvation, children will die first, then the adults and lastly the old, as the old require less nourishment than adults, and the adults less than the children. In the same manner women consume less food than men, and hence can bear starvation longer and better.

Cold.—Ordinarily adults are presumed to live longer than the young and the old, as the former bear cold better than the latter. Men generally stand cold better than women; but this hypothesis should be modified by the amount and kind of clothing, the physical condition of the body and the habit of using alcohol or other intoxicating drugs.

Heat.—Adults do not bear heat so well as children and old people, and hence the former are supposed to die before the latter, if exposed to a common danger of heat.

Burns.—Children die sooner from the effects of extensive burns than adults, as the former cannot resist, and the same is true of old people as compared with adults.

Delivery.—When mother and child die during delivery, there is a strong presumption that the mother survived the child but, if she died of hæmorrhage, it would be presumed that she died first.

In addition to the above considerations, the medical man should note the presence of the degree of warmth and rigor mortis to ascertain which of them died first, if several bodies meeting death in the same accident were sent to him for *post-mortem* examination.

CHAPTER VII

DEATHS FROM ASPHYXIA

Violent deaths resulting chiefly from asphyxia are : Hanging, Strangulation, Suffocation, and Drowning.

HANGING

Definition.—Hanging is a form of death produced by suspending the body with a ligature round the neck, the constricting force being the weight of the body or the head. The term " partial hanging " is used for those cases in which the body is partially suspended off the ground, or for those which are in a sitting, kneeling, reclining, prone, or any other posture. In all such cases death is inevitable, if there is enough force upon the ligature to constrict the neck.

The Nature of the Ligature used.—Any substance, that is available at the time of the impulse, has been used by suicides as a ligature for hanging, e.g., cotton, hemp or *moonj* ropes of any thickness, *newar*, *dhoti*, *saree*, turban (*safa*), bed-sheet, sacred-thread, neckerchief, neck cloth (*dupatta*), etc. When a material with which an individual is alleged to have been hanged, is sent for medical examination, the medical jurist should see if the mark on the neck corresponds with its thickness, and if it is strong enough to bear the body weight or the sudden strain. He should also note its texture and length, and return it in a sealed packet to the police constable who brought it.

Symptoms.—The first symptoms are loss of power and subjective sensations, such as flashes of light, and ringing and hissing noises in the ears. These are followed by loss of consciousness, which is so very rapid that hanging is re-

garded as a painless form of death. Owing to this rapid unconsciousness, an effort at saving oneself is not possible in accidental or suicidal hanging. In the case of judicial hanging convulsive movements of the limbs may be seen. Respiration stops before the heart, which may continue to beat for about ten minutes.

Causes of Death.—*1. Asphyxia.*—In most cases this is the true cause of death. The ligature is usually situated above the thyroid cartilage, and the effect of its pressing the neck in that situation is to force up the epiglottis and the root of the tongue against the back of the pharynx. Hence the floor of the mouth is jammed against its root, and occludes the air passages.

2. Apoplexy.—This is due to the congestion of the venous blood in the brain on account of the compression of the large (jugular) veins in the neck.

3. Syncope.—This results from pressure on the large arteries of the neck, which prevents blood from going to the brain, and consequently produces its anæmia.

4. Shock.—This occurs from pressure on the pneumogastric nerves.

5. Fracture or Dislocation of the Cervical Vertebræ.—In judicial hanging a sudden drop of five to seven feet produces fracture or dislocation of cervical vertebræ, which pressing on the spinal cord causes instantaneous death. Usually the first and second vertebræ are injured, but in a few cases the third and fourth may be found fractured.

6. Combined Asphyxia and Apoplexy.—This is supposed to be the commonest cause of death, as in most cases the air passages are not completely blocked by the ligature passed round the neck.

Fatal period.—Death is almost instantaneous if the cervical vertebræ are injured as in judicial hanging. It may occur instantaneously or rapidly in cases of asphyxia,

but may occur in five to eight minutes, if the blocking of the air-passages is partial only. Death is, as a rule, slow in cases of apoplexy.

Treatment.—The first and the most important thing to do is to let the individual down, and to remove constriction of the neck by cutting the ligature. Artificial respiration should then be used after pulling out the tongue, and wiping out the froth from the mouth and nostrils. This may be supplemented by the application of ammonia vapour to the nose. Cold effusion may be applied to the head, and the galvanic battery may be used, if the body is warm but, if the body is cold, warmth should be restored by friction and mustard plaster on the chest, abdomen and calves. If the patient is able to swallow, stimulants should be given by the mouth, or else, they should be given hypodermically or per rectum. It may be necessary to perform venesection to relieve distension of the right side of the heart and pulmonary circulation or cerebral congestion. The patient should be watched for some time after respiration has been established, as death may occur from a relapse of the symptoms. The secondary effects of hanging in subjects, who have recovered, are, sometimes, hemiplegia, epileptiform convulsions, amnesia and dementia.

Post-Mortem Appearances.—These are external and internal appearances.

External Appearances.—External appearances are those due to the ligature on the neck and those peculiar to the mode of death.

Ligature-Mark.—This depends on the nature of the ligature used, and the time of suspension of the body after death. If the ligature be soft, and the body be cut down immediately after death, there may be no mark. Again the intervention of a thick and long beard or clothes on the neck may lead to the formation of a slight mark.

Situation of the Mark.—The mark is usually situated above the thyroid cartilage between the larynx and the chin, and is directed obliquely upwards following the line of the mandible (lower jaw) and interrupted at the back, reaching the mastoid processes behind the ears. The neck is found stretched and elongated, and the head is always inclined to the side opposite to that of the knot. The mark may, however, be circular, if the ligature is first placed at the nape of the neck, and then its two ends are brought horizontally forward and crossed, and carried upward to the point of suspension from behind the angles of the lower jaw on each side. The mark will be both circular and oblique, if the ligature is passed round the neck more than once.

Character of the Mark.—The mark varies according to the nature of the material used as a ligature and the period of suspension after death. It is a superficial and broad mark if a cloth or a soft rope is used ; while it is well-defined, narrow and deep, if a firm string is used. The mark is a groove or furrow, the base being pale, hard, leathery and parchment-like, and the margins red and congested. The color becomes reddish brown or chocolate brown, if seen after some hours of suspension. Ecchymoses and slight abrasions are rare, but may be found in some cases, e.g., in judicial hanging.

Ecchymoses alone have no significance as to whether hanging was caused during life or not, but abrasions with hæmorrhage are strongly suggestive of hanging having taken place during life.

Other Signs.—The face is usually pale and placid. The eyes are closed or partly open, and the pupils are usually dilated. The tongue is drawn in, or caught between the teeth, or protruded and bitten. It is usually swollen and blue, especially at the base. Bloody froth is sometimes seen at the mouth and nostrils. Saliva is very often found running out of the angle of the mouth down the chin, and on the chest in

front. This is a sure sign of hanging having taken place during life, as the secretion of saliva being a vital function cannot occur after death. The hands are often clenched, especially in violent hanging. The genital organs are congested, and there may be emission of semen mixed with blood from the penis, or bloody discharge from the vagina. There may be the escape of urine and fæces. *Post-mortem* staining will be seen on the lower parts of the body, if suspension has been continued for some time after death.

Internal Appearances.—On dissection the subcutaneous tissue under the ligature mark is usually dry, white and glistening, more marked, if the body has been suspended for a long time. The inner and middle coats of the carotid arteries may be found lacerated, if there has been a sudden drop as in judicial hanging. Similarly fracture-dislocation of the cervical vertebræ together with the injury to the spinal cord may be noticed. Fracture of the hyoid bone, and of the laryngeal cartilages is very rare, and that too only in judicial or homicidal hanging.

The mucous membrane of the trachea is found red, and congested containing fine bloody froth in some cases. Very rarely it is found lacerated.

In the case of constriction occurring at the end of expiration the lungs are congested, oedematous and exude bloody serum on being cut, but are pale if constriction occurred at the end of inspiration. Sub-pleural ecchymoses are very rare. The right side of the heart, the pulmonary artery and venæ cavæ are full of dark fluid blood, and the left side is empty. The abdominal organs are usually congested. The brain is usually normal, but may be pale or congested according to the mode of death.

Medico-Legal Questions.—The medico-legal questions likely to arise in a case of hanging are—

1. Whether death was caused by hanging.

2. Whether hanging was suicidal, homicidal, or accidental.

1. **Whether Death was caused by Hanging.**—In India it is a common practice to kill a victim, and then to suspend him by a tree or a rafter of a roof to avert suspicion. It is, therefore, necessary to find out if hanging was the cause of death in a suspended body.

The presence of the ligature-mark alone is not diagnostic of the death from hanging, inasmuch as it being a purely cadaveric phenomenon may be produced, if a body is suspended after death. Casper has illustrated by experiments that a mark similar to one observed in persons hanged alive can be produced, if suspended within two hours after death. Besides, a similar mark may also be produced by dragging a body along the ground with a cord passed round the neck soon after death. However, one can safely say that death was due to hanging, if in addition to the cord mark there were trickling of saliva from the mouth, and the *post-mortem* signs of asphyxia, and at the same time, if there were no evidence of the signs of struggle, fatal injuries, or of poisoning.

2. **Whether Death was Suicidal, Homicidal or Accidental.**—Hanging is usually suicidal. Blindness or age is no bar against suicidal hanging. A blind man of seventy-five committed suicide by suspending himself from a branch of a tree in Lucknow. After chastisement or some other violence children have been known to have committed suicide by hanging from shame, or grief. Sometimes hanging is adopted as a last resort, after other forms of suicide, e. g., cutting of the throat or ingestion of a poison, have failed to produce the desired effect.

Homicidal hanging, though rare, has been recorded. Usually more than one person is combined in the act, unless the victim is a child, or very weak and feeble, or is rendered unconscious by some intoxicating or narcotic drug.

Accidental hanging is extremely rare. It has occurred among children during play while imitating judicial hanging, or among athletes who are in the habit of exhibiting hanging.

STRANGULATION

Definition.—Strangulation is a violent form of death, which results from constricting the neck by means of a ligature without suspending the body. It is called throttling, when constriction is caused by the pressure of the fingers on the neck. Strangulation may also be brought about by compressing the throat with a foot, knee, elbow, stick, or some other solid substance, or by pressing the throat between two sticks, one in front of the neck and the other on its nape.

Symptoms.—If the windpipe is compressed so suddenly as to occlude the passage of air altogether, the individual is rendered powerless to call for any assistance, becomes insensible and dies instantly. If the windpipe is not completely closed, the face becomes cyanosed, bleeding occurs from the mouth, nostrils and ears, and convulsions precede death. As in hanging, insensibility is very rapid, and hence death is quite painless.

Causes of Death.—The same as in hanging; viz., asphyxia, apoplexy, shock, or asphyxia and apoplexy combined. Very rarely the cervical vertebræ may be fractured.

Treatment.—It is hardly necessary as most cases are homicidal, but in case of necessity the constriction of the neck should be removed, and artificial respiration should at once be started. This may be assisted by the application of ammonia to the nostrils, and galvanism or inhalation of oxygen. Venesection should also be resorted to, if necessary. Hot bottles may be applied to the body, if it is cold. After recovery the patient may die from any of the secondary complications, such as, convulsions, paralysis, lesions of the larynx and lungs, and from abscesses.

Post-Mortem Appearances.—These are external and internal appearances.

External Appearances.—The external appearances are those due to the constricting force applied to the neck, and those due to asphyxia.

Appearances on the Neck.—These vary according to the means used.

1. **Ligature-Mark.**—It is a well defined and depressed mark corresponding to the breadth of the ligature, usually situated low down in the neck below the thyroid cartilage, and encircling the neck horizontally and completely. The marks are multiple, if the ligature is twisted several times round the neck. The mark may be oblique as in hanging, if the victim has been dragged by a cord, after he has been strangled in a recumbent posture, or if the victim was sitting, and the assailant applied a ligature on the neck while standing behind him, thus using the force backward and upward. The base of the mark, which is known as a groove or furrow, is usually pale with reddish and ecchymosed margins. It is rarely hard, yellow and parchment-like as in hanging. Very often there are abrasions and ecchymoses in the skin adjacent to the mark.

2. If the fingers are used (throttling), marks of pressure by the thumb and fingers are usually found on either side of the windpipe. The thumb mark is ordinarily higher and wider on one side of the front of the neck, and the finger marks are situated on its other side obliquely downwards and outwards, and one below the other. These marks look like soft, red bruises, if examined soon after death, but they look brown, dry and parchment-like sometime after death. The position of these marks may definitely indicate whether the left or right hand was used, as also the size of the hand. Very often crescentic marks produced by the finger-nails are found if the nails are long, and not paired down.

Besides these marks, there may be abrasions and bruises on the mouth, nose, cheeks, forehead, chin or any other part of the body, if there has been a struggle. Similarly a fracture of the ribs with injury to the lungs may be present, if an assailant kneels on the body of his victim, while pressing his throat.

3. If a stick or a foot is used, there is a bruise in the centre of the front of the neck generally on the windpipe, corresponding in width to the substance used. There will be a similar mark on the nape of the neck, if two sticks are used. In such a case severe local injury will be evident.

Appearances due to Asphyxia.—The face is swollen and cyanosed, marked with petechiae. The eyes are prominent and open. In some cases they may be closed. The conjuctivæ are congested, and the pupils are dilated. Lips are blue. Bloody foam escapes from the mouth and nostrils, and sometimes pure blood comes out from the mouth, nose and ears, especially if great violence has been used. The tongue is often swollen, protruding and dark in color, and occasionally bitten by the teeth. The hands are usually clenched. The genital organs may be congested. There may be a discharge of urine and fæces from the bladder and rectum.

Internal Appearances.—There is extravasation of blood due to ecchymoses in the subcutaneous tissues under the ligature-mark or finger marks, as well as, in the soft structures of the neck. Sometimes there is laceration of the sheath of the carotids, as also of their internal coats. The cornua of the hyoid bone may be fractured, but the fracture of the cervical vertebræ is very rare. A *post-mortem* examination on a case of strangulation was held on the 17th September 1915, at the Agra Medical School mortuary, when a fracture-dislocation of the first and second cervical vertebræ, together with the usual cord-mark was seen. In addition to these

injuries, the right humerus, the left femur and the first and second ribs of both the sides were fractured. The fracture-dislocation of the spine was either caused by forcibly twisting the neck during the act of strangulation or by a violent blow with a blunt weapon across the nape of the neck.

Both the larynx and trachea are congested, and contain frothy mucus. The larynx or the rings of the trachea may be fractured, when considerable force is used. The lungs are usually congested, showing the appearance of red hepatization, and exuding dark fluid blood on being cut. They may show emphysematous patches on their surface due to the rupture of the air-vesicles. The bronchial tubes usually contain frothy, bloody mucus. The right side of the heart is full of dark fluid blood, and the left empty. The right ventricle is found contracted and empty like the left, if the heart has continued to beat after the stoppage of respiration. Sometimes both the cavities are found full, if the heart stopped during diastole. The abdominal organs are darkly congested. The brain is also congested.

Medico-Legal Questions.—The questions that are raised in a court of law in connection with strangulation are (1) whether death was caused by strangulation. (2) whether strangulation was suicidal, homicidal, or accidental.

1. **Whether Death was caused by Strangulation.**—No inference should be drawn simply from a ligature-mark, for it may be indistinct or absent, if a soft ligature like silk is used, and may be produced even after death. Similarly abrasions and finger-marks may be produced on the neck by a person in an epileptic or hysterical fit. To come to the conclusion that death was due to strangulation it is necessary, therefore, to note the effects of violence in the underlying tissues in addition to the cord-mark or finger-marks, and other appearances of death from asphyxia. At the same

time the possibility of other causes of death should be excluded.

2. **Whether Strangulation was Suicidal, Homicidal or Accidental.**—Suicidal strangulation is not very common, though sometimes met with. In these cases some contrivance is always made to keep the ligature tight, after insensibility supervenes. This is done by twisting a cord several times round the neck and then tying a knot, which is usually single and in front or on the back of the neck, by twisting the cord tightly by means of a stick, or some other firm substance, or by tightening the ends of the cord by tying them to the hands or feet or to a peg in a wall. Thus it will be seen that throttling can never be suicidal.

Homicidal strangulation is the commonest of the three forms. Usually there is a single turn of the cord round the neck with one or more knots. Sometimes there may be more turns, in which case, more ligature-marks will be found on the neck. In addition to the cord-mark or the finger-marks there are evidences of struggle, and marks of violence on other parts of the body.

Very often an individual is first rendered unconscious by blows on the head, or by intoxicating drugs and then strangled; hence the viscera should be examined for the evidence of poison, and preserved for chemical analysis in doubtful cases.

Sometimes a cord is passed round the neck and over the body, and then tied to the hands and feet to simulate suicidal hanging. In such cases the manner of tying it should be examined carefully to see if it could have been done by a suicide.

Lastly it must be borne in mind that strangulation may be committed without disturbing any noise even if other persons are in close vicinity.

Accidental strangulation is rare, though it may occur, if a

string is used in suspending a weight on the back slips from across the fore-head, and compresses the neck.

Differences between Hanging and Strangulation.—The differences between hanging and strangulation are given below in a tabulated form :—

Hanging	Strangulation
1. Mostly suicidal	1. Mostly homicidal.
2. Ligature mark, oblique, non-continuous, placed high up in the neck between the chin and the larynx ; the base of the groove or furrow being hard, yellow and parchment-like.	2. Ligature-mark, horizontal or transverse, continuous, low down in the neck below the thyroid, the base of the groove or furrow soft and reddish.
3. Abrasions and ecchymoses round about the edges of the ligature-mark, rare.	3. Abrasions and ecchymoses round about the edges of the ligature mark, common.
4. Subcutaneous tissues under the mark, white, hard, and glistening.	4. Subcutaneous tissues under the mark, ecchymosed.
5. Injury to the muscles of the neck, rare.	5. Injury to the muscles of the neck, common.
6. Carotid arteries, internal coats ruptured in violent cases of a long drop.	6. Carotid arteries, internal coats ordinarily ruptured.
7. Fracture of the larynx and trachea, very rare and that too in judicial hanging.	7. Fracture of the larynx and trachea, often found.
8. Fracture-dislocation of cervical vertebræ, common in judicial hanging.	8. Fracture-dislocation of cervical vertebræ, rare.
9. Scratches, abrasions and bruises on the face, neck and other parts of the body, usually not present.	9. Scratches, abrasions and bruises on the face, neck and other parts of the body, usually present.
10. Face, usually pale and no petechiæ.	10. Face, congested, livid and marked with petechiæ.

Hanging	Strangulation
11. Neck, stretched and elongated in fresh bodies.	11. Neck, not so.
12. External signs of asphyxia, usually not well marked.	12. External signs of asphyxia, very well marked.
13. Bleeding from nose, mouth and ears, very rare.	13. Bleeding from nose, mouth, and ears, may be found.
14. Saliva, running out of the mouth down on the chin and chest.	14. Saliva, no such running.
15. Emphysematous patches on the surface of the lungs, not present.	15. Emphysematous patches on the surface of the lungs, may be present

SUFFOCATION

Definition.—The term, suffocation, is applied to that form of death, which results from the prevention of entrance of air into the lungs by means other than compression of the neck.

Causes.—The causes of suffocation are :—

1. Smothering or closure of the mouth and nostrils.
2. Obstruction of the air-passages from within.
3. Pressure on the chest.
4. Inhalation of irrespirable gases.

1. **Smothering or Closure of the Mouth and Nostrils.**—Infants are very often accidentally smothered by being overlaid by their mothers, when they have been drunk. This is more common among the lower classes of women in England. In India such cases are rare, as infants are generally not allowed to sleep in the same bed with their mothers, but in separate cradles; however, they are sometimes smothered by inexperienced *girl-mothers* by being pressed too closely to their breast during suckling. A common method

of killing infants and children is to close their mouth and nostrils by means of the hand, bed clothes, soft pillows or mud.

Cases have been recorded of adults being accidentally smothered by plaster of Paris at the time of taking a cast or mould, or by falling face downwards into vomited matter, flour, cement, sand or mud, especially when drunk or during an epileptic fit.

2. **Obstruction of the Air-passages from within.**—This may be due to—

(*a*) The presence of foreign bodies, such as, a piece of meat, potato skin, a fruit-stone, a corn, a button, a coin, cork, a loose tooth, artificial teeth, a rag, mud, cotton, leaves, an Indian-rubber teat, live fish, round-worm, etc.

It is not necessary that the foreign body should be of such a size as to completely block the air-passages. Even a small object partially blocking the lumen may cause death by spasm. On the 26th September 1912 a Mahomedan girl about ten years old was standing with her infant sister one year old in her arm in a street at Agra ; a boy came, and playfully gave her a push from behind ; the infant girl fell down, and died immediately. On *post-mortem* examination a split gram (*chaneki-dal*) was found obstructing the lumen of the larynx. It appears that the infant girl had a parched gram in her mouth at the time of the fall, and it got into the larynx during the involuntary inspiratory movement.

Illegitimate infants, and grown-up children for the sake of ornaments of a very trifling value, are very often murdered by forcing mud, leaves, rags, etc., into their throats. A five year old boy was murdered by stuffing his mouth and throat with leaves.

(*b*) Diseases, such as, tumours pressing on some portion of the air-passages, or a false membrane as in diphtheria, or œdema of the glottis, or effusion of blood from hæmoptysis,

epistaxis and wounds of the throat, or of pus from an abscess in the tonsils or caseating glands ulcerating into the trachea. A foreign body in the pharynx or œsophagus may cause obstruction pressing on the wind-pipe from behind.

3. **Pressure on the Chest.**—This may occur accidentally by the chest being pressed violently in crowds at big fairs, or by being trampled on the chest from a fall in the rush of such crowds. Pressure on the chest may also occur in railway accidents or by being buried in the debris of a falling wall or roof.

In homicidal cases of pressure on the chest external marks of violence are usually found. In one case at Agra the dacoits killed a young Vaish by sitting on his chest, and penetrating his lungs at several places by sharp iron nails.

4. **Inhalation of Irrespirable Gases.**—Inhalation of gases, such as, carbon dioxide, carbon monoxide, hydrogen sulphide, or smoke from a burnt out house, will produce suffocation.

Mode of Death.—Usually death is due to asphyxia, but it may be due to shock, when the heart stops by reflex action through the vagus nerves.

Fatal Period.—Death is instantaneous, if the windpipe is completely blocked by a foreign body but, under ordinary circumstances, it occurs from four to five minutes after complete withdrawal of air from the lungs. Recovery may occur, if treated within three minutes.

Post-Mortem Appearances.—These appearances are external and internal.

External Appearances.—These are those due to the cause producing suffocation, and those due to asphyxia.

Appearances due to the Cause producing Suffocation.—Bruises and excoriations on the lips, angles of the mouth, the tip of the nose and on the nostrils will be found, if the mouth and nostrils have been closed by forcible

application of a hand There may be similar marks of violence on the cheeks or on the malar bones. No marks can be found, if a soft cloth or pillow has been used to block the mouth and nostrils. Similarly, in the cases of compression of the chest, broad, horny bruise-marks, symmetrical on both sides are found usually with the fracture of the ribs, which generally take place along the anterior margins of the axillæ. In some cases the sternum is also found fractured.

Appearances due to Asphyxia.—The face may be pale or suffused. The eyes are open, the eyeballs prominent and the conjuctivæ are congested. The lips are livid, and the tongue is sometimes protruded. Bloody froth comes out of the mouth and nostrils. The skin shows punctiform ecchymoses with lividity of the limbs.

Internal Appearances.—Mud or any other foreign matter may be found in the mouth, throat, larynx or trachea. It may also be found in the pharynx or œsophagus. The mucous membrane of the trachea is usually bright red, covered with bloody froth and congested. The lungs are congested and emphysematous. They may be lacerated or contused, if death has been caused by pressure on the chest even without any fracture of the ribs. Punctiform sub-pleural ecchymoses (Tardieu's spots) are usually present at the root, base and lower margins of the lungs, and are characteristic of death by suffocation, though they may be present in asphyxial deaths from other causes. They are also found on the thymus, the pericardium, and along the roots of the coronary vessels. The lungs may be found quite normal, if death has occurred rapidly. The right side of the heart is often full of dark fluid blood, and the left empty. Blood does not readily coagulate, and hence wounds caused after death may bleed.

The brain is generally congested, and so are the abdominal organs.

Medico-Legal Questions.—These are :

1. Whether death was caused by suffocation.
2. Whether suffocation was suicidal, homicidal or accidental.

1. **Whether Death was caused by Suffocation.**—Sometimes it is not easy to state whether death is due to suffocation inasmuch as, the signs of asphyxia may be altogether absent, or these signs may be present in deaths from epilepsy, tetanus, or strychnia poisoning. It is, therefore, very essential to look for evidences of violence in the shape of external marks surrounding the mouth and nostrils, or on the chest, or the presence of foreign bodies in the throat, to come to a definite conclusion. Again it cannot be positively affirmed from the presence of Tardieu's spots that death occurred from suffocation since, they are found in deaths from apoplexy, heart disease, pneumonia, etc.

Circumstantial evidence should always be taken into consideration to establish the proof of death from suffocation.

2. **Whether Suffocation was Suicidal, Homicidal or Accidental.**—Suicidal suffocation is very rare, though a few cases of suicide among insane persons have been recorded. They are said to have stuffed their mouth with rags, pieces of blanket or hay.

Homicidal suffocation is common, and usually resorted to in murdering infants by forcing mud, etc., down their throat, or by smothering them in clothes, etc. In adults it is only possible if the victim is weak and feeble, or is unable to resist, having been previously stupefied by intoxicating or narcotic drugs. Homicidal suffocation from pressure on the chest may occur but, in that case, more than one person are usually involved in the act.

Burying alive used to be resorted to in India as a form of punishment, and lepers used to be buried alive as well.

In the case of infants dying under suspicious circumstances and exhumed from the grave a question might arise as to

whether they had been buried alive. The presence of fine dust into the œsophagus and stomach is a convincing proof of the infant having been buried alive. In a burial after death fine dust may be found in the air-passages, but never in the œsophagus or stomach.

Accidental suffocation is frequent and is produced as described above.

DROWNING

Definition.—Drowning is a form of death from asphyxia, which prevents the air from entering into the lungs on account of submersion of the body into water or some fluid medium. It is not necessary that there should be complete submersion. Death is sure to occur, even if the face only is submerged under water, so that air is prevented from entering the respiratory orifices.

Stages of Drowning.—As soon as a person falls into water, he sinks to a depth proportional to the momentum obtained during the fall, but immediately rises to the surface owing to the struggling movements of the limbs, though the specific gravity of the body is slightly higher than that of water. If he is not a swimmer, he cries and shouts for help, when his mouth being at the level of the water surface, he draws water into the stomach and lungs. The water in the lungs excites coughing and, during violent expiratory efforts due to cough, a certain amount of air is expelled from the lungs, and its place is taken up by water which is drawn into the lungs. The weight of the body increases and he sinks. He rises again to the surface by the involuntary movements of his limbs, and draws more water into the lungs in an effort to keep above water, and consequently goes to the bottom. This alternate rising and sinking goes on longer than the proverbial three times, until all the air has been expelled from the lungs and its place has been taken up by water. He now becomes

insensible, and sinks to the bottom to die. Sometimes convulsions precede death.

Symptoms.—The subjective symptoms felt by a drowning person are auditory and visual hallucinations, and return to memory of past events, which had already been forgotten. In some cases there is mental confusion.

Mode of Death—Asphyxia.—This is a common cause in the majority of cases, as water getting into the lungs, gets churned up with air, and produces fine froth which blocks the air vesicles.

Shock.—This is brought about by fright or terror, or it may be caused during a fall, the water striking against the chest and pit of the stomach. Again, if water is very cold, it may induce shock through the recurrent laryngeal or trigeminal nerves, which reflexly inhibit the action of the heart and lungs.

Concussion.—This may be caused by a fall from a height head downwards or by the buttocks striking the surface of the water.

Syncope.—This may occur in persons suffering from heart disease or epilepsy by falling suddenly in cold water.

Apoplexy.—Cerebral vessels, especially if they happen to be diseased, may be ruptured by a sudden rush of blood to the brain due to cold, excitement or the first violent struggles to keep above the surface of the water.

Exhaustion.—This results from continued efforts to keep above the surface of the water.

Injuries.—Fracture of the skull bones and fracture-dislocation of the cervical vertebræ may result during a fall, especially among divers, or those who fall into narrow, deep, *pacca* wells.

Fatal Period.—Asphyxia supervenes within two minutes after complete submersion, and the heart stops in two to five minutes afterwards. It has been found from observations

that even expert divers cannot hold their breath under water for two minutes continuously, the average time being fifty seconds in the case of Ceylon pearl divers, seventy-five seconds in the case of Arab divers in the Red sea, and seventy-six seconds in the case of the Navarius sponge divers. Thus, it will be seen that death is almost sure after complete submersion for five minutes, unless water was prevented from entering the lungs on account of shock or syncope caused at the time of the fall. Such cases are possible to be resuscitated even after an immersion of twenty to thirty minutes.

Treatment.—In the case of persons rescued from drowning, an attempt at resuscitation should be made at once on the spot without delaying for a moment, and should be continued for at least an hour, unless it is certain that death has occurred.

The chief object in the treatment of an apparently drowned person should be the removal of water from the lungs and the introduction of air instead. This can be best accomplished by stripping the person naked to the waist and starting artificial respiration. This should be supplemented by the application of ammonia, snuff or smelling salts to reflexly excite respiratory efforts, by friction to promote heat of the body, by alternate splashes of hot and cold water to the face and chest, by galvanic battery, and by hypodermic injections of strychnine, atropine sulphate, or adrenaline chloride.

There are five methods of artificial respiration; viz., (1) Schäfer's method (Prone posture), (2) Sylvester's method, (3) Howard's method, (4) Marshall Hall's method, and (5) Laborde's method. But Schäfer's method is the best and simplest to perform, and has been recommended by the authorities of the Humanitarian Society of England. There is another method of promoting respiration by anal dilatation.

It is said that it is very effective in resuscitating the apparently drowned or narcotized by chloroform anæsthesia.

After respiration has been established, the patient should be covered with warm blankets, put to bed with hot-water bottles at the sides, and given a little brandy in warm water or warm milk, if he can swallow it. The patient should be carefully watched for sometime as, after recovery, death may occur from exhaustion or pneumonia.

Post-Mortem Appearances.—These are the signs of asphyxia unless death occurred from shock or syncope. It must not be forgotten that bodies taken out of water putrefy so very rapidly, that it is not possible to find the *post-mortem* signs of drowning, unless a body is examined immediately after removal from water. Besides, the signs will depend on the time that the body has remained under water.

External Appearances.—The clothes on the body are wet unless examined a long time after removal from water. The face is pale, the eyes are half open or closed, the conjuctivæ are congested, and the pupils dilated. The tongue is swollen and sometimes protruded. Fine leathery froth, sometimes mixed with blood, is seen at the mouth and nostrils. If not visible, it will appear on compressing the chest. This is regarded as a diagnostic sign of drowning, but too much reliance cannot be put on this sign alone, as it is seen in cases of opium poisoning, and in deaths occurring from slow asphyxia. It also appears after putrefaction has set in. The granular and puckered appearance of the skin, known as *cutis anserina* or *goose-skin*, is found on the anterior surface of the body, particularly the extremities. It is caused by the contraction of the muscle fibres termed as the *arrectores pilorum* connected with the hair follicles, and is considered as an important sign showing that drowning had occurred during life, but it may occur immediately after death, while the muscles are still warm and irritable. It is not confined to drowning

alone as, it being the result of a mental shock is found in other violent and accidental deaths. Again, the *cutis anserina*, as it disappears after rigor mortis, is rarely seen in India, for bodies are seldom seen immediately after death from drowning in this country.

The male generative organ is found contracted and retracted. Casper lays a great stress on this point as a sign suggestive of death from drowning, but the same remarks are applicable to it as in the case of *cutis anserina.*

Mud, gravel, weeds, twigs or leaves may be found firmly grasped in the hands as a result of cadaveric spasm. The presence of this sign is indicative of death having occurred from drowning. Mud or sand may also be found under the nails together with abrasions on the fingers, as well as, on the toes.

The skin of the palms of the hands and soles of the feet assumes a greyish blue coloration from hypostasis, when a body has remained in the water from twelve to twenty-four hours. This condition of the skin is known as the *cholera hand.* After a lapse of two or three days the skin of the hands and feet becomes corrugated and sodden, and is then known as the *washerwoman's hand.* This sign proves that the body has remained for a long time in water without reference to its cause.

Internal Appearances.—The usual signs of asphyxia are found, but the following are characteristic of drowning. The larynx, trachea and pharynx contain fine clear or blood-stained froth, and may contain sand, mud or fragments of weeds. Their mucous membrane is usually congested. The lungs are distended like balloons, and overlap the heart and protrude out of the chest on laying it open. They are œdematous, non-elastic, and pit on pressure. They are congested and exude copious frothy, bloody liquid on being cut. The bronchial tubes may contain water and some foreign matter,

such as sand, mud, and leaves of aquatic plants. During putrefaction the watery fluid may transude from the lungs into the pleural cavity. Froth appears within two minutes of submersion, and its quantity varies according to the length of submersion and the violent respiratory efforts. Food may be found in the windpipe and the lungs, especially if the stomach was full at the time of drowning. The stomach is usually found full of water, which has the same characters as that in which the body was found. In addition to water, sand, mud, algæ, weeds, etc., may be found in the stomach. However, the stomach may be found empty, if the person died from syncope or became insensible or unconscious immediately after falling into the water, and thus could not drink it or, if the body had far advanced in putrefaction. In fact, it is very rare to find the stomach containing water in summer, when the body usually arrives in an advanced state of decomposition to the *Sadar* mortuary.

It must be borne in mind that it is not probable, though possible, for water to get into the stomach after death, if the body has been submerged in very deep water; but the presence of water in the duodenum is a positive proof of death by drowning, as the passage of water into the intestine is only due to its peristaltic movement, which is a vital act. The presence of water in the middle ear is regarded as an important sign of drowning.

Medico-Legal Questions.—These are :

1. Whether death was caused by drowning.
2. Whether drowning was suicidal, homicidal or accidental.

1. Whether Death was caused by Drowning.—In Northern India it is a common custom to throw dead bodies into running streams, and hence the fact of finding a dead body in water does not lead one to presume that death was caused by drowning. Again victims are often

murdered or poisoned first, and then thrown into water to avoid the detection of crime. Once the body of a boy five years old was taken out from a well, and sent to the Agra mortuary with the police report that death was alleged to have been caused by drowning but, on *post-mortem* examination, the cause was found to be suffocation brought about by closing the mouth and nostrils. It is, therefore, very essential to examine the body carefully for the evidence of external and internal injuries—*ante-mortem* or *post-mortem*—or for the signs of poisoning.

After excluding these possibilities, an opinion as to the cause of death from drowning should be given from a number of characteristic signs. It must, however, be remembered that death from drowning might occur without exhibiting any characteristic signs. In the case of doubt, it is always safer to preserve the viscera for chemical analysis.

2. Whether Drowning was Homicidal, Suicidal or Accidental.—Homicidal drowning is rare except in the case of infants and children. It is not possible to drown a strong, young person, unless he is attacked unawares, and pushed or thrown into the water, unless he has been previously stupefied by some narcotic drug.

Suicidal drowning is very common. Females, even on the least provocation, commit suicide by jumping into a well or tank in the neighbourhood of their house or village. Sometimes a woman falls in the water with her child. If she survives and the child dies, she is tried for having committed an attempt at suicide, and for murder. Very often heavy loads or stones are attached to the bodies, and their hands and feet are also found tied. Injuries are generally absent, but they may be found by the body coming accidentally into contact with a hard substance during a fall.

Accidental drowning is also common in India. It occurs generally in deep water while taking a bath, and hence the

body is usually found naked with a loin-cloth only, having no weight attached to the body. Accidental drowning in shallow water is very rare except when the individual happens to be intoxicated, insane, or epileptic.

CHAPTER VIII.

DEATH FROM STARVATION, COLD AND HEAT.

STARVATION.

Starvation or inanition results from the deprivation of a regular and constant supply of food, which is necessary to keep up the nutrition of the body. Starvation is regarded as *acute*, when the necessary food has been suddenly and completely withheld, and *chronic*, when there is a gradual deficient supply of food, as in famine times.

Symptoms.—Pain in the stomach relieved by pressure. The intense feeling of hunger lasts for thirty to forty-eight hours, and is then followed by a feeling of thirst. After four or five days of starvation general emaciation and the absorption of fat begins. The eyes appear sunken and glistening, the pupils are widely dilated, and the bony projections of the face become prominent. The lips and the tongue are dry and cracked, and the breath is foul and offensive. The voice becomes weak, faint and inaudible. The skin is dry, rough, wrinkled and boggy, emanating a peculiar, disagreeable odour. The pulse is usually weak and frequent but, sometimes becomes slow. The temperature is usually subnormal, the diurnal variation reaching 3·28°F. instead of it being 0.3 to 1°F. as in the normal body. The abdomen is sunken, and the extremities become thin and flaccid with loss of muscular power. There is usually constipation, the motion being dark and dry, and the urine is scanty, turbid and high colored. Loss of weight is the most marked and constant. A loss of two-fifths or forty per cent. of weight ordinarily ends in death. The intellect remains clear till death though, in some

cases, illusions of sight and hearing may be met with. Occasionally delirium and convulsions precede death.

Fatal period.—Death occurs in ten to twelve days, if both water and food have been totally deprived but, if food alone is withdrawn, life may be prolonged for a long period, say, from thirty to forty-five days or even more, since there are many instances of Jain Sadhus fasting for such a long period without taking anything but boiled water. This is, however, influenced by certain conditions, such as, age, sex, condition of the body and its environments.

Age.—Children suffer most from want of food. Old people can bear deprivation of food better than young adults, but not for a long time.

Sex.—Women stand starvation better than men, as they require less food and are ordinarily fatter than men.

Condition of the Body.—People who have a lot of adipose tissue, and are in perfect health can bear starvation better and longer than thin, lean and weakly persons.

Environments of the Body.—The effects of starvation are not felt very much, so long as the body temperature is maintained by suitable clothing. Exposure to cold tends to shorten the period of life. Starvation is well borne by those persons in whom, the activity of their vital functions is lowered, as in the cataleptic.

Post-mortem Appearances—External.—The body is greatly emaciated. The eyes are red and open, the eyeballs, sunken. The cheeks and temples are hollow. The skin is dry and shrivelled. The muscles are pale, soft and wasted, and there is complete absence of subcutaneous fat.

Internal.—The heart is smaller in size and empty. The lungs are collapsed, and contain very little blood, when cut. The stomach and intestines are empty and contracted, and show an extensive thinning of their walls. Sometimes, ulcerations are found in their walls, which are very likely due to

the inflammation resulting from injudicious ingestion of substances. The large intestines may contain hard scyballous fæcal matter. The liver, spleen and kidneys are small and reduced in size. The gall-bladder is usually found full of dark, inspissated bile.

Medico-Legal Questions.—

1. Whether death was caused by starvation.
2. Whether starvation was suicidal, homicidal or accidental.

1. Whether Death was caused by Starvation.—One must always bear in mind that there are certain pathological conditions, viz., the malignant disease of the alimentary canal, progressive muscular atrophy, Addison's disease, diabetes mellitus and tuberculosis, which lead to progressive wasting and emaciation of the body. It is, therefore, very necessary to search for the existence of any of these diseases while holding a *post-mortem* examination, before one can give the opinion that death occurred from starvation.

2. Whether Starvation was Suicidal, Homicidal or Accidental.—Suicidal starvation is very rare though it may be seen among lunatics or prisoners, who may go on "hunger strike". In this connection it must be remembered that the forcible feeding of prisoners, when they refuse to take any food on account of passive resistance is not an assault but quite lawful.

In India, sometimes, young hysterical women imagine that they are possessed by deities, and say that they can live without food for a prolonged period, or they do so to practise deception on their friends and relatives. When people watch them, they actually abstain from food, and prefer to die rather than their imposture should be found out. Persons watching them must be very careful, as they are criminally responsible for abetting suicide, if death results from this enforced fasting.

Homicidal starvation is met with in the case of infants and children. Illegitimate infants are generally done to death by depriving them of proper food, and at the same time exposing them to cold. Rarely mothers-in-law in the lower classes in India starve their little daughters-in-law to death. Two such cases occurred at Agra. Both were sisters and were married in the same house. They were seven and ten years old respectively, were burnt at several places and were not given sufficient food, until they died from inanition.

Accidental starvation may occur in ship-wreck, in mines on account of an accident, or during famine.

COLD.

Children and old persons are very susceptible to cold. Individuals, whose vitality has been lowered from fatigue, want of food, indulgence in alcoholic drinks and previous ill-health, are less able to withstand the effects of cold than healthy, well-nourished adults of temperate habits.

Symptoms—Local.—These are seen on the skin in the form of erythematous patches, called frost-bite (frost-erythems) and chilblains produced by the contraction of the cutaneous vessels and thus depriving the tissues of their nourishment. The exposed parts, such as ears, nose, fingers and toes, are usually affected. The condition of frost-bite being a vital action can never be produced after death.

General.—There are no bad effects from moderate cold; on the contrary, it invigorates the body, and produces appetite and hunger; but exposure to severe cold continued for a long time produces deleterious effects, especially if a person is not properly clothed to keep up the body heat, and does not get sufficient food or exercise. The skin becomes pale and numb; sometimes it assumes a dusky, reddish and livid hue, with the formation of vesicles. The muscles become so stiff, rigid and heavy, that the patient is unable to move or raise his

limbs. This condition is followed by general lethargy, drowsiness and an inclination to sleep which, if not controlled, passes gradually into stupor, coma and ultimately death. Sometimes convulsions, hallucinations and delirium may occur before death. In rare cases the body temperature has fallen to 78° or 79°F. without causing death.

Cause of Death.—Death occurs from a lesser supply of oxygen to the nervous centres and tissues, as hæmoglobin is unable to part with it at a lower temperature.

Post-Mortem Appearances—External.—The surface of the body is usually pale, marked with irregular dusky red patches of frost-erythems, especially on the exposed parts, such as, the tips of the fingers and toes, nose and ears. These are not situated on the dependant parts as in *post-mortem* staining. Rigor mortis is slow to appear and, hence lasts longer. If a body buried in snow is found in a condition of commencing decomposition, the death is very likely not from cold, which prevents decomposition.

Internal.—The brain is congested, with effusion of serum into its ventricles. The heart contains fluid blood in both the chambers. The lungs and other organs are congested. The blood is bright red in color except in the heart, where it appears dark when viewed in mass.

Medico-Legal Aspect.—Death from cold is mostly accidental, though very rare in India. Drunkards may be found dead in the streets, when exposed to cold on a wintry night. It may form a case for medico-legal enquiry, as newly born infants are very often murdered by exposure to cold by depriving them of necessary clothes.

HEAT.

The effects produced by exposure to excessive heat may be considered under one group, viz., heat stroke, which manifests itself into three distinct types, namely—

1. Mild thermic fever.
2. Heat exhaustion.
3. Sunstroke.

The exposure to direct rays of the sun is not necessary. An individual may be affected while working in a closed, hot, and badly ventilated room or factory. People, however, from prolonged habit, can bear very high temperatures, for a considerable period. Even persons unaccustomed to very much heat can bear it for sometime, if there is not much moisture in the atmosphere, and if they keep on drinking a lot of water, so that they may perspire freely.

The predisposing causes are ill-nourishment, over-exertion to a fatiguing point, such as, long marches, over-indulgence in alcohol and a previous attack of the disease.

1. **Mild Thermic Fever.**—This affects persons working in small, closed rooms with open ovens, as in glass works.

Symptoms.—These are general lassitude and insensibility to light or sounds. The skin becomes hot, with a temperature of 103° or 104°F. Severe headache, prostration and delirium then follow. The condition may last from three to ten days in temperate climates but, in India, these symptoms may be followed by coma, death occurring in three to four days.

2. **Heat Exhaustion.**—The attack may come on suddenly or gradually. In a sudden attack the patient falls down, and dies immediately or within a short period, the shortest recorded fatal period being ten minutes. When the attack is gradual, the first symptoms are giddiness, nausea, headache of a throbbing character, and dim vision with dilated pupils. Collapse then supervenes, with a subnormal temperature, rapid and feeble pulse and sighing respirations. Death occurs from heart failure, or reaction sets in after some time, followed by recovery. Throughout the course, consciousness, is, as a rule, not lost.

3. Sunstroke (Heat Apoplexy, Insolation or "Coup de Soleil").—The symptoms supervene all of a sudden in a person exposed to very great heat in the summer months especially if he has been fatigued by prolonged and extreme exertion, but in some cases prodromal symptoms, such as, a feeling of heat, headache, giddiness, nausea and vomiting, may be experienced. Insensibility soon sets in, and the patient may be struck down. The temperature rises very high, even upto 112° or 115°F. The face is flushed, and the pupils are first dilated and insensitive to light, but become contracted towards death. The pulse is full and bounding, and the respirations are hurried and stertorous. Death results from asphyxia and coma, very often followed by convulsions and delirium. The shortest fatal period is five minutes; it may be prolonged to three days.

After-Effects.—After recovery from heat stroke the patient becomes very susceptible to the variations of temperature, and usually complains of headache and nervous irritability. Sometimes he may suffer from epilepsy or insanity for the rest of his life.

Post-Mortem Appearances—External.—Rigor mortis is well marked, but comes on early and passes off rapidly putrefaction following immediately after. Petechial and livid patches are found on the skin.

Internal.—The brain and its meninges are congested, and the ventricles contain serum. The lungs are congested and œdematous. The right side of the heart and pulmonary arteries are dilated, and gorged with dark fluid blood, and the left side is empty, and contracted. The abdominal organs are congested.

Medico-Legal Importance.—There is no medico-legal importance attached to deaths occurring from heat stroke, as they are all accidental, but the medical man may have to hold a *post-mortem* examination on such a body, if found lying dead

on the road side or in a railway carriage, as it sometimes happens on the hot summer days, and the police are bound to send such cases for autopsy.

CHAPTER IX.

DEATH FROM BURNS, SCALDS, LIGHTNING, AND ELECTRICITY.

BURNS AND SCALDS.

Definition.—Burns are injuries produced by the application of flame, radiant heat or some highly heated substance, to the surface of the body. The injuries caused by friction, lightning, electricity, X-rays and corrosive chemical substances are all classified as burns for medico-legal purposes.

Scalds are injuries produced by the application on the body of liquids at or near their boiling points, or their gaseous forms, such as steam.

Scalds are usually not so severe as burns, as the liquids producing them run off the surface of the body, and hence rapidly cool on account of their evaporation, but they resemble burns very much in severity when produced by oils, which boil at a much higher temperature than water, or by molten metals which adhere to the surface.

The Classification of Burns.—Dupuytren has classified burns into the six following degrees according to the nature of their severity :—

First Degree.—This consists of erythema or simple redness of the skin caused by a momentary application of flame, or solids and liquids much below the boiling point. They can, also, be produced by mild irritants. The redness and swelling of the skin, marked with superficial inflammation usually disappear in a few hours, but may last for several days, when the upper layer of the skin peels off. At any rate they disappear after death due to the gravitation of blood to the

dependant parts. There being no destruction of the tissues, no scar results from this kind of burn.

Second Degree.—This comprises acute inflammation and formation of vesicles produced by the prolonged application of flame, liquids at a boiling point, or solids much above the boiling point of water. They can also be produced by the application of strong irritants or vesicants, such as cantharides. If the burns are caused by a flame or a heated solid substance, the skin is blackened, and the hair singed at the seat of lesion, which assumes the character of the substance used. No scar results as, only the superficial layers of the epithelium are destroyed. Some slight staining of the skin, however, may subsequently remain.

Third Degree.—This refers to the destruction of the cuticle and part of the true skin, which appears horny and dark, owing to its having been charred and shrivelled up. The nerve endings are exposed in this form of burns and hence, it is the most painful. This leaves a scar, but no contraction as the scar, which forms after healing, contains all the elements of the true skin, and consequently the integrity of the part is retained.

Fourth Degree.—This means the destruction of the whole skin. The sloughs, which form, are yellowish brown and parchment-like, and separate out from the fourth to the sixth day, leaving an ulcerated surface, which heals slowly, forming a scar of dense fibrous tissue with consequent contraction and deformity of the affected parts. On account of the complete destruction of the nerve endings this kind of burn is not very painful.

Fifth Degree.—This includes the penetration of the deep fascia and implication of the muscles, and results in great scarring and deformity.

Sixth Degree.—This involves charring of the whole limb, and ends in inflammation of the subjacent tissues and organs, if death is not the immediate result.

Effects of Burns.—Burns and scalds vary in their effects according to the following conditions :—

1. The degree of heat applied.
2. The duration of exposure.
3. The extent of the surface.
4. The site.
5. The age of the patient.
6. The sex.

1. The Degree of Heat applied.—The effects are much more severe, if the heat applied is very great.

2. The Duration of Exposure.—The symptoms are, also, more severe, if the application of heat is continued for a long time.

3. The Extent of the Surface.—The involvement of one-half to two-thirds of the superficial surface of the body is likely to end fatally.

4. The Site.—Extensive burns of the trunk, even though superficial, are much more dangerous than those of the extremities ; burns of the genital organs and the lower part of the abdomen are often fatal.

5. Age of Patient.—Children are more susceptible to burns, but stand prolonged suppuration better than adults. Aged people bear burns well.

6. Sex.—Men bear burns better than women, but sensitive and nervous females are more susceptible than strong women.

Causes of Death—1. Shock.—Severe pain caused by extensive burns results in death instantaneously or within twenty-four hours, causing shock to the nervous system, producing a feeble pulse, pale and cold skin and collapse. In the case of children it may lead to stupor and insensibility deepening into coma and death within forty-eight hours. It is advisable not to give opium in any form in such cases, to avoid the suggestion that coma was due to this drug.

2. Suffocation.—Persons when removed from houses

destroyed by fire are found dead from suffocation due to the inhalation of smoke, carbon-dioxide or carbon-monoxide gas, the products of combustion. In such a case burns found on the body would be *post-mortem.* On or about the 12th. January 1917, a lunatic in the asylum at Agra was suffocated to death in bed from smoke produced by the quilt catching fire with which he had covered his face, and the extensive superficial burns found on the body appeared to have been caused after death.

3. **Accidents or Injuries.**—Death may result from an accident occurring in an attempt to escape from a burning house or from injuries inflicted by walls and timbers falling on the body.

4. **Inflammation** of serous membranes and internal organs, such as, meningitis, peritonitis, pleurisy, bronchitis, pneumonia, enteritis and ulcer of the duodenum.

5. **Exhaustion** from suppurative discharges lasting for weeks or months.

6. **Lardaceous** disease of the internal organs resulting from suppurative exhaustion.

7. **Erysipelas, Pyæmia, Gangrene and Tetanus.**

Fatal Period.—As already mentioned death may occur within twenty-four to forty-eight hours, but, usually the first week after receiving burns is the most fatal. In suppurative cases death may occur after five or six weeks or longer.

The Nature of Burns in the Absence of Death.—In a case, where death has not occurred, burns will constitute simple or grievous injury as the case may be (vide Appendix IX, sections 319, 320, 324, 326 I. P. C.). Burns of the first and second degree, if not extensive, are mostly simple. Burns are grievous, if they cause permanent loss of sight of either eye, or, permanent impairment of the power of a member or a joint on account of the formation of a cicatrix and contraction, if a joint and its neighbouring parts have been severely burnt.

Lastly the burns are grievous, if the individual has suffered from shock, or if he has been bed-ridden, and unable to follow his usual pursuits for twenty days.

Post-Mortem Appearances—External.—The external appearances of burns vary according to the nature of the substance used to produce them. Thus, the skin is whitened when the burn has been caused by radiant heat.

Burns produced by flame may or may not produce vesication, but there is always singeing of the hair and blackening of the skin.

A highly heated solid body or a molten metal, when momentarily applied to the body, may produce only a blister, but will cause roasting and charring of the parts, when kept in contact for a long time.

The flame of an explosive, such as a mixture of coal gas and air, scorches and mummifies the skin.

The flame of gunpowder blackens the skin, and some of its particles may be found embedded into it.

Burns caused by kerosene oil are known from its characteristic odour and the sooty blackening of the parts.

When the body has been exposed to great heat, it becomes so rigid with the limbs flexed and arms fixed that it assumes an attitude of defence called the "pugilistic" or "fencing" posture. This stiffening occurs on account of the coagulation of its albuminous constituents. If the heat applied is very great, cracks and fissures resembling incised wounds occur often in the skin and tissues, but no blood clot, nor infiltration of the blood is found in the cellular spaces, and the blood-vessels are seen stretching across the fissures, as they are not usually burnt. Sometimes, the skin, being hard and brittle due to the effect of heat, cracks easily when an attempt is made to remove a body from a house destroyed by fire.

Scalds caused by boiling water or steam produce blisters and sodden the skin, which has a dirty white appearance.

X-ray burns caused by an over exposure produce redness of the skin or dermatitis with the shedding of the hair. The cicatrix formed is radiate in shape. In some cases sloughy ulcers are found as a result of blisters, which heal very slowly after they have burst.

The corrosive substances affect only the tissues, and do not produce vesication, nor scorching of the hair in the vicinity, but they can be recognised from the color stains on the skin and clothes, and from their chemical analysis.

If a body has been very much burned, it is very necessary to note the sex, probable age and other peculiar marks to establish the identification of the individual.

Internal. – Skull bones are found fractured or burst open, if intense heat has been applied. There is extravasation of blood under the dura mater. The brain is sometimes shrunken though its form is retained. If death has occurred from suffocation, the trachea and bronchial tubes may contain dark froth and sooty particles.

The pleuræ are congested or inflamed, and there may be serious effusion into their cavities. The lungs are usually congested ; they may be shrunken and rarely anæmic. The right chamber of the heart is full or empty. Blood is cherry red in color, if death has occurred from suffocation. The abdominal organs are reddish and congested. There may be inflammation and ulceration of Peyer's patches and solitary glands of the intestines. Ulcers may also be found in the duodenum, when the patient dies some time after receiving the burns. These ulcers are more common in women than in men, whereas the idiopathic ulcer in the duodenum is more frequent in men.

Distinction between Ante-mortem and Post-mortem Burns.—People, sometimes, produce burns on a dead body to support a false charge of murder, and at other times the police remove a dead body while in the act of burn-

ing on a cremating pyre, and send it to the medical officer for *post-mortem* examination, when they suspect that the body is being hurriedly cremated to conceal a crime of murder. In both cases the medical officer should be prepared to tell the difference between *ante-mortem* and *post-mortem* burns.

The three main points to differentiate between *ante-mortem* and *post-mortem* burns are :—

1. The line of redness.
2. Vesication.
3. Reparative processes.

1. The Line of Redness.—In the case of a burn caused during life a line of redness involving the whole true skin is formed round about the injured part. It is a permanent line, persisting even after death, but redness or erythema, which is found beyond this line of redness due to the distention of capillaries is transient, disappears under pressure during life and fades after death. The line of redness being a vital function as it separates living from dead tissue, is always present in burns caused during life, though it takes some time to appear. Hence it is possible that it may be absent in the case of a person of a very weak constitution, who dies immediately from shock due to burns.

2. Vesication.—Vesication caused by a burn during life contains a serous fluid consisting of albumen and chlorides, having a red inflamed base with raised papillæ. The skin surrounding it is of a bright red or coppery colour. This is known as *true* as compared with *false*, when produced after death. False vesication contains air only, but may contain a very small quantity of serum comprising a trace of albumen, but no chlorides as in a person suffering from general anasarca. Again, its base is hard, dry, horny and yellow, instead of being red and inflamed.

3. Reparative Processes.– Reparative processes, such as signs of inflammation, formation of granulation tissue,

pus and sloughs will indicate that the burns were caused during life. Burns caused after death have a dull white appearance with the openings of the skin glands colored grey. The internal organs are roasted, and emit a peculiar offensive odour.

The Period of Burns.—In the case of a burn the question is raised as to when it was caused ; and in the case of several burns on the same individual a further question is raised as to whether they were inflicted simultaneously or not. Both these questions can be answered by examining carefully their condition as regards the different stages of reparative processes.

Redness and vesication form immediately or within a few hours, say, two to three, after receiving burns. Pus forms in two to three days but not before thirty-six hours. The formation of granulation and separation of sloughs occur after several days. The last result is the formation of a cicatrix and deformity.

Suicidal, Homicidal and Accidental Burns.—Suicidal cases are very rare except among lunatics ; but lately a few cases among Bengali girls have been recorded, who committed suicide by soaking their clothes first with kerosene oil and then setting fire to them.

Homicidal cases are very common in India. Burns are caused very often by a mother-in-law on the body of her infant daughter-in-law for very trifling faults. The substances selected are generally a pair of hot tongs (*chimta*) or *karchi*, and the sites selected are usually the arms, hands, thighs and private parts. I have seen several such cases with two deaths in Agra. Among grown-up females the burns are produced usually on the pudenda, as a punishment for adultery. A master, when he becomes angry with his servant for disobedience or petty theft, produces burns on his body with a hot pipe or *chilam*. Robbers and dacoits

very often inflict burns as a torture to extort information about valuables hidden in the house of their victims.

Accidental cases are also common, specially among women and children on account of their loose garments catching fire, while sitting near an *angethi*, *chula*, or an open lamp. Again children may be scalded by trying to drink from a spout of a kettle containing boiling water, or by it accidentally falling on them. Sometimes, along with the burns, wounds caused by falling of rafters, bricks etc., may be seen on the body when removed from a burnt out house.

Spontaneous or Preternatural Combustion.—The possibility of spontaneous combustion of a human body may be raised as a defence plea, but it must be remembered that it has not yet been proved scientifically that a body can be consumed without the application of fire or flame, though a few unauthentic cases have been recorded. It is possible that the combustibility of a body may increase, if the individual has been fat, bloated and has passed middle life, and has been saturated with alcohol on account of intemperate habits. It is also possible for a body to burn spontaneously owing to the evolution of inflammable gases during the process of decomposition. Even an individual may eliminate an inflammable gas in breath during life. Dixon Mann quotes the case of a man who, while attempting to blow a match lighted to light his cigarette, woke his wife from sleep owing to a loud noise due to the explosion, occurring from combination of his breath (marsh gas) with the light of the match.

LIGHTNING.

During thunderstorms, people are struck down by lightning or atmospheric electricity in the open fields or in their houses, especially near open doors and windows, through which it enters. It is attracted by the highest points, and

hence it is dangerous to stand near tall trees during thunderstorms. Similarly it is dangerous to have a good conducting material on the body or in its vicinity.

Symptoms.—Death occurs immediately from shock, or may occur subsequently from the effects of burns and lacerations after some days or even weeks. In non-fatal cases the individual complains of giddiness, ringing in the ears and headache. These symptoms pass off very soon, or he may become hysterical and nervous, when the lightning discharge is very slight though, in severe shock but not enough to cause fatal results, the patient may suffer from loss of memory, paralysis, tetanic convulsions, cardiac affections, blindness, deafness or dumbness.

Post-Mortem Appearances—External.—The lesions produced by lightning stroke on the skin near the point of its entry and exit are ecchymoses, contusions and lacerations. Wounds of all varieties, and fractures of bones are also present. In addition to blisters, fissures and charring caused by burns, reddish-brown arborescent (tree-leaf) markings are often seen on the body. It was thought that these markings were due to the photographs of the neighbouring trees imprinted on the body by the electric current but, in reality they are the result of the passage of an electric current along the skin and consequent rupture of the superficial vessels.

The hair on the head, face and body is singed, and the impressions of metallic articles are formed on the skin. The wearing apparel and boots or shoes are burnt, torn or rent, and thrown off the body at some distance without injuring the body in some cases. The metallic articles carried about the person are fused and articles of steel, such as a penknife, carried in the pocket, are magnetised. This sign is important when a murder during a thunderstorm is attributed to lightning.

Internal.—The internal signs are not very characteristic. There may be extensive hæmorrhage in the brain. The

blood is usually fluid, but may be found clotted. The cavities of the heart are either empty or full. The bloodvessels may be found ruptured, and the internal organs torn.

ELECTRICITY.

Accidental cases of injury or death from electricity occur in those cities, where it is used for lighting and motive purposes. The electrical mains break, and the two ends fall on a person thus making a short circuit, or the workman may grasp the ends of the live wires, or may stand on one with the other in his hand.

In the United States electrocution is the method employed for the execution of criminals instead of hanging.

The human body is a bad conductor of electricity. It is supposed to be three million times less than mercury and fifteen million times less than copper; but the nerves are as good conductors as metals.

The Effects of Electricity.—The effects produced by electricity vary in accordance with—

1. The nature of the current.
2. The resistance of the body.

1. The Nature of the Current.—The alternating current is much more dangerous than the continuous current. The opening current of an induction coil is much more intense than its closing current. An alternating current of three hundred Volts has proved fatal, and one of fifteen hundred Volts is sure to destroy life and, hence it is used in electrocution. A continuous current, being very weak, requires three thousand Volts to prove fatal. Ordinarily currents of more than two-hundred and fifty Volts are not supplied to dwelling houses for the purpose of lights and fans.

Cause of Death.—Death occurs from shock or sudden stoppage of the heart, or sometimes, from paralysis of the respiratory organs.

Treatment.—The current should be at once switched off, or the patient should be removed from the vicinity of the live wires, but the person trying to remove him should guard himself against its effects by wearing india-rubber gloves, by standing on hay, or by using a long stick to remove the wires. The treatment to be adopted after removal is stimulation, warmth, friction, artificial respiration and venesection, if necessary.

Post-Mortem Appearances—External.—Burns and wounds at the point of contact. Fusion of metals, and magnetisation of steel articles.

Internal.—Congestion of internal organs. Minute hæmorrhages are seen in the meninges, and Tardieu's spots are found on the pleuræ, pericardium and endocardium.

CHAPTER X.

MECHANICAL INJURIES.

Mechanical injuries are, for medico-legal purposes, divided into contusions or bruises, and wounds.

CONTUSIONS.

Contusions or bruises are injuries, which are caused by a blow with a blunt weapon, or by a fall, or by crushing or compression. These are accompanied by a painful swelling and crushing or tearing of the subcutaneous tissues, without solution of continuity of the skin. The swelling is due to the rupture of the subcutaneous blood vessels producing into the cellular tissues an extravasation of blood, which is known as ecchymosis or effusion of blood.

Ecchymosis.—The ecchymosis or effusion of blood may be *superficial* or *deep*. The superficial ecchymosis makes its appearance over the seat of injury in one or two hours after the injury. It may appear even in less time, if the skin injured is very thin, as in the eyelids and scrotum. Deep ecchymosis, on the other hand, appears at an interval of some days or weeks at some distance from the seat of injury following the line of least resistance and in obedience to the law of gravity ; e. g., the appearance of a black eye in the case of a contusion on the forehead or on the head. Sometimes an ecchymosis may not appear until after death, when a contusion has been caused immediately before death.

The extent of ecchymosis depends, under ordinary circumstances, upon the nature and severity of the force used, the vascularity of the part struck, looseness of the underlying

cellular tissue and the condition of the assaulted victim. Thus it will be extensive in the eyelids, scrotum and vulva, and very little in the scalp where the skin is tense. Again it may not appear in the abdomen even if a cart-wheel were to pass over the body, and to cause death from the rupture of an internal organ. No evidence of ecchymosis is present, if the weapon used is a yielding one, such as a sand bag.

It is more easily produced in the case of children, flabby women and old people, even by slight violence ; on the contrary, it will be very slight, if a person happens to be strong and muscular.

In certain diseases such as scurvy, purpura, erythema nodosum, hæmophilia, the malignant cases of infectious diseases, rashes due to the continuous use of some drugs, and in the aged with sluggish circulation, subcutaneous hæmorrhages may occur spontaneously, which may be mistaken for ecchymoses, but they can be easily distinguished from their number, size, and symmetrical situation, generally on the legs, and from the absence of abrasions over the spots.

Similarly subconjuctival ecchymoses may occur in whooping cough. These are bright red in appearance and undergo no color changes, before they disappear. Sometimes ecchymoses may result from great muscular exertion as in epileptic seizures. These are usually numerous, but smaller in size.

Sometimes blebs and bullæ may form over the injured part, especially when ecchymosis is caused by fractures or by an oblique and glancing blow.

The Result of Bruises.—Contusions are, as a rule, simple injuries. They are seldom fatal unless accompanied by rupture of an internal organ, or by extensive crushing of the tissues and large extravasations of blood, producing sloughing and gangrene of the parts. However, several

bruises, though trivial individually, may cause death from shock or fright, as in flogging.

The Age of a Bruise.—The age of a bruise can be ascertained from the color changes which ecchymosis undergoes during its absorption. These color changes are due to the disintegration of the red blood cells and staining of the hæmoglobin thus set free. They commence at the periphery and extend inwards to the centre. Thus, during the first three days they are blue, bluish black, brown or livid red, become greenish from the fifth to the sixth day, and yellow from the seventh to the twelvth day. This yellow color slowly fades in tint till the fourteenth or fifteenth day, when the skin regains its normal appearance. Moreover, its disappearance is more rapid in healthy persons than in sickly and old people with feeble circulation. Besides, it depends on the nature of the violence used. An ecchymosis caused by slight force will disappear more quickly than an extensive one caused by considerable force. Deep ecchymoses do not exhibit any gradations of color during their absorption.

The Difference between Accidental and Homicidal Bruises.—The usual question that a defence pleader puts to a medical witness in the case of bruises is whether they were caused accidentally by a fall or homicidally by mechanical force. The reply to this question is not easy in all cases; however, the position and arrangement of the bruises may help him in giving a definite reply. In the case of a fall, he should look for sand, gravel or mud on the body. Again the shape and size of the bruise generally corresponds to the weapon alleged to have been used in inflicting the injury.

The Difference between an Ante-Mortem and Post-Mortem Bruise.—A swelling and the color changes are found in a bruise caused during life. There is usually a coagulation of the effused blood into the subcutaneous tissues

and infiltration of blood in the muscle fibres. These signs are absent in a bruise caused after death. A bruise is likely to be disfigured by putrefaction. However it is difficult to differentiate between a bruise caused during life and that caused within a short time after death. Sir Robert Christison proved by experiments that it was possible to produce a bruise within two to three hours and a quarter after death, which would be difficult to distinguish from one caused during life; but he found that very great violence had to be used and even then the resulting bruise was much smaller than one produced during life.

WOUNDS.

A wound is defined as the forcible solution of continuity of the soft tissues of the body including the skin or mucous membrane. Medico-legally wounds have been classified as—

1. Incised wounds.
2. Punctured wounds.
3. Lacerated wounds.
4. Contused wounds.
5. Gunshot wounds.

1. Incised wounds.—An incised wound is produced by a sharp cutting instrument, such as a knife, razor, a pair of scissors, *gandasa*, chopper, axe, hatchet, scythe, *kookri*, *etc.*

The characters of an incised wound.—The incised wound is always larger than the weapon causing it, on account of the retraction of the divided tissues. It is somewhat spindle-shaped and gaping, its superficial extent being greater than its depth. This gaping is greater in deep wounds when the muscle fibres have been cut transversely or obliquely. Its edges or margins are smooth, even, clean-cut, well-defined and everted. While describing an incised wound it is always necessary to note its direction. The commencement of the wound is deeper, and it gradually becomes shallower and tails

off towards the end, but no direction is noticed, when the weapon has not been drawn while inflicting a wound.

The bleeding in the case of incised wounds is usually much more than in the case of other wounds, and it may be so severe as to cause death, especially if a main artery has been cut.

2. Punctured Wounds.—These are termed penetrating wounds when, passing through the tissues, they enter a cavity of the body and injure an important internal organ. Both punctured and penetrating wounds are produced by a piercing or stabbing instrument, such as a bayonet, spear, dagger, pick-axe, arrow, needle, pin, etc. The point of the instrument may be sharp or blunt.

The aperture of a punctured wound is a little smaller than the weapon used, due to the elasticity of the skin. Its edges should be carefully examined to find out the nature of the weapon used. They are clean-cut and the wound is fusiform or diamond-shaped, when a double-edged weapon has been used. The edges are wedge-shaped, when one side of the blade is sharp, and the other blunt.

Great care should be taken in probing these wounds. If necessary, a blunt probe or catheter should be used.

External hæmorrhage is not a criterion of the danger to life. There may be very little external hæmorrhage and yet profuse hæmorrhage may take place internally owing to some vital organ having been penetrated.

In the case of punctured wounds perforating a part of the body there are two wounds, one, a wound of entry and the other, a wound of exit. The wound of entry is usually larger with inverted margins, and the wound of exit is smaller and has everted margins. The margins of the entrance wound may be found everted, when a weapon is rough and rusty.

In some cases two or more punctures may be found in the soft parts with only one external orifice. This shows that the

instrument had been partially withdrawn after it pierced the tissues, and thrust again in a new direction.

Sometimes it is argued that a punctured wound may have been caused by a fall on a broken piece of glass, earthenware or a piece of stone. In that case fragments of such broken articles will be found embedded in the soft tissues.

3. **Lacerated Wounds.**—These are produced by violent falls on a sharp and hard projecting surface, by machinery and railway accidents, by finger nails and teeth-bites, by claws and horns of animals and by projecting nails. These wounds do not generally correspond in shape or size to the weapon producing them. Their margins are jagged, torn, irregular and swollen. The tissues are torn and the skin beyond the seat of injury is ecchymosed. Hæmorrhage is not very extensive owing to the fact that the arteries are torn across irregularly, and not evenly cut.

4. **Contused Wounds.** These are ordinarily produced by a blunt weapon, such as, a *lathi*, club, crowbar, stone, brick, etc., or by a cutting instrument, when considerable force is used or when its blunt edge is used or when something in the form of a *pugrie* intervenes between the weapon and the part struck. The wounds are usually accompanied by a considerable amount of bruising of the surrounding and underlying tissues, and have inverted and irregular margins. Hæmorrhage may be very little in some cases.

Occasionally wounds produced by a blunt weapon look like incised wounds, when inflicted on tense structures covering the bones, such as the scalp, shin, etc., or by a fall on the knee or elbow, when the limb is flexed. In such cases hair bulbs at the base of the wound should be examined. They will be found cut, if the wound is caused by a cutting instrument, but crushed if produced by a blunt weapon. Again, in the case of the latter there will always be a certain amount of con-

tusion and irregularity of the margins, when seen with a lens. Similarly wounds produced by pieces of glass, broken crockery or sharp edges of a stone have the characters of incised wounds, but the margins are found irregular, inverted and contused, if examined carefully with a lens.

5. Gunshot Wounds.—These are injuries produced by projectiles discharged from fire arms. They generally produce two wounds or apertures; viz., one of entrance and the other of exit. In the case of shot guns and muzzle loading guns there may be several wounds on account of several projectiles issuing from a single discharge.

When the wound of entrance is present but no exit wound, it means that the bullet is lodged in the body except in those cases in which a hard bullet by coming in contact with a bone is so deflected as to pass out by the same orifice as it entered. If the bullet is lodged in the body, it must be taken out by any means if death has occurred, as it forms inherent evidence of the greatest value. While searching for a bullet it must be borne in mind that it takes a very erratic and circuitous course while passing through the body. In one case of suicide a bullet entered the mouth, and was found lodged under the left scapula after a good deal of dissection at the *post-mortem* examination. In another case a man who was working in a field, was shot in mistake for a black buck while in a squatting position. On *post-mortem* examination the bullet was found to have entered the outer side of the left arm and came out at its inner side. It again entered the body at the second left intercostal space and the left lung, passed out of it at its root, entered the right lung near its root, passed out at its base, and lodged itself in a flattened condition on the inner side of the right eighth rib causing its fracture.

When the bullet is found, it should be sent in a sealed packet to the superintendent of police.

In a case where death has not occurred, the bullet should be located by means of X-rays, if available.

The wound of entrance is usually small and round, having inverted edges, and ecchymosis round about it. Wadding, a piece of clothing or other debris may be found lodged in the wound. The wound of exit is usually large, with torn, irregular and everted edges ; but the edges of both the wounds of entry and exit may be found everted in fatty persons, due to protrusion of fat in the wounds, or to the expansible action of the gases generated during decomposition of the body.

Moreover the appearances of these wounds depend largely on the *shape of the projectile, its velocity* and *the distance of the firearm.*

1. The Shape of the Projectile.—Large bullets cause greater damage to the structures than small ones. The shape of the wound is usually round, but it is oval, when the bullet strikes the body obliquely. Round bullets produce wounds having the characters of contused and lacerated wounds. They cause extensive laceration of the tissues and communited fractures of the bones, if they strike the body at a right angle ; but their course is deflected, if they strike the body at an angle other than the right, or sometimes their course is arrested by coming in contact with buttons or other hard articles carried in a pocket.

Conical bullets produce much less laceration than the round ones, and the wounds produced by them are punctured in appearance. The conical bullets rarely split, though round ones do so very often.

The modern bullets used in army weapons have the shape of an elongated cone and owing to the great velocity usually pass straight and direct through the body without any deflection or deviation, and without causing much damage. The wounds of entry and exit are almost circular and similar in appearance without any bruising or laceration of the surround-

ing parts. Such wounds also heal very rapidly. Even the wounds caused by such bullets in the brain, lungs or intestines often run a perfectly normal course, and heal without any difficulty.

Expanding, grooved, Dum-dum bullets are very destructive in character, and produce extensive wounds with ragged margins.

Fragments of shell, when it bursts, are also destructive and cause extensive wounds.

Irregular missiles, such as pieces of stone, iron, *kankar*, beads of brass or nickel anklets or wristlets, seeds, etc., used in muzzle loading guns produce several irregular, lacerated wounds, and the exit wounds are larger than the entrance wounds. In one case several *kankars* managed to penetrate the lungs of an old woman, who was shot with a muzzle loading gun. The woman died of gangrene of the lungs after three months' stay in hospital.

Wadding and gunpowder may penetrate the internal organs of the body and cause death, if a fire-arm is discharged within four inches of the body without any bullet.

2. Velocity of the Projectile—The bullet, when it penetrates the body at a high velocity, produces clean, circular, punched out wounds or only slits as in stabbing wounds, while with a low velocity it causes contusion and laceration of the margins and great damage to the tissues through which it passes. The track made by the bullet widens as it goes deeper. This is the reverse of a punctured wound. When the force or momentum is all spent up, the bullet does not penetrate the body, but grazes the skin and produces a mere contusion.

3. Distance of the Firearm.—If the weapon is discharged very close to the body, within a few inches or in actual contact, subcutaneous tissues over an area of two or three inches round the bullet opening are lacerated and,

the surrounding skin is scorched and blackened by smoke and tattooed with unburnt grains of gunpowder. The hair gets singed, and the clothes are burnt owing to the flame of the gas. If the powder is smokeless, there will be no blackening of the skin, but there may be a greyish or white deposit on the skin round the wound. No blackening, nor scorching is found, if the firearm is discharged from a distance of more than four feet. Moreover, these signs may be absent even when the shot has been discharged very close to the body.

The time when a Weapon was fired.—Sometimes a medical man is asked to find out when a particular weapon was fired. If he is not a sportsman and conversant with different weapons, he should never hazard an opinion, but a student should remember for the purposes of examination that, after recent discharge, a deposit of sulphide of potassium and carbon is found in the barrel of the firearm. Its solution becomes alkaline when dissolved in distilled water, gives off an offensive smell of sulphuretted hydrogen and produces a black precipitate, if treated with a solution of lead acetate. After exposure to the air and moisture for some hours or days, the potassium sulphide gets converted into the sulphate, the solution of which is neutral in reaction and gives a white precipitate with lead acetate. At later periods oxides and sulphate of iron are formed in the barrel. Nitro powders leave only a slight yellow deposit in the barrel of a recently discharged firearm. But all these deposits will not be found, if the weapon has been thoroughly cleaned after the discharge.

Direction from which the Weapon was fired.—To guess this the position of the victim at the time of the discharge of the bullet should be first ascertained, and then a straight line drawn between the entrance and exit wounds and prolonged in front should indicate the line of dire ction.

CHAPTER XI.

THE MEDICO-LEGAL ASPECT OF WOUNDS.

EXAMINATION OF THE INJURED PERSON.

The medical officer is supplied by the police Superintendent or the Magistrate with a printed form, which he is required to fill up after examining the injured person sent by them (vide Appendix iv). He must fill up this form very carefully. First of all he should write the name of the injured person and the name and number of the police constable, who accompanies him, and should note the mark or marks of identification so as to be able to recognize him (injured person) in court. He should then note the exact time of the examination, viz., hour, date, month and year, and proceed with the examination proper as below :—

The Nature of Injury.—While describing the wounds in columns 1, 2 and 3 of the form he should carefully note their nature and number, the character of their margins, their size as regards length, breadth and depth, the line of direction and their situation. If necessary, he should use a magnifying lens. All the wounds should be measured with a tape measure, and the exact measurements in inches must be given ; they should never be guessed. While mentioning the exact situations a reference to some bony prominences or anatomical landmarks should be made, as for example, so many inches above or below the front or back of the left or right wrist, elbow, etc. In describing these points technical terms must be avoided as far as possible.

The wound of the chest and abdomen ought not to be probed, so that it may not be converted into a penetrating wound ; but in doubtful cases, it may be enlarged, under proper

precautions, to find out the condition of the underlying bone or organ.

Simple, Grievous or Dangerous Injury.—In column No. 4 it must be mentioned whether the injury is simple, grievous, or dangerous to life.

A simple or slight injury is one, which is neither extensive nor serious, and which heals rapidly without leaving any permanent deformity or disfigurement behind.

The grievous injuries as described in the footnote of the form and S. 320. I. P. C. are as follows :—

1. Emasculation. 2. Permanent privation of the sight of either eye. 3. Permanent privation of the hearing of either ear. 4. Privation of any member or joint. 5. Destruction or permanent impairing of the powers of any member or joint. 6. Permanent disfiguration of the head or face. 7. Fracture or dislocation of bone or tooth. 8. Any hurt which endangers life or which causes the sufferer to be during the space of twenty days in severe bodily pain or unable to follow his ordinary pursuits.

It must be remembered that a mere stay in hospital for twenty days does not constitute an injury grievous, as some lawyers are inclined to believe.

The danger to life should be imminent before wounds are designated "dangerous to life". Such wounds are extensive, and implicate some important structures or organs so that they may prove fatal without the interference of surgical aid. For instance, a compound fracture of a skull bone, a wound of a large artery, or rupture of some internal organ, such as the spleen, should be considered "dangerous to life." But the wounds which prove fatal remotely by intercurrent diseases, such as tetanus, erysipelas, etc., should not be considered as dangerous.

If an opinion as regards the nature of the injury cannot be formed at the time of the examination, as in the case of an

extensive swelling of a limb its fracture cannot be detected, or in the case of a head injury where the symptoms are obscure, the injured person must be kept under observation, until a definite opinion can be formed, and the police should be notified of the fact in police form No. 238 (Appendix iv).

The Kind of Weapon.—In the fifth column the kind of weapon with which the injury was probably caused should be mentioned. This can be inferred from examining the margins, ends and the shape of the wound, but sometimes it is difficult to give an opinion as to whether a particular injury especially a contusion, or a contused or a lacerated wound was caused by a blunt weapon or a fall. In that case it is better to give a guarded opinion, mentioning the possibility or probability, as the case may be. While forming an opinion the medical man should not always depend on the statement of the injured person, which is often false. Again, as a precautionary measure it is better to mention the fact, if he found that the injuries were such as could not have been caused in the manner suggested by the police or the injured person. This is important to avoid unnecessary cross-examination at the time of giving evidence in court.

If a weapon alleged to have been used in producing the injuries is sent by the police, it should be examined for marks of blood stains or fragments of hair, etc., adherent to it. At the same time any foreign body, such as a piece of broken glass, a splintered piece of a bamboo staff, a broken point of a cutting instrument or a pellet, bullet or wadding of fire-arms, when found lodged in a wound or in its surrounding tissue, should be carefully preserved, and sent in a sealed packet to the superintendent of police or magistrate. These articles help one materially in judging as to whether a particular weapon had caused the alleged injuries or not. Besides, the clothes should be examined for rents, cuts, tears, or burns, which should correspond to the injuries on the body.

Dangerous Weapon.—The sixth column of the form refers to the description of the weapon as to whether it is dangerous or not. It need not be filled up, as a foot-note No II is given at the bottom of the form which describes a dangerous weapon as any instrument for shooting, stabbing or cutting, or any instrument which, used as a weapon of offence, is likely to cause death.

The Age of Injury. In the column of remarks the age of the injury should be noted. It has been frequently found that medical men do not make any mention in their report of the period as to when an injury was inflicted, but it is not fair to do so, inasmuch as the guilt or innocence of a person charged with robbery, burglary, or dacoity may be proved from the injury found on his body, for its appearance may or may not correspond to the time when it is alleged to have been inflicted according to the version of the police.

It is not easy to give the exact time of infliction of any injury, but an approximate time can be given from the data given below. Hence it is necessary to always mention "about" while giving the period of the injury.

The Data to Ascertain the Age of Injury—

1. The age of a contusion can be ascertained from the color changes, which its ecchymosis undergoes. These changes commence from eighteen to twenty-four hours after its infliction.

2. A superficial cut, such as, one made with a razor during a shave heals, and scabs over within ten to twenty-four hours.

3. Vascular congestion and inflammatory swelling of a wound appears within less than forty-eight hours.

4. Pus appears in about thirty-six to forty-eight hours in a wound, which has been dirty or which has not been properly treated.

5. The margins of a small wound join together by the

exudation of serum within forty-eight hours, when it commences to heal, and heals completely in four to seven days.

6. In a wound, which heals by the formation of granulation tissue, it generally appears after about a week.

7. A contused wound on the head, as ordinarily observed, heals in a week's time but, if the margins are very much lacerated, it may take about ten to fourteen days, if properly treated, and if no pus has formed.

8. A wound may not heal for several days or even weeks, if it has suppurated, and especially if the injured person happens to be flabby or anæmic.

9. In fracture of a bone, the reparative process will enable one to fix its approximate time. The signs of inflammation and exudation of blood in the soft parts and round about the fractured ends are noticed from the first to the third day. Inflammation slowly subsides, and granulation tissue, known as the soft provisional callus, is formed from the third to the fourteenth day. This callus binds together the fractured ends of the bone. The formation of the amount of callus depends on the mobility or immobility of the fractured ends. It is less if the ends are immobile and impacted. It begins to ossify from the fourteenth day to the fifth week, and six to eight weeks is the average period taken by the callus to be absorbed completely so that the fractured ends may be united entirely with the formation of bone.

10. In the dislocation of a joint the time can be judged from the color changes of a bruise, which usually accompanies it, when caused by violence.

11. When a tooth has been knocked out, bleeding from its socket stops in about twenty-four hours but, sometimes on probing it, blood may come out even after two or three days. The cavity of the socket usually fills up within seven to ten days, and the alveolar process becomes quite smooth after fourteen days.

CAUSES OF DEATH FROM WOUNDS.

Before discussing the causes of death it is necessary to point out that the assailant is not responsible for the death of his victim occurring on receiving injuries, if it can be proved from *post-mortem* examination that it was due to natural causes, such as apoplexy, heart disease, phthisis or any other pathological condition or poison, and that the infliction of the injuries did not operate in any way, immediately or remotely, to cause the death which might have occurred at the time even if the injuries had not been inflicted. To substantiate the charge of murder or culpable homicide, the death should, therefore, be clearly traceable to the injuries inflicted and to no other cause. In such a case it is very necessary to hold a thorough *post-mortem* examination, and to examine the various organs and blood vessels for the presence of any morbid condition.

The causes of death from wounds are *immediate* or *direct*, and *remote* or *indirect*.

The Immediate or Direct Causes.—These are—

1. Hæmorrhage.
2. Injury of a vital organ.
3. Shock.

1. Hæmorrhage.—This may be external or internal. External hæmorrhage may cause death by producing syncope, when a large blood vessel, such as the carotid or femoral artery has been cut. The amount of hæmorrhage required to cause syncope varies according to circumstances. A sudden loss of blood is more dangerous than the same quantity lost slowly. In adults the loss of blood from five to eight pounds is almost enough to end fatally, but the children, women and old persons die from the loss of a much smaller quantity. Persons with hæmorrhagic diathesis or hæmophiliacs may die of hæmorrhage even from a trifling injury, which may cause bleeding.

The internal hæmorrhage may occur in penetrating and gunshot wounds. It need not be profuse for the occurrence of a fatal result; for a small quantity of hæmorrhage into the brain or into the pleural or pericardial cavities may prove rapidly fatal by disturbing the functions of the brain, lungs or the heart from mechanical pressure on them.

2. Injury of a Vital Organ.—Severe injury of a vital organ, such as the brain, heart, lungs, etc., is, as a rule, rapidly fatal.

When death occurs from a slight injury inflicted on a previously diseased organ, such as the rupture of an enlarged spleen, perforation of a chronic intestinal ulcer or bursting of an aneurysm, etc., the assailant inflicting such an injury is responsible for having caused death, but the offence is very much mitigated if it be proved that his intention was not to kill his victim, that he could not have possibly known the existence of that disease and that the same injury could not have proved fatal when inflicted on an ordinary healthy individual; but he is held responsible, if he was previously aware of the morbid condition of his victim.

3. Shock.—Death may occur from shock without any visible injury from paralysis of the heart by a blow on the cardiac region, or from the inhibitary action of the solar plexus on account of a blow on the pit of the stomach in the upper part of the abdomen.

Shock may be produced from exhaustion resulting from several injuries combined together, though each one of them separately may be very slight. Shock may also result from pain as in flogging or from fright.

Shock usually appears immediately after receiving the injuries, but it may supervene after some time, if the individual at the time of receiving injuries was in a state of great excitement and mental preoccupation.

Remote or Indirect Causes.—It is necessary to know

the remote causes of death due to injury as the assailant, according to the law of England, is responsible for the death of his victim, if it occurs within a year and a day after inflicting the injury. There is no such law in India, but the usage in such cases is to follow the English law.

The remote causes of death operating secondarily from the injury are—

1. Inflammation of an internal organ, *e.g.*, cerebritis, pneumonia, peritonitis, etc.
2. Septicæmia, pyæmia, erysipelas and tetanus.
3. Gangrene.
4. Supervention of a disease, such as an aneurysm resulting from injury to the coats of an artery, or hernia due to a scar produced by a previous injury.
5. *Neglect of the Injured Person.*—If death occurs from complications arising from a simple injury owing to the neglect of the injured person as regards its proper care and medical treatment, the assailant is responsible for the death, but the circumstances mitigating the offence are most probably, taken into consideration by the judge while awarding the sentence.
6. *Result of a Surgical Operation.*—If death follows a surgical operation performed for the treatment of an injury, the accused is responsible for the result, if it is proved that the death was inevitable even without the operation, which was absolutely necessary to save the life, and was performed by a competent surgeon with reasonable care and skill.

WHICH OF THE SEVERAL INJURIES CAUSED DEATH?

In the case of multiple injuries inflicted on a person by more than one accused either at the same time or at different times it is very essential to find out the injury which proved fatal, and whether it was the result of one or more blows ; for, the defence pleader may admit the death, but may plead that

it was not due to the wound attributable to his client. This can be ascertained by examining the wounds individually and noting which of them involved an injury to some vital organ or large bloodvessel, or led to secondary results causing death. For instance, there may be several wounds on the scalp, but only one may cause the fracture of the skull ending in death. Similarly fractures of more than one skull bone may result from only one blow. It must, however, be noted that, even if he fell dead at the hands of one of them, all the accused are responsible for having caused the death of their victim, if they started with a common object of intentionally causing such hurt as was likely to end fatally.

THE POWER OF VOLITIONAL ACTS IN A VICTIM AFTER RECEIVING THE FATAL INJURY.

Sometimes the prosecution sets up a theory that the victim, after receiving mortal injuries involving a vital organ such as, the brain, was able to speak and mentioned or wrote down the name or names of his assailants. Similarly the defence may try to prove an alibi of the acccused, if he was seen with the victim a moment before his death at a particular spot, and the victim had moved to some other place before death on the ground that he would not have walked after having received the fatal injury, if the accused had dealt him that fatal blow. In both these cases the question that is required of the medical witness to answer is whether a person is capable to speak, walk, or perform any other volitional act, which would involve bodily and mental power for some time after receiving a fatal injury. A very guarded reply should be given in such cases, seeing that a few cases have been recorded in which the victim was able to perform some act as of walking or climbing requiring some exertion, and survived

some hours or days after receiving very grave wounds, which would ordinarily have proved rapidly fatal.

DIFFERENCE BETWEEN WOUNDS INFLICTED DURING LIFE OR AFTER DEATH.

In India the custom of inflicting wounds on a dead body to support a false charge against an enemy is so very common that every medical officer, who has done medico-legal work, must have come across such cases during his professional career.

The following are the principal points by which a wound inflicted during life can be recognised :—

1. Hæmorrhage.
2. Eversion and retraction of the edges of the wounds.
3. Signs of inflammation and reparative processes.

1. Hæmorrhage.—There is more or less copious bleeding in all wounds except in contused or lacerated wounds, when it may be very little. There is consequent staining of the edges of the wounds, and of the muscular and cellular tissues in their vicinity. This stain cannot be removed by washing There will also be clots of effused blood in the wounds, or in the tissues, and in the neighbourhood of the body. Clotting of blood does not take place at once but in about five minutes.

Besides, there will be signs of spouting of arterial blood on the body, clothing, or in its vicinity.

In a contusion there will be the presence of ecchymosis, absorption changes of its color, clotted blood on being incised and a swelling of the neighbouring tissue.

2. Eversion and Retraction of the edges of the Wound.—The margins of the wound are usually found everted but sometimes inverted, when the muscle fibres are adherent to the skin, as in the scrotum. The sides of the wound and the muscles also retract, and hence the wound

appears gaping. Both these conditions being due to vital actions do not occur in wounds caused after death.

3. Signs of Inflammation and Reparative Processes.—The signs of inflammation, the formation of granulation tissue, pus, scabs or cicatrization, are a very strong proof to say that the wound was inflicted some days before death occurred.

The absence of the above signs will show that the wound was inflicted after death ; h wever, it must be borne in mind that hæmorrhage and retraction of the edges may take place in the case of a wound caused within one to two hours after death during the molecular life of the tissues, when the body is still warm. In such a case, hæmorrhage is slight, unless a large vein is cut, and there is no spouting, or formation of a clot which rarely occurs ten minutes after death.

Table showing the Distinction between Ante-mortem and Post-mortem Wounds.

Ante-mortem.	Post-mortem.
1. Hæmorrhage, more or less copious and generally arterial.	1. Hæmorrhage, slight or none at all, and always venous.
2. Marks of spouting of blood from arteries.	2. No spouting of blood.
3. Clotted blood.	3. Blood is not clotted, if, at all, it is a soft clot.
4. Deep staining of the edges and cellular tissue, which is not removed by washing.	4. The edges and cellular tissue are not deeply stained. This staining can be removed by washing.
5. The edges are everted or inverted in a few cases. The skin and muscle fibres are retracted.	5. The edges are not everted but inverted. The skin and muscle fibres are not retracted, unless the wound is caused within one or two hours after death.
6. Ecchymosis and reparative processes.	6. No ecchymosis or reparative processes.

DIFFERENCE BETWEEN SUICIDAL HOMICIDAL AND ACCIDENTAL WOUNDS.

In the case of death occurring from wounds, the question is, very often, raised as to whether they were the result of suicide, homicide or accident. The answer is not always easy, but it can be given to some extent by the medical man by noting the following points :—

1. The situation and character of the wounds.
2. The number, direction and extent of the wounds.
3. The condition of the locality, and the surroundings of the wounded person.

1. The Situation and Character of the Wounds.—Suicidal wounds are usually on the front or on the sides of the body, and affect the vital organs. They are usually incised or gunshot wounds. The suicidal incised wounds are generally situated on the throat or on the heart. Incised and punctured wounds, situated on the back or in such a position as cannot be reached by a suicide are homicidal, though an insane person can produce wounds, which may have the appearances of their being homicidal.

Wounds on the forearms, hands or fingers along with those on the other parts of the body are usually homicidal. Wounds on the nose, ears or genitals are usually homicidal, and are inflicted on account of jealousy or revenge in cases of adultery.

Gunshot wounds inflicted into the mouth, or on the forehead, temple or heart, are, as a rule, suicidal, when the skin in the neighbourhood is blackened and scorched. The blackening of the hand is a positive sign of the wound being suicidal.

Contused and lacerated wounds are either accidental or homicidal. Accidental wounds are generally situated on the exposed parts of the body and mostly on the same side. Wounds of the vertex are homicidal unless there is a history

of falling head downwards from a height, when there will be abrasions and lacerations on other parts of the body also. Contused wounds on the forehead may be suicidal, homicidal or accidental. Contused wounds on the occiput are more often homicidal than accidental. If they are homicidal, wounds on the back of the fingers may be found, as the assaulted person involuntarily raises his hand to guard against the blow after receiving the injury, and consequently the fingers are likely to be injured.

2. The Number, Direction and Extent of the Wounds.—Several injuries on the body if they are deep and extensive, are, as a rule, homicidal. In India murderers select a heavy cutting instrument, such as a *gandasa* and inflict several deadly wounds on the head cutting the skull bones and exposing the brain tissue, or on the neck cutting the larynx, œsophagus, large blood vessels, vertebræ and even the spinal cord. They are not generally satisfied by inflicting only one wound, but inflict several mortal wounds, and sometimes hack the body so much that either the head is severed altogether from the trunk, or remains connected to it by a mere tag of skin. In addition to these wounds, several wounds on the shoulders, trunk, and on the limbs are inflicted. In one case twenty-six wounds on the body of a boy three years old were inflicted with a *gandasa* by a girl of twelve years of age.

Suicidal wounds when caused by a cutting instrument on the neck are generally single, and do not reach the vertebræ unless the person happens to be insane. Sometimes there may be two or more simple cuts at the commencement of the wound, when the suicide is still hesitating or nervous, and then makes a deep cut, when he plucks up courage to destroy himself. In India suicidal wounds of the throat are very rare. During fifteen years of my medico-legal practice I have seen only three cases of suicidal cut throats. In two cases

the larynx was cut ; but in the third case the wound was quite superficial, and the woman was prosecuted for having attempted to commit suicide under section 309 of I. P. C. The motive being poverty, she was sentenced to simple imprisonment for one day till the rising of the court.

Suicidal wounds of the throat are directed obliquely from a higher to a lower level and from left to right, while homicidal wounds are, as a rule, horizontal and directed from right to left ; but the reverse is the case if the assailant happens to be left-handed. Again a homicidal wound on the throat may resemble a suicidal one, if the assailant has inflicted it from behind the victim, or by standing on the right when the victim is lying. It is very difficult to decide in the case of ambidextrous persons, who can use both their hands.

Suicidal wounds of the chest are usually on the left side, and directed downwards and inwards, unless the person happens to be left-handed. Homicidal wounds of the chest are usually distributed over a wider area, are more horizontal, and most of them may be deadly owing to the vital organs being injured. They may be directed from below upwards, which is rarely seen in suicidal wounds.

Suicidal wounds on the arms are directed from above downwards, and those on the lower limbs from below upwards.

Several slight wounds on the front of the body may be suicidal. Thus, a student of the Agra College inflicted twenty wounds on the abdomen, twenty-eight on the right thigh and thirty on the left, after he had inflicted some nasty wounds with a razor on his room fellow. They were very characteristic and suggestive of suicide. The wounds on the abdomen were mostly transversely oblique, and directed from left to right. None of them had gone deeper than the muscles. Those on the right thigh were all superficial and directed from below upwards, and from within outwards, while those on the left were directed from below upwards, and from

without inwards. Thus all the wounds were caused by the right hand. They varied in length from three to eight inches.

3. The Condition of the Locality and Surroundings of the Wounded Person.—The door of a room found locked from inside points to suicide, especially when it is the only way of entrance into it. The finding of a farewell letter in the room or the evidence of design is strongly presumptive of suicide. A weapon firmly grasped in the hand is also a strong proof of suicide; but hair or a torn piece of clothing firmly grasped by the hand is indicative of homicide. The disordered state of clothing and the disarranged state of the room indicates a struggle having taken place before death, and this is greatly in favour of homicide.

A body found at the foot of a precipice, or on a railway line points to suicide or accident; but it may have been placed there to concealt he act of homicide. In that case a careful search should be made for the presence of marks of dragging the body on the ground, marks of blood-stains, and foot prints on the ground and in the vicinity.

The absence of a weapon in the vicinity of the body is suggestive of homicide. Homicide is generally suspected, but not always, if a weapon is found lying near the body. It should be examined for the presence of blood-stains, and it should be determined whether the wounds of the body could have been caused by the weapon or not; for it is quite possible that the weapon found might not be the same with which the injuries were inflicted. It is also possible that the weapon may be quite clean, if it was wiped out with a piece of cloth or towel, which would, very likely, be found lying in the vicinity.

All the articles found on or near the body and likely to be of any value in the detection of the crime should be carefully preserved, and sent to the Superintendent of Police or Magistrate in sealed packets.

CHAPTER XII.

REGIONAL INJURIES.

HEAD.

Scalp—The injuries of the scalp are either accidental or homicidal. In India most of the scalp injuries are homicidal, and are generally produced by a blunt weapon, *e.g.*, a *lathi*, a stone or a wooden pestle (*musal*), and occasionally by a cutting instrument, such as, a *gandasa*, a *khurpi*, or a sword. The injuries are consequently bruises, contused and lacerated wounds, as well as, incised and punctured wounds. The swelling and inflammation are not usually very much as the scalp is a dense tissue. It must be remembered that an oblique blow generally causes a large wound and a direct blow, a small wound. These wounds may be simple or complicated with fractures of skull bones. While examining them it is always advisable to find out, if there is any fracture.

In the case of a contusion the effusion of blood, sometimes, is so great that it forms a hæmatoma (cephal-hæmatoma), which may readily be mistaken for a depressed fracture owing to the sensation of crepitus, which it imparts to the fingers on palpating it. The diagnosis is not easy in such cases. In a hæmatoma there is pitting on pressure and there may be a pulsation, if any large artery is involved. Its ridge is raised above the surface of the skull, and if subcutaneous, is movable on its surface. While in a depressed fracture the edge is at or about the level of the rest of the skull and is sharper, more irregular, and less evenly circular than in a hæmatoma.

The wounds of the scalp usually heal very rapidly though, in rare cases, fatal results may follow from the supervention

of cellulitis or erysipelas, or suppuration may set in, and travel into the brain through blood vessels or through necrosis of bone resulting from cellulitis, or through an unnoticed fissured fracture. Thus, cases have occurred in which the scalp wounds have apparently healed, and yet death has occurred from the formation of pus on the brain after a few days or weeks.

Skull.—Fractures of the skull bones are sometimes caused without any contusion or wound on the scalp, though there may be extravasation of blood on its inner surface. The varieties of the fractures of the skull, that are usually met with, are fissured, partial (outer or inner table, though the inner table is more commonly fractured), stellate or radiating, depressed, elevated, punctured, and communited. Sometimes the separation of sutures occurs with or without the fracture. The temporal bone and the orbital plate of the frontal bone are easily fractured. In old age the bones become thin, brittle, and hence are more fragile.

Fractures may be due to mechanical force produced by a blow with a heavy weapon, or by a fall from a height, or from a violent push by a cart or a running bicycle ; as it happened in the case of an old woman at Agra who fractured her occipital bone when overthrown on the ground by a push from a running bicycle near the Agra Fort.

Vault.—Fracture of the vault occurs at the place of contact by direct violence or at its opposite side by *contre coup* (counter side), when the head is not supported. An extensive fracture running parallel to the two points of contact (bursting fracture) will occur, if a mechanical force is applied on one side of the head, when it is pressed on the other side against a hard substance as a wall, while the individual is standing, or against the hard ground or floor, when he is in a lying posture. In such cases the fracture may extend transversely even to the base of the skull.

The Base of the Skull.—The fracture of the base of the skull is caused by a blow on the vertex, as the head is pressed on the other side by the spinal column. Its fracture may be caused by a direct blow with the point of an umbrella or stick thrust through the orbit or up the nose or by a blow on the chin. It may also result indirectly from a fall on the feet or nates.

The signs of the fracture of the base are—

(1) Signs of concussion or compression of the brain.

(2) Effusion of blood in the subconjuctival tissue, or in the suboccipital and mastoid regions.

(3) Bleeding, or discharge of cerebrospinal fluid from the nose, mouth, or one or both ears.

(4) Lesions of the nerves issuing from the base of the skull giving rise to paralysis or loss of sensation of the parts supplied by them.

The result is not always fatal. Sometimes recovery takes place, though headache, deafness, or other nervous derangements may persist for a long time.

Brain.—Injuries of the brain may occur even without the fracture of the skull, and result in immediate or remote consequences.

Contusion and Laceration of the Brain.—A fall or a blow on the head may produce contusion and laceration of the brain on the same side or on the opposite side by *contre coup.* It is not necessary that there should always be fracture of the skull bones. These injuries may also be caused by penetrating or gunshot wounds.

The symptoms depend on the extent of the injury to the brain. If laceration is slight or superficial, the signs of cerebral irritation are present. In severe lacerations there may be symptoms of concussion, which may be followed by compression.

Concussion of the Brain.—This may be produced

by direct violence on the vertex, by a fall on the feet or nates from a height, or by an unexpected fall on the ground, when pushed forcibly by a running cart or even by a bicycle.

Symptoms.—The symptoms depend on the nature of the injury. Thus the patient may become confused and giddy with or without falling, if there is a slight injury, and recovers in a short time.

With severe injury, the patient falls down and becomes unconscious, though he can often be partially roused by shouting. The muscles are relaxed and flaccid, but there is no paralysis. The sphincters are relaxed with involuntary evacuations from both the bladder and bowel. The face is pale, and the pupils are usually contracted and react to light but, in more severe cases they are dilated and insensible to light. The skin is cold and clammy with the subnormal temperature. The pulse is rapid, weak, small and hardly perceptible. The respirations are slow, irregular and sighing. Death occurs rapidly from syncope, or recovery follows, with the setting in of nausea or vomiting. The skin becomes hot and dry, the pulse is full and strong, and the respirations are increased in rate. After apparent recovery in some cases, death may result after some days from inflammation or compression.

Post-Mortem Appearances.—In most cases there may be nothing more than slight congestion of the brain with minute capillary hæmorrhages in its substance. In some cases there may be a contusion or laceration of the brain substance.

Compression of the Brain.—This may result from a depressed fracture of a skull bone pressing on the brain or from cerebral hæmorrhage. It may also result from the pressure of inflammatory exudation or pus on the brain tissue.

Symptoms.—These may come on immediately, or may be delayed for some hours or days after receiving the injury. The symptoms are those of coma. There is complete loss of consciousness. The patient cannot be roused by shouting or even by shaking. The face is flushed, and the pupils are dilated and insensible to light, but they may be contracted or unequal, if there is a small degree of compression over a limited area of the brain. The temperature of the body is normal or subnormal, but may be above normal as well. The pulse is full and slow, but becomes rapid and irregular towards death. Breathing is slow, laboured and stertorous with the lips and cheeks being puffed in and out. There is paralysis of the muscles and extremeties according to the area of the brain involved. The reflexes are lost, and there is retention of urine and marked constipation, though there is involuntary passage of fæces in some cases. Sometimes convulsions precede death.

In some cases partial recovery may occur owing to the arrest of blood in an injured artery of the brain by the formation of a clot, but death may take place later on, when the clot is disturbed and fresh hæmorrhage takes place on account of the heart being excited owing to some exercise or indulgence in alcohol.

Permanent recovery may occur when the compressing factor, such as, a depressed piece of a fractured cranial bone, is removed by trephining. In such cases, however, remote effects, e.g., headache, epilepsy, paralysis, or insanity, may supervene from permanent damage to the brain tissue.

Post-Mortem Appearances.—Effusion of blood between the skull and the dura mater, upon the surface of the brain, or at the base of the skull. This effusion is usually due to fracture of the skull bones, but it may be due to a rupture of the middle meningeal artery or of the venous sinuses without

any fracture. The brain and its meninges are also found congested.

Medico-Legal Questions.—The questions that are usually raised in court are—

1. Whether the effusion of blood found *post-mortem* was due to mechanical violence, or disease or due to excitement during a quarrel.

2. How old the effusion was.

1. When due to violence, the effusion of blood is almost always extradural, but it may be subdural and in the substance of the brain, especially when it is lacerated. The hæmorrhage is usually very profuse, and may be from several places. It is usually found beneath the point injured or directly opposite to this. Besides, the external signs of injury are generally visible.

When due to disease, the effusion of blood generally occurs in individuals over forty years of age, and is ordinarily produced by the diseased condition of the arteries, such as, arterio-selerosis, atheroma, or aneurysm. Besides, there may be the evidence of chronic heart or kidney disease, or of syphilis. Sometimes there may be the signs of scurvy, purpura or hæmophilia. Again the hæmorrhage occurs most frequently in the internal capsule due to a rupture of the lenticulo-striate and optic arteries, known as Charcot's "arteries of cerebral hæmorrhage."

It must be borne in mind that a slight injury on the head may cause cerebral hæmorrhage in a person previously predisposed to it from age or disease, and that the head may be injured during a fall from cerebral hæmorrhage caused by disease.

It is possible but rare for the cerebral arteries to rupture at any age from mere excitement, which may be due to alcoholic indulgence or otherwise. In addition to effusion in such a case, the blood vessels are found congested, but spontaneous

rupture is contraindicated, if there is any evidence of violence, such as a bruise or a wound on the scalp or a fracture of the skull.

2. It is difficult to give the exact date of an effusion of blood, but an approximate idea may be formed from its colour and consistence as to whether it is recent or old. The colour of a recent effusion is red, which changes to chocolate or brown after some days, and turns to an ochre colour generally in from twelve to twenty-five days. The consistence of the coagula becomes firmer and more or less laminated with the progress of the time, and the compressed lymph may be between the laminæ or around the coagula.

FACE.

Wounds of the face heal, as a rule, rapidly on account of its great vascularity, but they are grievous, if they are severe and cause permanent disfiguration or deformity.

Face Bones.—The nasal bones are, very often, fractured by a blow with a fist or a blunt weapon, such as a *lathi.* When caused by considerable force, they may involve the fracture of the ethmoid bone and its cribriform plate forming part of the base of the skull, and may cause death by meningitis. Fractures of the superior maxillæ, malar bones and the mandible (inferior jaw) are produced by a blow with a blunt weapon, such as a heavy stone. Sometimes, in addition to the fractures of these bones the whole face is reduced to a pulpy condition, when struck with a heavy stone slab.

Eyes.—Injury to the eye, e.g., a contused wound produced by a blunt weapon or by throwing of a brick bat may damage the tissues so severely as to necessitate the enucleation of an eye ball. A blow on the eye may cause a permanent injury to the cornea or lens, or a detachment of the retina. The

injury may prove fatal from the inflammation of the orbital tissues extending into the brain, and the consequent formation of pus. Similarly a penetrating wound of the orbit will prove fatal by setting up meningitis through penetration of the thin orbital plates. Neuralgia and temporary or permanent amaurosis may result from paralysis of the upper eyelid, when there is a wound of the eyebrow.

The eyes can be gouged out with the fingers, but in this connection it should be remembered that the birds of prey generally attack first the eyes of a dead body, when exposed in a field or a jungle.

Nose.—The nose is, very often, cut off or bitten off during a quarrel, or owing to sexual jealousy, the victim being a female in the latter case. These wounds are grievous, if they leave permanent disfigurement or deformity. A blow on the head sometimes, causes bleeding from the nose due to a partial detachment of its mucous membrane without injury to the nose. An extensive contused wound of the head may lead to a loss of the sense of smell, and a penetrating wound of the nose caused by thrusting a sharp pointed instrument up the nostril may result in death by injuring the brain through the cribriform plate of the ethmoid bone, though no sign of an external injury is visible.

The left nostril or the septum of a female is liable to be injured by pulling at the nose ring worn by her.

Ears.—A blow on the ear may produce a rupture of the tympanum leading to temporary or permanent deafness. It may also injure the labyrinth.

Lips.—Injuries to the lips are caused by a blow with a fist, shoe, or a blunt weapon, or by teeth bite. Sometimes the half of the upper lip along with a portion of moustache is cut off, the motive being sexual jealousy. Such injuries are grievous, if they cause permanent disfiguration.

Teeth.—The teeth are dislocated or fractured either by a fall or by a blow with a blunt weapon, such as, a fist, a shoe,

the butt end of a *lathi*, etc. When their dislocation or fracture is caused by mechanical violence, the injuries are, in all probability, found on the lips, gums or on their sockets. While reporting on a person who alleges to have his teeth knocked out, the following points should be taken into consideration :—

1. The condition of the neighbouring and other teeth as to whether they are firm, shaky, or diseased.

2. The number of the teeth present in each jaw.

3. The condition of the sockets of the missing teeth, as to whether there is any stump left if a tooth is fractured, whether there is any bleeding and whether there is any laceration.

4. The condition of the lips and gums as regards the presence of injury.

5. The tooth, if sent with the injured person, should be examined to ascertain if it corresponds to the missing tooth. Its fangs should be especially examined to find out if fracture or dislocation has occurred. After examination, the tooth should be returned in a sealed packet to the police constable accompanying the injured person.

NECK.

Wounds of the neck are mostly incised. In India they are more often homicidal than suicidal, and very rarely accidental. They are supposed to be instantly fatal, if the carotid arteries are cut, but this is not always the case, as a person can run a few yards after these arteries are cut. Wounds of the larynx or trachea are attended with comparatively little danger, those of the trachea being less important than those of the larynx. They may, however, cause death by suffocation owing to the flow of blood into the air-passages, though most of it is coughed up. They may also cause death from subsequent œdema or inflammation blocking the air-passages or from septic pneumonia. Wounds of the œsophagus in the

neck are always fatal. Wounds of the sympathetic and pneumogastric nerves may be fatal, and those of the recurrent laryngeal nerves cause aphonia. A forcible blow on the front of the neck may cause unconsciousness or even death by a reflex inhibitory action or by a fracture of the larynx usually involving the thyroid and cricoid cartilages, and consequent suffocation from hæmorrhage or œdema of the larynx.

SPINE AND SPINAL CORD.

Wounds and injuries affecting the spine and the spinal cord are generally accidental, may be homicidal, but are never suicidal.

Fractures of the Spine—These are produced by (1) direct violence as in a railway accident or by a fall of a heavy load on the body, and (2) indirectly by forcible bending of the body or by a fall on the head. They may, in certain cases, be produced by forcible twisting of the neck, as during wrestling. They may also be caused by a very slight twist, if a person happens to be suffering from Pott's disease.

The fractures are generally accompanied by dislocations, and cause compression or crushing of the cord, which produces paralysis of the body below the seat of injury. In such cases hæmorrhage occurs in the substance of the cord, or around it between, or outside its membranes. These cases are very rare. In the Agra District during the last twelve years out of about one thousand medico-legal autopsies death was found to be due to the fracture of the spine in only five cases. In two cases death was due to a fracture of the eleventh and twelvth dorsal vertebræ from a fall in a well. In a third case a young man about twenty years old took a somersault in wrestling, and died immediately from the dislocation of the fifth cervical vertebra. There was no disease of the

vertebræ. The fourth case was that of a girl ten years old, who died from fracture-dislocation of the third cervical vertebra due to a bale of grain weighing about two maunds falling on her neck; and the fifth case was that of a man about fifty years of age who, while carrying a heavy load on his head, was suddenly knocked down by a bicycle, and died immediately from a dislocation of the fourth cervical vertebra.

The cases of spinal injuries are, as a rule, immediately fatal, owing to implication of the phrenic nerves, if the fracture occurs above the fourth cervical vertebra, though death may be delayed a few hours even after fracture of the odontoid process of the axis with forward displacement of the atlas. Death usually occurs within twenty-four hours, if the lower three cervical vertebræ are injured. In rare cases death may not occur for some months, when the trunk and the limbs will be paralysed.

When the dorsal vertebræ are injured, the patient becomes bed-ridden on account of paralysis of the lower limbs. He also suffers from paralysis of the bladder and rectum, and is always in danger of getting bed-sores and septic infection of the bladder and kidneys, which generally hasten death. Thus, death may occur after two or three weeks if the upper dorsal vertebræ have been injured; while life may be prolonged for years with partial paralysis of the limbs, if the lower dorsal or the lumbar vertebræ have been fractured.

Concussion of the Spine.—This condition may occur without any evidence of an external injury to the spinal column. It may follow a severe blow on the back, or a jar, or fall from a height. This is the most common form of injury met with in railway collisions, and is then known as "railway spine."

The symptoms may develop immediately or may be delayed for some weeks. The patient becomes restless, excitable and emotional, and generally suffers from nerve pros-

tration or neurasthenia. He complains of pain and tenderness over the spine and weakness in the limbs. Hence he is unable to walk. He also complains of amnesia, and derangement of the special senses. These symptoms are very much exaggerated by any kind of mental excitement, *e.g.*, during the time of medical examination. Most of the symptoms being subjective, it is very difficult for the medical man to determine whether the patient is feigning or not. It has very often happened that the symptoms have abated immediately after a civil suit for damages brought by the patient against his employer or a railway company has been decided in court.

Being well protected by anatomical structures, incised or punctured wounds of the spinal cord are very rare indeed except between the first and third cervical vertebræ, where they are more exposed owing to the narrowness of the laminæ. A punctured wound caused in this region even by a small needle proves almost instantaneously fatal, as it injures the medulla and the upper part of the cord which contains the respiratory and other vital centres. The process of killing in this manner is called *pithing*, and the wound caused is so very small, that it may be overlooked altogether, if the weapon is thrust obliquely.

CHEST.

Injuries of the chest are mostly homicidal, suicidal in a few instances, but rarely accidental. Blows with a blunt weapon on the chest may cause contusions or lacerations of the lungs resulting in pleurisy, traumatic pneumonia or hæmothorax without any external mark of injury.

Ribs.—Fracture of the ribs results from direct violence, as by blows or stabs, and from indirect violence as in compression of the chest or very rarely from muscular contraction during violent coughing. When, due to direct violence it is more dangerous, as the splinters are driven inwards, and

are likely to injure the underlying pleura, lungs, heart, large vessels, liver, or diaphragm while, in indirect violence the fracture occurs at the most convex part of the ribs near their angle, and the fragments are driven outwards. The ribs that are most frequently fractured are the middle ones, viz., the fifth, sixth, seventh and eighth, as they are most prominent and fixed at both ends. The upper ribs are not usually fractured, unless very great force is used, when the lesions of the viscera, as a rule, occur. The lower ribs often escape on account of their greater mobility. Owing to diminished elasticity and increased brittleness, fracture of the ribs takes place more easily in the old than in the young and healthy.

Symmetrical fractures of the ribs on both sides are very often met with, when a person sits on the chest and compresses it considerably by means of knees or elbows, by trampling under foot, or by means of two bambooes, a process known as *bans dola.* They may also occur in accidents as in a fall from a height, or when run over by a heavy cart or motor, or when caught between railway buffers.

Sternum.—Fracture of the sternum is ordinarily due to direct violence, and occurs transversely either between the manubrium and gladiolus or a little below this level. If depressed it becomes serious, as it is liable to damage the viscera behind it.

Lungs.—Wounds of the lungs may be immediately fatal from profuse hæmorrhage, or from suffocation due to respiratory embarrassment on account of the presence of blood in the pleural cavity or in the air-passages, or may result in death subsequently from septic pneumonia. They may be produced by the penetrating wounds of the chest caused by a cutting or stabbing instrument, by the sharp fragments of a fractured rib, or by a projectile from a fire-arm ; and hæmorrhage is recognized by the escape of bright

red and frothy blood from the mouth, and from the external wound if present.

Heart.—Wounds of the heart are produced by a cutting or stabbing instrument, a bullet or a sharp end of a fractured rib or sternum. Its right ventricle is more likely to be wounded as it exposes its widest area on the front of the chest. These wounds are almost always instantly fatal except in a few cases, when the individual has been able to walk a short distance, and has performed some other volitional act after receiving the injury, but some cases have been successfully treated by a surgical operation.

Rupture of the heart may be caused by a blow with a blunt weapon, by a carriage wheel running over the chest or by a fall on a hard projecting surface without leaving any external mark of violence. In such cases the heart is usually ruptured on its right side and towards its base. The heart may, also, rupture spontaneously without any external violence, if it has already been diseased. In such a case the rupture occurs in the left ventricle at its apex. In Agra, a Hindu hawker of about 70 years went to a prostitute's house to purchase empty bottles, and after ascending a staircase sat down on a *charpoy* and asked for a glass of water, but he expired before it was brought to him. At the autopsy I found that death was due to rupture of the left ventricle owing to thinning of the heart muscle on account of chronic ulceration.

Blood Vessels.—Wounds of the aorta or the pulmonary artery are rapidly fatal. Wounds of the smaller arteries may prove fatal on account of profuse bleeding. Wounds of the veins may result in death from the air entering into the blood and consequently into the right side of the heart.

Diaphragm.—Wounds of the diaphragm are liable to be produced by penetrating wounds of the chest or of the abdomen. They are not rapidly fatal, unless the important

organs in contact with it are wounded also. In non-fatal cases diaphragmatic hernia may subsequently occur, after the wound has healed, and a cicatrix has formed.

Rupture of the diaphragm may occur from a blow with a blunt weapon, a violent kick, or a fall on the abdomen, when the stomach and intestines are full. It is the central tendon that is ruptured most frequently, and death generally occurs from shock.

ABDOMEN.

The Abdominal Parieties.—Injuries of the abdominal parieties may be contusions, or non-penetrating or penetrating wounds.

Contusions of the abdominal parieties are produced by a blunt weapon, a kick, a carriage wheel passing over the abdomen, or by a fall. It is not necessary that they should show an external mark on the skin. Sometimes the effusion of blood may be seen in the tissues or muscles under the spot where violence was used; however, it must be borne in mind that the effusion of blood in the muscles may occur spontaneously without any external violence. The contusions are, as a rule, simple unless accompanied by lesions of the visceral organs when they prove fatal from shock, hæmorrhage, or from peritonitis. In some cases peritonitis may occur without evident injury to any of the abdominal organs. Besides, it has already been mentioned that a blow on the epigastric region may cause death by its inhibitory action on the heart through the reflex action on the solar plexus.

Wounds of the abdomen are produced by a cutting or stabbing instrument, a fire-arm, the horns or claws of an animal, or by a fall on an iron railing or on a sharp projecting point. They are simple and heal rapidly, if they are non-penetrating affecting only the integuments, but death may occur rapidly from extensive bleeding, if the epigastric

artery is divided, or a hernia may occur at the weakest spot subsequently after the healing of the wound. The penetrating wounds may occur with or without injury or protrusion of the abdominal viscera. These wounds are not fatal, if there is the protrusion of the viscera only. They heal rapidly even without surgical interference, but they are always dangerous, if the viscera are damaged. In that case death may occur immediately from shock or hæmorrhage, or subsequently from peritonitis.

Stomach.—Rupture of the stomach, though rare, is produced easily by a blunt weapon, a crush or a fall on the epigastrium, when it is distended with food or diseased from ulcer or cancer. The pyloric end and the greater curvature of the stomach are the usual sites of rupture. It should be borne in mind that its spontaneous rupture may occur when there is an ulcer in the stomach. Penetrating or stabbing wounds of the stomach are generally fatal, and very often involve the adjoining viscera, such as the liver or the spleen.

Intestines.—Rupture of the intestines not unfrequently occurs from violent blows, or by kicks, falls, crushes or compressions. In many cases no mark of injury on the abdominal wall is visible though, in addition to the rupture a great deal of contusion and laceration of the intestines may be present. Like the stomach the intestines may rupture spontaneously from chronic ulceration or from very slight force, if they are diseased or distended.

When caused by injury, the rupture may take place at the point of impact or, in some cases, at a distance from it. In the former case, the margins of the rupture are clean cut, and in the latter they are usually ragged and irregular. Rupture usually occurs at the commencement of the jejunum, and in the lower three feet of the ileum, but very rarely in the large intestine. However it must be remembered that rupture of the large intestine at the junction of the sigmoid

with the rectum may occur from straining at stool without the presence of chronic ulceration or any other disease.

Death occurs immediately from shock or subsequently from peritonitis owing to the expulsion of the contents into the peritoneal cavity. If a puncture is very small, the mucous membrane becomes everted, and closes the little opening and thus prevents the escape of the intestinal contents. The power of locomotion or other muscular exertion is very often preserved after these injuries.

Rectum.—Fatal injuries of the rectum are sometimes produced by the forcible thrusting of a blunt weapon, a method of torture, which is resorted to in India for adultery and theft. Severe injuries of the rectum may also occur accidentally from falls on an iron railing, or any projecting point, or from forcibly sitting upon a piece of broken bottle or broken china.

Pancreas.—Wounds of the pancreas are very rare. They may occur from direct violence applied to the epigastrium or from penetrating wounds of the abdomen. They are usually accompanied by injuries of the other abdominal organs. The total extirpation of the organ is followed by diabetes.

Liver.—Owing to its size, its fixed position and its friable consistence, the liver is frequently wounded from a stabbing wound on the abdomen, or is very often ruptured from a blow, kick, crush, or fall, or even from a sudden contraction of the abdominal muscles. It may also be lacerated by the fractured end of a rib perforating the diaphragm. There may or may not be signs of an external injury. Ruptures usually involve the right lobe, and occur at the anterior surface and the inferior border. They are ordinarily directed antero-posteriorly or obliquely, but rarely transversely, and are generally one or two inches deep, but rarely pass through the entire substance of the organ. The liver is more easily lacerated, if it is enlarged and fatty.

In ruptures of the liver death occurs immediately from shock and hæmorrhage, especially if the portal vein or vena cava are injured, or it may occur within forty-eight hours. Sometimes life may be prolonged for days. A case occurred in Agra in which a man survived three days after the liver was ruptured. Sometimes recovery may occur after slight wounds or lacerations.

Gall-bladder.—Wounds and rupture of the gall-bladder may result from penetrating wounds or from a blow, kick, or compression with the knee. The gall-bladder may rupture spontaneously, when distended with gall-stones. Death occurs from peritonitis owing to the effusion of blood and bile into the peritoneal cavity.

Spleen.—On account of its situation, rupture of the normal spleen is very rare, unless caused by considerable compressing force, such as the passing of a carriage or motor car over the body, or by a crush in a railway accident, or by a fall from a very great height; but in all such cases there is a possibility of rupture of other organs as well.

When the spleen is enlarged, softened and brittle, it is liable to rupture from a fall or violence of a very slight degree. In such cases the abdominal wall may not show the external mark of contusion. Sometimes the enlarged spleen ruptures spontaneously from the contraction of the abdominal muscles during the act of sneezing, coughing, vomiting or straining. The rupture usually takes place at its concave or inner surface, and causes death rapidly from hæmorrhage owing to its great vascularity. Very often there may be more than one rupture from one single blow, and its substance may rupture leaving the thickened capsule intact. In such a case death may be delayed for some days, as the capsule limits the rupture or prevents excessive bleeding, and the small quantity of blood, which has already effused under the capsule forms into a clot, and

presses on the rupture and prevents further bleeding. But with sudden muscular exertion or excitement, the clot is disturbed, further bleeding occurs and death takes place immediately. Thus, an old *punkhah* cooly in the Agra Fort, who had his spleen ruptured by a kick on the left side of the abdomen, appeared to be all right for three days, and died on the fourth day, when he went to his village on a jolting *ekka*.

The rupture of the enlarged spleen from very slight violence is a very common occurrence in malarious districts, and every medical jurist is familiar with such cases. Sometimes the enlargement is so great that its length is more than fourteen inches and its breadth more than eight inches, while the weight is often more than four pounds. Of all the enlarged spleens that were seen ruptured in the Agra District between 1909 and 1910 (the years of a high malarial incidence) the smallest spleen measured $6'' \times 5'' \times 2''$ and weighed nine ounces ; while the largest measured $13'' \times 7'' \times 2\frac{1}{2}''$ and weighed four pounds and eight ounces.

Kidneys.—Owing to their deep situation in the abdomen rupture of the kidneys is very rare by direct violence from blows, even if they are diseased, unless the force used is very considerable and inflicted on the loin. During the last Hindu-Mahomedan riot at Agra a young Hindu of about twenty years of age was hit by one of the rioters with a *lathi* in the left lumbar region and died immediately. On *post-mortem* examination the left kidney, which was quite healthy, was found ruptured.

The kidneys may be accidentally ruptured, when an individual is run over by a heavy cart, or when he is crushed between the buffers of a railway carriage. They are also apt to be injured, when the body is violently flexed forwards at the lumbar region. The rupture may prove rapidly fatal from collapse or hæmorrhage, or more slowly from peritoni-

tis or suppuration caused by extravasation of urine. A slight rupture may result in recovery.

Bladder.—Rupture of the bladder may be produced generally at the posterior and upper surface by blows, crushes or kicks on the hypogastrium, especially, when it is distended with urine. Sometimes very slight violence will rupture the bladder without any external sign of injury. The rupture may also occur from a fall, from fracture of the pubic bone, or by a sharp weapon penetrating through the vagina or rectum. Spontaneous rupture of the normal bladder is very rare, almost impossible, though it may occur at its base from over-distension, when it is diseased or ulcerated. Similarly it is liable to rupture in females during parturition, owing to the pressure of the child's head, if the bladder is over-distended on account of it not being emptied beforehand.

The symptoms of rupture of the bladder are pain, inability to pass urine and the presence of blood in the urine. In some cases symptoms may be delayed for eight hours or more. The patient may be able to walk for sometime after receiving the injury.

Death occurs from peritonitis due to the extravasation of urine into the peritoneal cavity, or from suppuration and sloughing due to urine being extravasated into the cellular tissue, if the bladder is ruptured at its extra-peritoneal portion.

Uterus.—The non-gravid uterus is not ordinarily injured, unless involved in the injuries of the pelvic organs, but the gravid uterus is likely to be ruptured by a blow, kick, or trampling on the abdominal wall, or by the passage of a sharp instrument per vagina to procure abortion; and death may result from hæmorrhage, peritonitis, or septicæmia. The pregnant organ may also be ruptured during obstetrical operations or spontaneously during parturition.

Partial or complete separation of the placenta caused by a blow on the abdomen during pregnancy may cause fatal hæmorrhage.

Urethra.—The male urethra may be ruptured by a kick in the perineum, by a fall astride some projecting substance, such as a fence or beam, or by a fractured piece of the pubic bone. The seat of rupture is usually in front of, or behind, the triangular ligament, just where the urethra passes under the pubic arch. Death may occur from extravasation of urine, but the rupture may heal without any serious effects, if the tear is a slight one, and if immediate surgical treatment is undertaken.

Penis.—Wounds of the penis or its total extirpation, if not fatal by shock and hæmorrhage are not dangerous. Cutting of the penis with a sharp knife or razor is very often resorted to in India as a mode of punishment for adultery though, sometimes, the victim is killed first, and then the organ is cut off.

Incised wounds of the penis are occasionally self-inflicted by lunatics or by individuals who want to be eunuchs or wish to dedicate their lives to a goddess, viz., *Bahucharaji* in the Gujrat Province.

Testicles.—Contusion of the testicles results from blows, kicks and squeezes, and is accompanied by severe pain of a sickening character, which may produce a fatal shock. The squeezing of a testicle is a common practice of assault in India, and sometimes the squeezing is so very forcible, that the testicle is protruded out of the scrotum. It may also be accidentally protruded through a lacerated wound of the scrotum caused in jumping over a barbed wire.

Vulva.—Wounds of the vulva look like incised wounds even if caused by a blunt weapon. The danger in these wounds is excessive hæmorrhage. The wounds may be caused homicidally by a blow or kick in front, or from behind

when the female is bending forward, or accidentally by sitting on a broken chamber pot while urinating or falling on a projecting sharp substance.

Vagina.—The vagina is very often lacerated during labour, or by passing an "abortion stick" to procure criminal abortion. It may also be ruptured by violent sexual intercourse especially by a strong healthy adult with a small girl, and fatal results may follow from profuse hæmorrhage or from pelvic cellulitis. Thus, in Agra, a girl of thirteen years died from septic cellulitis caused by a lacerated wound in the posterior wall of the vagina, the result of sexual intercourse by her husband, who was a young, strong man.

The common practice of punishment for adultery in India is to introduce a bruised marking nut (*Bhilawa*), or chillies into the vaginal cavity.

MUSCLES.

Contusions and sprains of muscles may occur from a blow or from a fall. They are generally simple in nature, but an abscess may form in the contused part of the muscle, or paralysis and subsequent atrophy of the muscles may occur on account of the injury to the nerve supplying those muscles. Similarly a person may become lame from a sprain of the gastrocnemius and soleus owing to their contraction.

Lacerations and crushing of the muscles due to a heavy cart or a railway or machinery accident may necessitate the amputation of a limb, or may cause death indirectly from gangrene or tetanus.

BONES.

Contusion of a bone and of its periosteum due to a blow or a fall is a simple injury and, under ordinary circumstances, subsides in a few days, though acute infective periostitis or necrosis may occur in the case of debilitated syphilitic or rheumatic people.

Fractures of bones may occur from blows, falls or from muscular contraction. Fractures are not ordinarily dangerous, unless they are compound, when death may occur from loss of blood, if a big vessel is wounded by the split end of a fractured bone, or from septicæmia, gangrene or tetanus.

In children and young persons the bones are tough and elastic, and hence, a green-stick or partial fracture occurs more frequently ; while in old people bones, being brittle owing to the increase of their inorganic constituents, are easily fractured even with very slight violence. Similarly they are more fragile in certain diseases, such as syphilis, arthritis, osteomalacia, rickets, sarcoma, cancer, scurvy, locomotor ataxy, and those nervous diseases which produce trophic changes.

There is a peculiar condition of bones called *fragilitas ossium*, in which bones fracture spontaneously or from very little force. This condition is hereditary and found in persons apparently in good health. It is also found in people suffering from general paralysis of the insane, and workers in phosphorus.

In criminal cases the defence very often admits the fracture of a bone, but raises the plea that it was due to an accident and not to direct violence. A fracture caused by direct violence can be judged from its position and the presence of a bruise or wound of the skin or subjacent tissues accompanying the fracture. Besides, it is transverse and sometimes communited. When due to an accident, such as a fall, the fracture occurs at the weakest part of the bone, is usually spiral or oblique and is, generally, not accompanied by a bruise or wound.

Distinction between Ante-Mortem and Post-Mortem Fracture.—Fractures caused during life show the signs of effusion of blood, laceration of muscles, pouring out of lymph, and formation of callus ; but these signs are absent

in fractures produced after death. However, it is difficult to distinguish if a fracture is caused immediately after death, when the body is still warm, though the effusion of blood will be much less. Besides, it should be remembered that, with ordinary force it is not possible to fracture a bone after death, as it loses its tonicity and elasticity.

DISLOCATIONS.

Dislocations are caused by falls, blows, or muscular action. They are not common in the old and among those, whose bones have become brittle, as well as, among children, in whom the separation of epiphysis is more common. They are not dangerous unless they are compound, when death may result from secondary complications.

After death they may be recognized by the copious effusion and coagulation of blood, and by the laceration of the soft parts in the vicinity of the joint.

CHAPTER XIII.

IMPOTENCE AND STERILITY.

Definition.—Impotence is defined as physical incapacity for accomplishing the sexual act, and is applied to the male more than to the female, as the latter is a passive agent in the act of copulation. While sterility means inability for procreation of children, and is referable more to the female than to the male.

It should be remembered that an impotent individual need not necessarily be sterile, nor a sterile individual, impotent.

QUESTIONS RELATING TO IMPOTENCE AND STERILITY.

Impotence and sterility in either man or woman may form the basis of medico-legal investigations both in civil and criminal cases. The civil court may call on the medical man to determine this point in suits of adoption, contested paternity, nullity of marriage and divorce. The criminal court may have to decide this question with the aid of the medical man in accusations of alleged adultery, rape and unnatural offences, in which the accused pleads impotence as an excuse for defence, and in cases, when an injured individual asserts he has become impotent from wounds or injuries received by him, especially if they happen to have been inflicted on the head, neck and on the loin.

According to the English law marriage is a contract, which may be declared "null and void", if it can be proved that either of the party was, at the time of contracting marriage, impotent *i.e.*, incapable of fulfilling the

rights of consummation of marriage ; but this incapacity must be permanent and incurable by an operation, even if the individual is willing to submit to it. The acquirement of impotence subsequent to marriage, or sterility alone, is not a sufficient ground to grant a decree of divorce. Again, it cannot be set aside, if marriage was contracted with full knowledge with an impotent person or with one who, from advanced age, might be inferred to be incapable of sexual intercourse.

CAUSES IN THE MALE.

The causes of impotence and sterility in the male are—

1. Age.
2. Malformations.
3. Local diseases.
4. General Diseases.
5. Psychical Influences.

1. Age.—Impotence is generally observed at the extremes of age. Boys are considered to be sexually potent at the age of puberty which is ordinarily attained at the fifteenth or sixteenth year, and hence according to the law of England boys under fourteen cannot contract marriage. The age of puberty is usually attained a year earlier in India ; however, intercourse is possible at about the thirteenth year, as the power of coitus commences earlier and ceases later than the power of procreation. The changes which occur in a boy at puberty are the development of the genital organs, the ability to secrete semen, the growth of hair on the pubes, axillæ and chin, and the deepening of voice. While examining an individual for sexual capacity the medical man should depend more on physical development than on age alone.

As age advances, the power of sexual intercourse and procreation diminishes, but no limit can be assigned at which

this power ceases, as men of, and over, eighty years have been known to have begotten children.

2. Malformations.—The absence or non-development of the penis renders a man impotent ; but the man is not sterile if semen can be deposited into the vagina with the partially developed penis. The penis adherent to the scrotum or abdomen cannot be a plea for divorce, if it can be remedied by a surgical operation.

In the case of epispadias and hypospadias sterility depends on the position of the opening of the urethra in such a way as to prevent the deposition of semen into the vulva. The spermatozoa, if deposited into the vulva, can certainly travel upwards into the vaginal canal on account of their motile power.

The congenital absence of the testicles produces sterility and impotence, but it is possible for a man to impregnate a woman after double castration, if semen had already been present in the vesiculæ seminalis before the operation ; though he becomes permanently sterile after this stock of semen has been exhausted. Monorchids, *i.e.*, those who have one testicle only are physiologically quite potent ; whereas cryptorchids *i.e.*, those who have undescended testicles, are, as a rule, impotent though, sometimes, they may be quite potent and fertile ; while cases have been recorded in which the testicles descended into the scrotum late in life.

3. Local Diseases.—Stricture of the urethra, phymosis, elephantiasis, hydrocele, tumours of the penis, and chronic inflammation and tumours of the testes may render an individual impotent and sterile, but most of these conditions can be remedied by careful medical and surgical treatment. An operation of lithotomy sometimes causes sterility from injury to the ejaculatory ducts.

4. General Diseases.—Certain diseases, which occasion extreme debility, may produce impotency, temporary or per-

manent, through the weakness to which they give rise, though the gential organs are apparently quite normal. For instance myelitis, tabes dorsalis, hemiplegia, paraplegia, general paralysis of the insane, neurasthenia, phthisis, diabetes mellitus and fevers produce impotency. Blows on the head damaging the brain may cause impotency. The excessive use of some drugs, such as alcohol, opium and cannabis indica may render a man impotent.

5. Psychical Influences.—An absence of desire for sexual intercourse may result from excessive passion, masturbation, excessive sexual indulgence, fear, timidity, aversion, hypochondriasis, and hysteria. Sometimes an individual may be impotent with one particular woman, but not with another.

CAUSES IN THE FEMALE.

The causes which prevent sexual intercourse in the female are the same as those are for impotence in the male; viz.,

1. Age.
2. Malformations.
3. Local diseases.
4. General diseases.
5. Psychical influences.

1. Age.—Puberty in the female may be dated from the fourteenth or fifteenth year in cold countries, and from the twelfth to the fourteenth year in India. The signs of puberty in a girl are the development of the external and internal genitals, the appearance of menstruation, the growth of hair on the pubes and axillæ, and the development of the breasts. There is a change in her tastes, and the girl does no more look like a child, but is more bashful and retiring. Luxurious living and early stimulation of the mental faculties tend to bring on menstruation at an earlier age, while feeble health and poor diet tend to retard it.

The power of fecundity commences with the first flow of menstruation, and lasts till the menopause, which usually occurs from the forty-fifth to the fiftieth year. However, girls have been known to have menstruated at the age of two or three years, and become pregnant at the eighth, ninth, tenth, or eleventh year, while late pregnancies have occurred at the fifty-fifth or fifty-seventh year. Pregnancy has also occurred without the woman menstruating at all throughout her life. Again women have been impregnated at the age of sixty-six and seventy-five, several years after the stoppage of menstruation.

2. **Malformations.**—The congenital defects, such as the absence or total occlusion of the vagina, and the tough, imperforate hymen are a barrier to coitus, and consequently lead to sterility. The conical cervix and the absence of the uterus, ovaries or fallopian tubes produce sterility, though allow the gratification of sexual intercourse.

3. **Local Diseases.**—Salpingitis, ovaritis, and displacements, inflammatory conditions and tumours of the uterus, may all cause sterility, but some of these diseases can be permanently cured by proper treatment. Owing to the pain caused at the time of coitus, vaginismus may lead to impotence. Again recto-vaginal fistula, ruptured perinœum, disorders of menstruation, leucorrhœa and acid discharges from the vagina, may contribute towards sterility.

4. **General Diseases.**—General diseases and a bodily deformity in women are not barriers to sexual intercourse, if the generative organs and menstruation are normal. Thus a woman suffering from paraplegia can become pregnant.

Psychical Influences.—Hatred, fear, passion, etc., may produce a hysterical fit at an attempt at copulation, and may thus render a woman impotent. It is possible for a woman to be sterile or impotent with a particular man, but not with another.

CHAPTER XIV.

VIRGINITY, PREGNANCY AND DELIVERY.

VIRGINITY.

The question as to whether a woman is a virgin (*virgo intacta*) or not arises in nullity of marriage, divorce and defamation cases, and in rape cases.

SIGNS OF VIRGINITY.

The signs of virginity in a healthy woman are seen in the genitals and breasts.

Genitals.—The labia majora are elastic and firm, and lie in close contact with each other so as to completely cover the labia minora or nymphæ and clitoris. The labia minora are soft, small and rose-colored, and the clitoris is small. The posterior commissure and the fourchette are intact and crescent shaped. They are rarely destroyed by sexual intercourse, but are not unfrequently lacerated in the attempts at sexual intercourse on children. The vagina is narrow and tight with rugose walls, but the rugosity of the vagina cannot be considered as a diagnostic proof of virginity, as it is only removed by the first birth, and not merely by sexual intercourse ; besides, in some cases, it may be absent even in a virgin. The clitoris is small.

The hymen is the most reliable sign of virginity. It is a thin fold of mucous membrane situated at the orifice of the vagina. It is generally circular in shape, but may be central with an antero-posterior slit, or semilunar, annular, or diaphragmatic. In rare cases it may be congenitally absent. It is situated more deeply in children than in young women, and so it more often escapes injury in an attempted rape on children.

Normally the hymen is ruptured by the first act of coitus, though it may persist even after frequent acts of coitus, if it happens to be loose and elastic, or thick, tough and fleshy. Cases have been recorded in which the hymen had to be incised at the time of delivery, while even prostitutes have been known to possess the intact hymen.

Besides the act of coitus, the hymen may be ruptured by—

1. An accident, e.g., a fall astride on a projecting substance, fence, or while playing at see-saw. The plea that is usually brought forth by the defence pleader in a rape case in muffussil courts is that the hymen was ruptured by a fall on the stem of a plant, such as *arhar*, projecting a little above the ground in a field. In such a case the rupture of the hymen alone is highly improbable. Again, forcible separation of the thighs will not rupture the hymen alone, unless the perinœum is ruptured. Owing to the situation of the hymen, its rupture is not possible by riding, jumping, dancing, etc.

2. Masturbation. In addition to the rupture of the hymen, the nymphæ are elongated and the clitoris is enlarged by the continued practice of masturbation. However this is highly improbable in children as, on account of the deep situation of the hymen, the manipulation is limited to parts anterior to it.

3. Introduction of instruments by medical men during examination or surgical operation.

4. Sola piths, plantains, etc., introduced to render very young girls fit for sexual intercourse (aptæ vires). These are very often resorted to by prostitutes.

5. Ulceration from diphtheria or other diseases. In such a case the whole hymen is destroyed leaving a scar only.

6. Clots of menstrual blood passing through the vagina, but this is highly improbable.

Breasts.—These are firm, elastic and hemi-spherical, with a small undeveloped nipple surrounded by a rosy areola in

fair women, and dark brown in dark women. They become large and flabby by frequent handling and sexual intercourse, as well as by masturbation, but are not affected by a single act of coitus.

PREGNANCY.

In courts of law the question of pregnancy may be disputed under the following circumstances :—

(1) When a condemned woman pleads pregnancy as a bar to execution or hard labour. According to section 382 of the Indian Criminal Procedure Code, the High Court is the only judicial court which can postpone the execution of a sentence of death confirmed by it, or commute it to transportation for life, after it is satisfied from the civil surgeon's certificate that the woman is pregnant. The usual custom to accept from the civil surgeon in such a case is whether the woman is "quick with child" or not. In England a jury of twelve matrons had to determine whether the woman was "with child of a quick child"; but this custom has become obsolete, and the judge now requests one or two medical men to examine the woman and to certify whether she is pregnant or not.

(2) When a woman may feign pregnancy soon after her husband's death so as to defraud the rightful heir by producing a supposititious heir to an estate, the heir-at-law may apply to the court to order an inquiry into the allegation.

(3) When a woman, who has filed a suit in court for breach of promise of marriage or seduction, claims to be pregnant.

(4) When a woman blackmails a gentleman, and accuses him that she is pregnant by him.

(5) When a widow, or an unmarried woman, or a married woman living separate from her husband, has been defamed or libelled to be pregnant.

(6) When a woman alleges she is pregnant in order

to secure greater compensation from some person or persons, through whose culpable neglect her husband has died.

(7) When pregnancy is alleged to have been a motive for suicide or murder of an unmarried woman or a widow. In such cases dead bodies have to be examined for the proof of pregnancy.

SIGNS OF PREGNANCY.

The signs of pregnancy in the living may be classified as *subjective* and *objective signs.*

SUBJECTIVE SIGNS.

These are—

1. Cessation of menses.
2. Morning sickness.
3. Sympathetic disturbances.
4. Quickening.

1. Cessation of Menses—This is the first sign of pregnancy, but it cannot be relied on, as menses may be suspended in certain diseases, such as anæmia, phthisis, cancer and nervous excitement. Unmarried women without being pregnant may miss their menstrual periods for some time after illicit intercourse simply from fear and nervousness. In married women an intense desire for pregnancy may stop menstruation for some time. Pregnancy may occur in a woman who has never menstruated. It may also occur in a woman during the amenorrhoea of lactation. When a woman suckles her child, she does not usually menstruate for the first six months after delivery, and it is quite possible for her to be impregnated during this period.

In some cases menstruation may occur for two or three periods after conception.

Lastly a woman may practise deception on the medical jurist by denying the stoppage of monthly course, and imitat-

ing the catamenia by blood, if she wants to conceal pregnancy. Similarly she may conceal menstruation, if she feigns pregnancy. In this case the fact of her having menstruated may be found out by inquiring of her washerwoman (*dhoban*).

2. Morning Sickness.—Nausea or vomiting, usually as a sign of pregnancy, most frequently occurs soon after the woman rises from bed in the morning. It commences about the beginning of the second month, and lasts generally till the end of the fourth month. It may, however, commence soon after conception. It is not a reliable sign, as it may occur in gastric troubles or chronic alcoholism, irrespective of pregnancy.

3. Sympathetic Disturbances.—Salivation, perverted appetite in the form of longings or cravings for very strange and even disgusting articles of food, and irritable temper are a few of the conditions which are caused reflexly by pregnancy.

4. Quickening.—The first perception of the fœtal movements felt by the mother is known as "quickening". It is attributed to the uterus coming into contact with the abdominal wall, and usually occurs from the 14th to the 18th week, but sometimes as early as the 12th. In the case of spurious pregnancy a nervous and hysterical woman may experience these sensations. Again, an inexperienced primipara may not feel them at all.

None of the above signs are reliable, and so the medical jurist should never venture an opinion on these signs alone.

OBJECTIVE SIGNS.

These are—

1. Mammary changes.
2. Pigmentation of the skin.
3. Changes in the vagina.
4. Changes in the cervix uteri.

5. Enlargement of the abdomen.
6. Kyesteine.
7. Intermittent uterine contractions.
8. Fœtal movements.
9. Uterine souffle.
10. Fœtal heart sounds.
11. Ballottement.

1. Mammary Changes.—From the very commencement of pregnancy the breasts become full and tender, and by the second month begin actually to increase in size. The superficial veins are seen more distinct and enlarged. The nipples are harder, firmer and more prominent, and the areolæ surrounding them become wider and darker. By the third month a clear, transparent secretion can be squeezed out of the nipples on pressing the breasts. This contains the colostrum corpuscles or milk, as pregnancy advances. Milk has, however, appeared in the breasts of women, who have not been pregnant or who have not even married.

After the sixth month silvery lines or striæ similar to the lineæ albicantes of the abdomen are seen especially in primiparæ on account of the stretching of the skin.

All these changes may, however, occur from various uterine and ovarian diseases. Sometimes they also occur independent of pregnancy, when women have reason to expect it shortly after marriage or after illicit intercourse.

Again pregnancy may occur without any changes in the breasts, or the breasts may even diminish in size after the middle of pregnancy.

These changes are also of very little diagnostic value after the first pregnancy as the areolæ retain their colour permanently, and the secretion of milk from the breasts is more or less permanent.

2. Pigmentation of the Skin.—This is well marked in dark women. The abdomen, axillæ and pubes become

darker due to the deposit of pigment, and a special dark band (linea nigra) is observed extending from the ensiform cartilage to the pubes.

3. Changes in the Vagina.—After the fourth week of pregnancy the normal pinkish colour of the mucous membrane of the vagina and vulva changes to violet, deepening to blue, as a result of venous obstruction owing to pressure of the gravid uterus. This is known as Jacquemier's sign, as it was first described by him. This sign may, however, be found just before, as well as immediately after, menstruation.

The anterior wall of the vagina is found flattened. When introduced into the vagina, the fingers may feel the pulsation of the vaginal arteries.

4. Changes in the Cervix Uteri.—From the very first month of pregnancy the cervix begins to soften from below upwards, and by the fourth month this softening can be very well felt by the fingers introduced into the vagina. This is a diagnostic sign of pregnancy, and is known as Goodell's sign, though certain morbid conditions, such as acute metritis, hæmatometra, etc., may produce softening of the cervix.

As softening continues, and involves the whole neck of the uterus, there is an apparent shortening of the cervix towards the last months of pregnancy. The orifice, instead of being transverse, becomes circular, and admits the point of the finger more readily, and to a greater depth.

5. Enlargement of the Abdomen.—The abdomen begins to enlarge gradually after the third month. Up to the first three months the gravid uterus remains in the cavity of the pelvis, and about the fourth month rises just above the symphysis pubis and comes into contact with the abdominal wall. At the end of the fifth month it is midway between the symphysis and the umbilicus (navel). At the end of the sixth month it reaches the level of the umbilicus, and at the end of the seventh month it is midway between the umbilicus and

the ensiform cartilage. At the end of the eighth month and in the early part of the ninth month it reaches the ensiform cartilage or epigastrium. During the last two months the uterus on account of its weight does not rise higher, but sinks deeper into the pelvis and tends to fall forward.

The enlargement of the abdomen may occur in ascites, ovarian cysts, ovarian and uterine tumours, and in phantum tumours.

6. **Kyesteine.**—About the end of the first month of pregnancy a fatty layer called kyesteine or gravidin often appears on the surface of the urine, if it has been allowed to stand for some time, but this sign is quite worthless, as it is not always present in pregnant women, and may be found in the urine of non-pregnant anæmic women, as also in that of men.

7. **Intermittent Uterine Contractions.**—Throughout pregnancy the uterus is subject to alternate contractions and relaxations, but before the third month it is difficult to observe them except by a very careful bimanual examination. After the fourth month the uterus can be easily felt as alternately contracting and relaxing by palpating the abdomen. The period of contraction and relaxation is variable, each contraction lasting from one to five minutes, and relaxation from five to twenty minutes. This is the most valuable sign, and is present even when the fœtus is dead or degenerated.

8. **Fœtal movements.**—Fœtal movements are felt and seen through the abdomen after the sixth month. They may be felt on bimanual examination through the vagina at the commencement of the third or fourth month, and may be heard on auscultating the abdomen about the middle of the fourth month. The fœtal parts may also be palpated through the abdominal walls. This is a certain sign of pregnancy.

9. **Uterine Souffle.**—The uterine souffle is described

as a soft, blowing murmur, synchronous with the mother's pulse, and heard towards the end of the fourth month on either side of the uterus just above Poupart's ligament. In some cases it may be heard as early as the ninth or tenth week. This sign is not infallible, because it may be heard in uterine or ovarian tumours.

10. Fœtal Heart Sounds.—The sounds of the fœtal heart constitute by far the most important sign of pregnancy. They are usually heard for the first time in the course of the fifth month, generally from the eighteenth to the twentieth week, and are compared to the muffled ticks of a watch under a pillow. They vary in rate from one hundred and twenty to one hundred and sixty per minute, and are not synchronous with the mother's pulse. They are not heard, when the fœtus is dead, or when there is an excessive quantity of liquor amnii.

11. Ballottement.—This is the name given to the sensation observed by moving the fœtus about in the liquor amnii. It can be felt internally per vaginam or externally through the abdominal wall. Ballottement can be tried from the fourth to the seventh month, but the test fails if the amniotic fluid is scanty. In practised hands it is a sign of great value.

Caution. From the above signs it is evident that before the eighteenth week there are no certain signs from which the medical witness may give definite opinion about the existence or otherwise of pregnancy. In such a case it is always a safe plan to wait until the definite signs develop, before giving an opinion one way or the other.

Signs of Pregnancy in the Dead.—In addition to some of the objective signs mentioned above, the diagnostic signs of pregnancy which are found in the dead body at the *post-mortem* examination are—

1. The pres nce of an ovum or fœtus.
2. The uterine changes.
3. The corpus luteum.

1. **The Presence of an Ovum or Fœtus.**—The presence of an impregnated ovum, a fœtus or the placenta in the uterus after death is a positive proof of pregnancy. Sometimes, in place of the ovum, certain abnormal products of conception, such as sanguineous and vesicular moles, may be present. These moles develop so very rapidly that the uterus is usually larger than at the corresponding period of normal pregnancy, but more frequently it is not enlarged beyond its size at the fifth or the sixth month of gestation.

2. **The Uterine Changes.**—As a result of pregnancy the uterus is thickened, and increases in size both in its length and width. The length increases from one-and-a-half inches to twelve inches, and the width from one-and-a-half to about nine inches. Its weight at the full term of pregnancy is twenty-eight ounces or more.

The nulliparous uterus weighs about an ounce and that of the woman, who has borne children weighs about an ounce and a half. The uterus also increases very much in its capacity, it being five hundred or more cubic inches at its full development. The marks of the attachment of the placenta are noticed as well.

3. **The Corpus Luteum.**—The corpus luteum is a cicatrix formed in the ovary after the escape of ova from the bursting of a Graafian follicle at the menstrual period. This corpus luteum is known as *false*, if impregnation does not occur, and *true* if pregnancy occurs. The false corpus luteum or the corpus luteum of menstruation, as it is frequently called, develops in size for about three weeks, and then undergoes rapid absorption; while the true corpus luteum or the corpus luteum of pregnancy continues to develop, and attains its largest size about the third month, forming a firm projection on the surface of the ovary. It is well marked at the time of delivery, and does not disappear for one or two months after.

The true corpus luteum used to be regarded as a positive sign of pregnancy, but it has now no forensic value, inasmuch as it is seen as a result of over congestion, as in fibroid tumours and other pathological conditions. It has also been found in the ovaries of women, who were neither pregnant nor menstruating. Again pregnancy has occurred without the formation of a true corpus luteum.

DELIVERY.

The cases, in which the medical jurist is requested to ascertain whether a woman has been delivered or not, are those of infanticide, concealment of birth, feigned delivery, legitimacy, and of libel actions.

SIGNS OF DELIVERY.

These signs are discussed under the following four headings :—

I. The signs of recent delivery in the living.
II. The signs of recent delivery in the dead.
III. The signs of remote delivery in the living.
IV. The signs of remote delivery in the dead.

I. SIGNS OF RECENT DELIVERY IN THE LIVING.

The signs of recent delivery at full term are—

1. Appearance of General Indisposition.—Immediately after delivery the woman appears exhausted and wears a haggard look, with the sunken eyes having a dusky pigmentation about the lower eyelids. There is a slight rise of temperature with profuse sweats. The pulse is soft and rapid. These signs may be absent in strong women, or may be found in any other illness or at the time of the monthly course. The intermittent contractions of the uterus are usually present for the first four or five days. These are termed after-pains, when they are vigorous and painful.

2. Breasts.—The breasts are full, firm, knotty and enlarged, and contain colostrum or milk. The areolæ are dark, and the nipples turgid.

3. Abdomen.—The abdomen is slightly full, but more often lax and flabby. The skin is wrinkled and shows the lineæ albicantes, which are pinkish in the beginning, but subsequently become white in color.

4. Uterus.—Just after delivery the uterus relaxes, and may be felt as a flabby mass extending to the umbilicus a few hours after delivery. It then diminishes in size, and is felt like a hard cricket ball for about two or three days in the lower part of the abdomen above the symphysis, but its fundus can be felt just above, or behind the symphysis pubis up to the fourteenth day.

5. Vagina.—The labia are tender, swollen and bruised or lacerated. The vagina is smooth, relaxed and dilated ; the fourchette is usually ruptured, and the perineum is sometimes lacerated.

6. Cervix—The cervix is soft and patulous, and its edges are torn or lacerated. The external os is patent admitting one or two fingers.

7. Lochia—The lochia is a discharge from the uterus and vagina, lasting for the first two or three weeks after delivery. It has a peculiar, sour, disagreeable odour. During the first three or four days the discharge is dark red *(lochia rubra)* consisting of pure blood mixed with large clots. It becomes serous and paler in colour *(lochia serosa)* during the next four days. About the ninth day the colour becomes yellowish grey or slightly greenish (*lochia alba or green waters*), and gradually diminishes in quantity, till it disappears altogether from the second to the third week.

From the above signs taken collectively it will scarcely be difficult to diagnose a case of recent delivery for the first fourteen days after parturition. These signs are more characteris-

tic of a full term delivery than of a premature one. They are likely to disappear within a week or ten days in the case of a multipara.

II. SIGNS OF RECENT DELIVERY IN THE DEAD.

The diagnosis of recent delivery in the dead hardly presents any difficulty. In addition to the signs described above, the uterus is found flabby and nine to twelve inches long, containing large clots of blood and its inner surface being lined by the decidua, if a necropsy is held on the body of a woman who is dead soon after delivery. The uterus in course of time becomes more and more contracted. In the first two or three days after a full-term delivery it is about seven inches long and four inches broad. At the end of a week it is between five and six inches long and about an inch thick. At the end of a fortnight it hardly exceeds five inches in length, and returns to the normal size at the end of a month. Soon after delivery the uterus weighs about twenty-eight ounces, twelve ounces at the end of a week or ten days, and about one and a-half ounces by the end of a month.

The site of the placental attachment is of a dark colour. The openings of its vessels are well marked, and recognizable for two or three months.

The ovaries and the fallopian tubes are usually congested, but may become normal in a few days. One or more corpora lutea may be seen in the ovaries.

III. SIGNS OF REMOTE DELIVERY IN THE LIVING.

1. Abdomen.—The abdominal wall is relaxed, and marked with white silvery streaks called the lineæ albicantes, which are the result of over-distension. These lines also occur in ascites, ovarian tumours, etc.

2. Breasts.—These are soft and pendulous, marked with lineæ albicantes. The areolæ are dark. The nipples are prominent and larger, unless the woman has not suckled the child.

3. Vagina.—The labia are more or less separated from each other. The vagina is somewhat capacious, its rugæ are absent, and its walls are relaxed, especially in a multiparous woman. The fourchette, and posterior commissure are destroyed, and the perineum may be found ruptured. The hymen is absent, or may be seen as separate nodules in the form of carunculæ myrtiformes.

4. Cervix.—The cervix is cleft transversely with ragged and irregular margins. The os is wider.

Most of the above signs may possibly be simulated by the passage of a large fibroid tumour per vaginam. Again, most of these signs may disappear in a woman who had had only one delivery short of the full term several years ago, and it is possible for the vagina and uterus to regain normal appearances as observed in a nulliparous woman.

IV. SIGNS OF REMOTE DELIVERY IN THE DEAD.

In the dead body of a woman, who has borne children, the uterus is larger, thicker and heavier than the nulliparous uterus. The walls are concave from inside, forming a wider cavity. The top of its fundus, as seen from the front or the back, is convex and on a higher level than the line of the broad ligaments. The cervix is irregular in form and shortened, its edges show cicatrices on account of previous tears and lacerations caused during delivery. The external os is enlarged, irregular and patulous so as to admit the tip of the finger, and the internal os is not so well defined as in the virgin or nulliparous woman. It must be remembered that the uterus undergoes atrophy in old age.

CHAPTER XV.

LEGITIMACY.

According to the law of England a child born in wedlock (lawful marriage) is presumed to be a legitimate child of the husband, unless it is proved that the husband was impotent, or that the husband and the wife had had no sexual access to each other at a time when conception could have taken place. A child born out of wedlock is called an *illegitimate* or *bastard child.* By the law of Scotland an illegitimate child becomes legitimate by the subsequent intermarriage of the parents, and inherits the property of its father, but not in England, as the English law does not recognize such children as legitimate. Section 112 of the Indian Evidence Act (Appendix VII) deals with the question of a legitimate child.

The question of legitimacy may arise in the following cases :—

1. **Inheritance.**—A legitimate child born in lawful wedlock can inherit the property of its father. According to the law of England a monster, who has not the shape of mankind, is incapable of inheriting, but there is nothing specific on this point in the Indian law.

2. **Tenancy by Courtesy of England.**—If a man marries a woman, who owns estates, and has by her a child born alive, he shall, for his life time, become the tenant of the estates by the *courtesy of England* after the death of his wife, but the child should be born during the lawful wedlock. Thus the husband cannot have any interest in the estates, if the child was delivered alive by Cæsarian section after the mother's death, though such a child is regarded as a legitimate child. If she has had no child born alive, her estates pass to her next heir-at-law at her death.

The law of tenancy by courtesy is not tenable in India, for section 4 of the Indian Succession Act of 1865 enacts that a person marrying after the 31st December 1865 shall have no interest in the property of the person whom he or she marries.

3. **Affiliation Cases.**—These are the cases brought up before Court, in which according to section 488 of the Indian Criminal Procedure Code (Appendix VIII.) the father is bound to maintain his illegitimate child until it attains to an age of sixteen years. In England the rate of five shillings per week is allowed as maintenance, and in India the magistrate of the first class may make a monthly allowance of Rs. 2/8 for the maintenance of such child.

4. **Supposititious Children.**—A supposititious child means a fictitious child. Very often a woman in India substitutes a living male child for a dead child, or a living female child born of her, or may feign pregnancy as well as delivery, and subsequently may produce a living child as her own, when she wants to extort money or to divert succession to property. Such cases often occur, when succession of large estates has been involved. Only recently a case occurred at Ahmadabad, where a young widow abducted with the help of a nurse from the Victoria Jubilee Hospital a newly born child which she passed off as her own, alleging that it had been born after her husband's death (*posthumous child*), and pretended delivery while in fact she had none.

MEDICO-LEGAL POINTS.

The medico-legal points that have to be investigated into these cases are—

1. The average duration of pregnancy.
2. The maximum period of pregnancy.
3. The minimum period of pregnancy and the viability of a child.
4. Superfœtation.

5. Superfecundation.
6. Paternity.

1. The Average Duration of Pregnancy.—By the average duration of pregnancy is meant the period that ordinarily elapses between conception and delivery. The methods employed for estimating this period are the arrest of menstruation, the date of conception from one single coitus, the peculiar sensations attending conception, and the time of quickening. But none of these methods are reliable, as menstruation may stop from various other causes, and it has not yet been known whether conception takes place immediately after the last period of menstruation, or before the commencement of the next. A single coitus does not fix the date of conception, but merely the date of insemination. If there is no ovum at the time ready to be impregnated in the uterus, or fallopian tubes, the spermatozoa are capable of living in the genital canal for at least a week after intercourse, so as to fertilize the ovum, if it appears within that period. The unusual sensations felt by the female at the time of a fruitful coitus, and a peculiar appearance of the eyes and swelling of the neck as first signs of pregnancy are too obscure to be of any use in determining the period of gestation. The time of quickening is very often variable, and the woman may not feel quickening throughout her pregnancy, or may mistake it for peristaltic movements.

From the above points it is quite clear that the actual duration of pregnancy in the female is not known ; however, the average period calculated from experience is two hundred and eighty days, or forty weeks, or ten lunar months.

2. The Maximum Period of Pregnancy.—Very often cases of disputed legitimacy arise in which it is necessary to determine how long gestation may be prolonged. In India and England, the law does not lay down any fixed limit. Each case is decided on its own merits. The longest period

so far allowed by law is 300 days, but in America the law takes a liberal view of the matter, and has allowed 313 and 317 days as the maximum period of gestation for the legitimacy of births.

3. The Minimum Period of Pregnancy and the Viability of a Child.—In a case of disputed legitimacy, when a child is born within a short time after marriage, or within a short time of the husband and wife living together after some years' separation, an important question that is raised is whether it is possible for a fully developed child to be born before the termination of the usual period of gestation. This question can be answered by determining the intra-uterine age of the fœtus from its length, weight and other characteristics, and in most of these cases it will be found that the fœtus is not full term, and yet it is capable of living. The question, therefore, resolves itself into another, viz., what is the shortest period of gestation at which a viable child can be born ?

Children born at or after two hundred and ten days or seven calendar months of uterine life are viable, i.e. are born alive and capable of being reared. Children born after one hundred and eighty days of uterine life may be reared, but those born before five calendar months or 150 days do not show any manifestation of life.

4. Superfœtation.—This means the impregnation of a second ovum after the first ovum has already been fertilized for some time. The occurrence of such a condition is not probable, as ovulation almost always ceases during pregnancy. It is, however, possible in a bipartite or double uterus. In such a case two fœtuses of different stages of development may be born at the same time, or two fully developed fœtuses may be born at different periods.

5. Superfecundation.—By superfecundation is meant the fertilization of two or more ova of the same ovulation. It

is probable that both ova may be fertilized at the same coitus or at two successive acts. Such a condition results in the birth of twins or triplets sometimes possessing physical peculiarities from which it may be inferred that they had separate fathers.

6. Paternity.—In questions of illegitimacy, the paternity of a child may be determined from the resemblance of its features, colour, voice, manner, etc., to those of the alleged father. Diseases or deformities may be transmitted from parent to offspring, and may serve as an important piece of evidence.

It is an accepted fact that in cases, where a woman marries a second time, her children may not resemble their father, but the first husband of their mother. Again children may not resemble their parents at all, and therefore the absence of likeness of features or of transmitted peculiarities does not disprove paternity, nor proves legitimacy. Moreover cases of atavism occur in which the child does not resemble its parents, but resembles its grandparents.

CHAPTER XVI.

RAPE AND UNNATURAL OFFENCES.

RAPE.

Definition.—Rape is defined as unlawful and carnal knowledge by a man of any female under twelve years according to the Indian law, and under thirteen years according to the English law, or above that age against her will and without her free consent. Section 375 of I. P. C. refers to the offence of rape, and section 376 refers to the punishment to be awarded for the offence.

Consent.—By the Indian law a girl above twelve can give her free consent to sexual intercourse, but her consent is invalid, if given under fear of injury or death, under misrepresentation of facts, under the influence of drugs or, if given by an idiot (non compos mentis). (Vide Appendix IX, Section 90, I. P. C.).

According to the English law, sexual intercourse with any female between the ages of thirteen and sixteen, even if she has given her consent, is a misdemeanour punishable by imprisonment up to two years with or without hard labour. Over sixteen years she can give her consent, when it is no longer a crime.

To constitute the offence of rape it is not necessary that there should be complete penetration of the penis with emission of semen. Partial penetration into the vulva with or without emission of semen, or even an attempt at penetration is quite sufficient for the purposes of law.

The English law does not recognize an attempt by a woman of compelling a young boy to hold sexual intercourse with her as an offence, but the French and the German law

punishes a woman who attempts sexual intercourse with a boy under eleven years of age.

Age of the Male.—The English law presumes that a boy under fourteen is sexually impotent, and hence incapable of committing rape. The law of India does not presume any such thing. In charges of rape brought against boys the court is guided by section 83 of the Indian Penal Code (vide Appendix IX). A case has been recorded by Chevers in which a boy of ten was convicted of rape on a girl three years old.

Age of the Victim.—In India as in other countries rape on children is common owing to the superstitious belief that gonorrhœa and syphilis are cured by sexual intercourse with virgins. Owing to the *Pardah* system prevailing in the Northern India girls mostly above ten are kept in *Zanana*, and hence lusty brutes commit rape on children under eight or nine years of age, as they are allowed to play about in streets. To these causes may be added that of retaliation on the part of parents on account of previous enmity as a motive for rape on children.

EXAMINATION OF THE VICTIM.

The female on whom rape is alleged to have been committed should be allowed to give her own account of the act without any questions being put to her. She should never be examined without her written consent taken in the presence of a witness, if she is a major, i.e., above sixteen years of age, or without the written consent of her parent or guardian, if she happens to be a minor. The examination of a female without her consent is regarded by law as an assault. Similarly an attempt at undressing the woman should never be made, but she should be requested to undress herself. The exact time of the examination should be mentioned, and then

the examination proper should be commenced in the following order :—

1. Clothes.—If the clothes are the same as those worn at the time of the occurrence of rape, they should be carefully examined for the presence of blood or seminal stains, and whether these are on the front or on the back of the garments. Usually the seminal stains are on the front of the clothes and those of the blood are on the back, but no arbitrary rule can be laid down. It should also be noted, if the clothes have been torn or soiled with mud. If there are any marks of suspicious stains, the clothes should be preserved with a view to forward them to the Chemical Examiner.

2. Marks of Violence on the Body.—The body, especially the face, chest, limbs and the back should be examined for marks of violence, such as scratches and bruises as a result of struggle. If present, they should be carefully described as regards their appearance, extent, situation and probable duration. Such marks are more likely to be found on the bodies of grown up women, who are able to resist, than on the bodies of children who are incapable of offering any resistance. To substantiate false charges, marks of violence are sometimes self-inflicted. Once I saw a young woman of twenty, alleged to have been raped by a man, who had several marks simulating scratches made with a *kankar* on the forearms and the chest, which could be wiped off by rubbing them with a piece of wet cotton-wool.

In addition to these marks the female may experience a difficulty in walking and pain in micturition or defæcation.

3. The Genitals.—To examine the genitals for the evidence of rape the female should be kept in the lithotomy position in front of good light, and the thighs should be well separated. In children the separation of the thighs is very painful, and it may, therefore, be necessary to apply cocaine to the parts, or an anæsthetic may have to be administered.

During the examination the following points may be noted :—

1. In grown up females, if the pubic hair is found matted due to the presence of semen, some two or three should be plucked and examined for the presence of spermatozoa, if possible, or they should be preserved to be forwarded to the Chemical Examiner.

2. Recently effused or dried blood may be found upon the genital organs or in their neighbourhood, and in recent cases there may be bleeding from the vagina, which is usually very slight, unless there is some injury to the vagina itself. It should not be forgotten that the bleeding may be due to menstruation, which is possible to be induced by sexual intercourse, or the genitals may be intentionally soiled with blood to substantiate a false accusation.

3. Bruising and laceration of the external genitals may be present with redness, swelling and inflammation.

4. In grown up unmarried females (virgins) the hymen as a result of complete sexual intercourse is lacerated, having one or more radiate tears, the edges of which are red, swollen and painful, and bleed on touch, if examined within a day or two after the deed. These tears heal up within five or six days, and after eight to ten days become shrunken and look like small granular tags called carunculæ hymenealis or myrtiformes. In some cases the fourchette may also be torn. The amount of injury to the hymen and the genital canal depends upon the degree of disproportion between the genital organs of both parties and the violence used on the female by the accused.

In small children the hymen, being situated high up in the canal, is not usually ruptured, but may become red and congested along with the inflammation and bruising of the labia, or, if considerable violence is used, there is very often laceration of the fourchette and the perineum.

In grown up married women accustomed to sexual intercourse, marks of violence, such as bruises, scratches, etc., may be found on the external genitals, perineum, abdomen, thighs, hands and neck.

5. The mucous secretion of the vagina should be obtained by introducing a glass pipette ; an ink pipette used for filling a stylographic pen will do very well. The secretion should then be examined for the presence of spermatozoa, which is a positive sign of rape in the case of children and grown up virgins. In grown up married women it does not necessarily indicate rape, but it proves the occurrence of previous sexual intercourse.

6. **Signs of Infection of Gonorrhœa or Syphilis.** —A muco-purulent or purulent discharge of greenish yellow colour from the vagina and soiling the linen may be due to gonorrhœal infection, but a definite opinion should not be given, unless the discharge is examined bacteriologically for the presence of gonococci. It is possible for the discharge to be due to dirt, irritation of thread worms, or to diseases, such as measles and struma. A female may also be infected from gonorrhœa by using the infected clothes, towels, sponges, etc. Similarly a female may be infected from syphilis after rape. In such cases it is advisable to examine the accused for the evidence of either of these diseases, and to note the incubation period, which is from two to eight days for gonorrhœa and two to six weeks for syphilis. It should be noted that infected men do not always communicate gonorrhœa or syphilis to a female after co-habitation.

ACCIDENTS FOLLOWING RAPE.

Convulsions, epileptic fits and mental derangements have been known to follow rape. Death may occur as a result of rape from shock due to fright and mental emotion, or from syncope due to excessive and severe injuries to the

genitals and perinœum, especially among children. These injuries, if not immediately fatal, may produce sloughing, peritonitis and ultimately death. In some cases death has resulted from suffocation caused by covering the mouth and nostrils with the hand or thrusting a piece of cloth down the throat to prevent the girl from crying for help. It is, therefore, necessary to examine the mouth for the presence of a foreign body, when a female body alleged to have been dead from rape is brought for *post-mortem* examination. Sometimes a female is first raped, and then murdered to destroy the only reliable witness of the offence. Occasionally men with perverted passions are gratified by murdering a female without violating her even though very serious injuries caused by the hand may be found on the genitals. Such a murder is known as *lust-murder*. In such a case the criminal may be impelled to an act of *anthropophagy* or *cannibalism*, when the body is opened and the genitals or other organs are torn out. Fortunately such a case has not been recorded in India. Rarely rape has been committed on a dead body (Necrophilia).

EXAMINATION OF THE ACCUSED.

Before examining the accused, his written consent should be taken, after it is explained to him that the result of the medical examination may go against him. While writing the report the following points should be carefully noted :—

1. The exact time of the examination.

2. The age, development of the genital organs and physical powers of the accused as compared with those of the victim (accuser).

3. The presence of tears on the clothes or loss of any portion or buttons from them indicating the evidence of a struggle.

4. The presence of mud, blood or seminal stains on the clothes or on the body. The presence of blood-stains is an important piece of evidence, especially if the alleged victim be a child or virgin who has sustained some injury giving rise to hæmorrhage. The absence of stains does not negative the charge of rape, as they may not be found on the body or clothes of the ravisher, though there may have been considerable loss of blood from the genitals of the victim, if they have been washed after the act. It is, therefore, necessary that the police should never allow the accused to go to the bath room alone under any pretext until the medical examination has been finished, if he is arrested soon after the crime.

The presence of seminal stains only on the body or clothes does not necessarily prove rape. It merely indicates its recent emission from any cause.

5. The presence of the marks of struggle, such as bruises, scratches, and teeth bites on the face, hands and the generative organ.

6. The clotting of pubic hair due to the emission of semen.

7. The presence of hair similar to that of the female alleged to have been raped. For instance, long hair of the head may be found on the body of the accused, or pubic hair of the victim may be found on or about the prepuce.

8. In addition to the scratches or lacerations on the penis caused by the finger nails during a struggle, an abrasion or a laceration may be discovered on the prepuce or glans penis, but more often on the frænum.

9. If a man is not circumcised, the existence of smegma round the corona glandis is a proof against penetration, since it is rubbed during the act of sexual intercourse. The smegma accumulates, if no bath is taken for twenty-four hours.

10. The presence of gonorrhœal discharge or of a syphilitic chancre. In such cases the female (victim) should be examined for the existence of either of these infectious diseases with due regard to their incubation period.

Lastly the locality, where the offence is alleged to have occurred, should be examined, as it may reveal valuable clues in the shape of blood stains, pieces of torn clothing, marks of the body on the ground, or the crushed and trampled condition of the grass in the vicinity.

MEDICO-LEGAL QUESTIONS.

The following are the controversial questions, which are likely to arise in a court of law in cases relating to rape :—

1. Can a healthy adult female be violated against her will?—Under ordinary circumstances it is not possible for a single man to hold sexual intercourse with a healthy adult female in full possession of her senses against her will, unless she is surprised unawares, thrown accidentally on the ground and placed in such a position as to render her completely helpless to resist, or unless she swoons away from fright or exhaustion after long resistance. The act may be accomplished if more than one man are concerned in the crime, or if the woman has been much too feeble to resist. In giving a definite opinion the relative strength of the parties should be taken into consideration. However, in the majority of rape cases on adult women, the charge is made with the object of blackmail, or the act is done with the consent of the woman but, when discovered, to get herself out of the trouble, she does not scruple to accuse the man of rape. If the complaint in these cases is made a day or two after the act, the case is probably one of concoction. It is also necessary to note the previous character of the female, and her relations with the accused.

2. Can a woman be violated during natural sleep? It is impossible that rape can be accomplished on a virgin during her natural sleep without her knowledge, because the pain caused by the first coitus would certainly awaken her from sleep. It is, however, probable for a woman to be violated during her sleep without her knowledge, if she has been used to sexual intercourse. Again it is possible, though improbable, for vulvar penetration to occur in a virgin without awaking her from sleep. A case is on record in which a virgin was violated during her deep sleep brought on by fatigue due to long continued exertion for two or three days, during which time she had not slept at all.

3. Can a woman be raped during unconsciousness?—There is no doubt that rape can be committed on a woman during a fit of syncope, coma or mesmeric or hypnotic trance, or during the period of unconsciousness produced by narcotic and intoxicating drugs or by chloroform. In connection with chloroform anæsthesia it must be remembered that it is possible, though not probable, to anæsthetise a person during sleep without awaking her. Again a woman, during the stage of anæsthesia, gets hallucinations that she has been raped, and insists on the belief after the effects of the drug have passed away, so that she brings an accusation against her medical attendant. As a precautionary measure against such an emergency, the medical man should never administer an anæsthetic to a female without the presence of another person, preferably her near relation.

4. Can a woman become pregnant by an act of rape?—A woman can certainly be impregnated by an act of rape, even if she was quite unconscious during the act. Formerly there was an erroneous belief that impregnation would not occcur if the intercourse was not voluntary, and followed by a pleasurable feeling, and that it would not follow the first act of coitus. But this belief is absolutely

wrong, as it has been proved physiologically and experimentally that conception will occur in a healthy woman, if living spermatozoa can be deposited into the vaginal canal even by a glass syringe, and if they can meet in the uterus or fallopian tubes ova ready to be fertilized.

UNNATURAL OFFENCES.

Section 377 of the Indian Penal Code treats of offences relating to unnatural connection with any man, woman or animal (Vide appendix IX). These offences may be classified as sodomy, tribadism and bestiality.

SODOMY.

This is also called buggery, and means an anal intercourse between man and man or between man and woman. It is termed pederasty, when the passive agent is a boy (catamite).

Sodomy is common all over the world. In India it is common, especially in the northern parts of the country. There is a particular community called *Hijras* who alternately act as active and passive agents. In a few cases that come up before the Court for trial, the active agent is usually a grown up male and the passive agent a boy. Both active and passive agents are guilty in the eye of the law, if the act has been committed with consent.

EXAMINATION OF THE PASSIVE AGENT.

As in rape the consent must be obtained before commencing the medical examination. The following signs may be discovered, if the boy (passive agent) is not accustomed to sodomy :—

1. Abrasions or lacerations on the skin near the anus with pain on walking, as well as, during examination. In three of many cases brought up before me four or five

superficial lacerations, each $\frac{1}{4}''$ long, were found external to the sphincter ani.

2. Owing to the strong contraction of the sphincter ani, the penis rarely penetrates beyond an inch, and consequently the laceration produced on the mucous membrane within the anus with more or less effusion of blood is usually triangular in nature, having its base at the anus and the sides extending horizontally inwards into the rectum. So far I have seen only one case with such a typical triangular wound.

It is difficult to differentiate between lacerations caused by the act of sodomy and those caused by the introduction of a blunt weapon into the rectum, but Chevers mentions that lacerations produced during sodomy are situated at the left superior or right inferior angle, and those caused by a blunt weapon are generally found on the upper and lower surfaces, and are of a notchy, patchy character. In some cases no signs would be perceptible, if very little force was used.

3. Dried blood may be found around the anus, and on the perinœum or the thighs, as also on the the clothes.

4. Spermetozoa may be found in the interior of the anus, and seminal stains may be found on the perinœum or on the garments of the boy too young to have seminal emissions.

5. Signs of struggle, such as bruises, scratches, etc., on his person, if he is a grown up boy and if he is not a consenting party.

6. Prolapse of the anus.

7. Gonorrhœal discharge, or the presence of syphilitic chancre.

8. The presence of fæcal matter around the anus is a corroborative sign. As in rape a passive agent is sometimes murdered after the act of sodomy. On the twenty-ninth of January, 1911 a *post-mortem* examination was held on

the body of a Hindu boy twelve years old and residing at Tajganj in Agra, when it was found that the boy had a laceration in the anus and death was due to the effects of irritant poisoning (arsenic). It appears he was poisoned after the commission of sodomy, or being mortified with shame, he committed suicide by taking the poison after the act.

EXAMINATION OF THE HABITUAL PASSIVE AGENT.

The signs usually met with in a passive agent habituated to the act of sodomy are as follow :—

1. The shaving of the anal hair but not necessarily the pubic hair. In a murder case that occurred in Lucknow on the 20th December 1918 a motive was ascertained for the murder by noticing at the autopsy the shaving of the anal hair and the presence of pubic hair on the body of the victim, a sowar (lancer) about nineteen years old, who was alleged to be a passive agent, and who was killed by his fellow sowar of the fifth cavalry.

2. A funnel-shaped depression between the nates, but this may be commonly present in very thin persons.

3. The dilated and patulous condition of the anus with the smooth and unpuckered skin round it. In a dead body the dilatation of the rectum and its protrusion occur from decomposition.

4. Cicatrices of old lacerations in the rectum near the anus.

5. Seminal fluid within the rectum, if seen immediately after the act.

6. Seminal stains on the person or clothes, if examined soon after the commission of the act.

7. The presence of gonorrhœal discharge, chancre or condyloma.

8. The presence of prolapse of the anus, fissures, piles or fistula.

THE EVIDENCE OF SODOMY IN WOMEN.

Among women who have been allowing the anal intercourse for a long time, the anus appears to be wide and gaping with fissures and purulent discharges. Syphilitic ulcers of the rectum are also very often present.

EXAMINATION OF THE ACTIVE AGENT.

No conclusive signs are evident, unless the man is examined soon after the commission of the crime. In that case there may be an abrasion or laceration on the prepuce, glans penis, or on its frænum, and stains of fæcal matter may be found on the penis, pubes, thighs, or on the clothes. The presence of blood and seminal stains are only corroborative evidence, but not positive. There may be marks of violence on the body, if the passive agent is a grown-up boy and, if the crime is perpetrated against his consent.

If he is suffering from gonorrhœa or syphilis, the passive agent should be examined for the evidence of either of these diseases.

In males who are habitual sodomites the penis is elongated and contracted in the middle with the twisted urethra.

TRIBADISM.

By tribadism is meant the sexual gratification of a woman by a woman, when the clitoris of one is inserted into the vagina of the other. This sort of sexual perversion is found among some women, though no such case has been brought before the court. However, the medical man may have to inquire into the mental condition of the woman if ever such a case is reported, as the practice of tribadism is common among nymphomaniacs.

BESTIALITY.

This means sexual intercourse by a man with the opposite sex of an animal. Very rarely a woman resorts to this practice. Cases, though rare, do occur among villagers, who go out in the fields to graze cattle far away from the gaze of a human being. The animals that have been selected for this purpose are the cow, mare, she-ass, goat, bitch and even a hen.

In cases of bestiality the perpetrators of the crime are caught red handed and, therefore, medical evidence is not required to prove the offence. But, as false accusations by village *chaukidars* are not uncommon in India, it is necessary that the accused should be examined by the medical man. The only important sign confirming the commission of the crime is the presence of the animal hair, especially of the genitals, on the person or the clothing of the accused together with some suspicious stains or abrasions on the generative organ. Sometimes, lacerations of the genitals of the passive animal with the effusion of blood may be found.

Among half-a-dozen cases of bestiality reported to me in Agra during the last ten years, I could give a definite opinion only in one case from identifying the hairs of the passive animal found under the prepuce, on the thighs and the loin cloth (*dhoti*) of the accused.

CHAPTER XVII.

MISCARRIAGE AND FŒTICIDE.

Definition.—Legally miscarriage means the premature expulsion of the product of conception, an ovum or fœtus from the uterus, at any period of pregnancy, before the full term is reached. Medically three distinct terms, viz., abortion, miscarriage and premature labour are used to denote the expulsion of the fœtus at different stages of gestation. Thus abortion is used only, when the ovum is expelled within the first three months of pregnancy before the placenta is formed. Miscarriage is used, when the fœtus is expelled from the fourth to the seventh month of gestation before it is viable, while premature labour is the delivery of a viable child, possibly capable of being reared before it has become fully mature.

By fœticide is meant the destruction of the fœtus before it is fully born, and has a separate existence out of its mother's womb. It should not be confused with criminal miscarriage or abortion, which means the unlawful expulsion of the fœtus, because an attempt may be made to destroy the life of a viable child, which may have been born prematurely from natural causes without inducing criminal abortion.

CLASSIFICATION OF MISCARRIAGE.

Miscarriage or abortion may be classified as *natural* and *artificial*, the latter being subdivided into *justifiable* and *criminal.*

NATURAL MISCARRIAGE.

It must be remembered that abortions are naturally very common among pregnant women, the proportion being one abortion to every five full term deliveries. Abortions

are most frequent within the first four months of pregnancy owing to the slight attachment of the ovum to the uterine wall. Within the first few weeks the ovum being very minute is cast off without being recognized or abortion being suspected. Very many cases, in which the woman goes one or two weeks over her time, and then has what is supposed to be merely a more than usually profuse period, are probably instances of such early miscarriages.

Causes.—The causes of natural abortion are classified as those which are directly referable to the mother, and those which affect the fœtus.

A. . **Causes referable to the Mother.**—1. Poisons circulating in the blood, such as small-pox, plague, influenza, malaria, syphilis, lead, copper, and mercury. Among these syphilis is one of the most frequent causes ofab ortion, and is likely to act in successive pregnancies. It causes the death of the fœtus.

2. Diseases affecting the circulation of the blood, such as anæmia due to excessive lactation or vomiting, jaundice, chronic Bright's disease, and heart and lung diseases.

3. Those acting through the nervous system, e.g., sudden shock, fear, joy, chorea gravidarum and reflex action from irritation of the bladder, rectum, or mammæ.

4. Local conditions, such as inflammations, chronic displacements and fibroid tumours of the uterus, old peritoneal adhesions, and excessive sexual cohabitation by inducing local hyperæmia.

5. Physical causes, which separate the ovum ; for instance a fall or a blow or other accidents of a trivial nature. Abortion from such causes usually occurs among women, who are predisposed to it. Otherwise injuries of the severest kind may not produce abortion.

B. **Causes Affecting the Fœtus.**—1. Death of the fœtus. The death of the fœtus occurring from a

faulty development, syphilis and other diseases leads to secondary changes, and ultimately produces the uterine contractions which end in its expulsion.

2. Diseases of decidua, and inflammation and fatty degeneration of the placenta.

ARTIFICIAL MISCARRIAGE.

1. Justifiable.—The induction of miscarriage is justifiable only when caused in good faith to save the life of the woman, if it is materially endangered by the continuance of pregnancy, but not to save the family honour or for any other ethical reason. It is much better to defer the operation till the child has attained viability, if it is possible, so that the mother and the child may be saved. If miscarriage has to be induced before the child has become viable, the physician should never undertake the operation without a preliminary consultation with another medical practitioner, preferably one holding superior qualifications, or an obstetrician specialist, and without the written consent of the woman and her husband or her guardian. If the consent is verbal, it should be duly attested.

Indications.—The indications for producing justifiable miscarriage are—

1. Obstruction to the passage of a fœtus owing to the contracted and deformed pelvis or the presence of a tumour.

2. Contraction of the soft parts and vagina due to cicatrices.

3. Incarceration of the retroflexed uterus.

4. Uterine hæmorrhage, hydramnios, and an ovarian or fibroid tumor.

5. Eclampsia, albuminuria, and chorea.

6. Severe vomiting, pernicious anæmia, diseases of the heart and lungs.

7. Threatened or incipient insanity.
8. Chronic phthisis.

2. Criminal Miscarriage.—Criminal miscarriage or abortion is common in India as in other countries. It is resorted to mostly by widows, and in a very few instances by single women, to get rid of the products of conception from illicit intercourse. Sometimes it is resorted to by married women to avoid additions to their families, but this is not so common in India as in Western countries. It is generally induced during the earlier months of pregnancy, when the abdomen is not enlarged, but, occasionally, between the third and sixth months of pregnancy, when the woman is almost sure of her condition.

Most of the cases do not come for investigation before the court of law as, very often, widows on noticing the altered condition of their body on account of pregnancy go to some distant town on a pretext of pilgrimage, where they manage to empty the contents of the uterus, and return to their native place after a month or so. Thus none of their neighbours know anything about them. The case comes before the court only when the death of a woman occurs as a result of abortion, or when some enemy of her family secretly communicates information to the police.

Legal Bearing.—Sections 312, 313 and 314 of the Indian Penal Code refer to the offence of criminal miscarriage and punishments awarded for the crime; and the section 511 is applicable for an attempt to cause miscarriage. Sections 315 and 316 refer to fœticide and punishments awarded for this crime. The woman's consent does not affect the crime according to the English law, but according to the Indian law it mitigates the punishment.

To convict a person under sections 312 and 313 it is necessary to prove that the woman was pregnant. It does not matter whether she was quick with child or not. If the woman dies from an act intended to cause miscarriage,

the offender is punished according to section 314 I. P. C., even though he did not know that his act was likely to cause her death, and even if she was not pregnant. It is enough to prove that the act was done under the belief that she was pregnant. In such a case the accomplice is charged with having caused her death under the English Law. Similarly for conviction under section 511 it is not necessary to prove the existence of pregnancy. Vide Appendix IX for the definitions of these sections.

MEANS TO INDUCE CRIMINAL ABORTION.

The means adopted to induce criminal abortion are—

A. Mechanical violence.

B. The internal use of drugs.

A. **Mechanical Violence.**—This may be local or general.

Local.—The commonest method of procuring abortion is to rupture the membranes by the introduction of an instrument like a uterine sound into the cavity of the uterus. Owing to the rupture of the membranes the liquor amnii flows away, and abortion frequently occurs from a few hours to two or three days but, occasionally may not occur for days or weeks. It is possible for a woman to pass a sound or other instrument into her own uterus, but it is difficult and fraught with danger. In India the so-called *Dhais* or abortionists, who mostly practise this immoral and unlawful trade, introduce into the vagina or the os of the uterus sticks from five to eight inches long, which are commonly known as "abortion sticks". These sticks are wrapped round at one end with cotton wool, or a piece of a rag, soaked with the juice of a marking nut, *madar* or euphorbium, or with the paste made of arsenious oxide, arsenious sulphide, and red lead. Instead of these sticks the twigs of some irritating plants, such as

Nerium odorum (*Kaner*) and Plumbago rosea (*Lal chitra*), are also used. These twigs are very often anointed with asafetida (*Hing*) before their introduction. Hair pins are often used in England.

In some cases, instead of the abortion stick the irritating juice is directly applied to the os, or a rag, in the form of a tampon, saturated with the irritating juice or paste is introduced into the vagina.

The other methods are the injection of hot water or irritating lotions, such as corrosive sublimate and Condy's fluid into the vagina or into the uterus. Electricity has been lately used to induce abortion especially in the United States. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, and the positive pole is placed over the sacrum or lumbar vertebra.

General.—General violence acts directly on the uterus or indirectly by promoting congestion of the pelvic organs or hæmorrhage between the uterus and the membranes. The following methods are usually employed :—

1. Severe pressure on the abdomen by kneading, blows, kicks, jumping and tight lacing.

2. Violent exercise, such as riding, cycling, jumping from a height, jolting caused in driving on rough roads, long walks, running up and downstairs and carrying or lifting heavy weights.

3. Local or general blood-letting by venesection.

4. Cupping, usually by placing a lighted wick on the abdomen and turning a brass mug (*lota*) mouth downwards over it.

5. The application of mustard plaster to the abdomen and thighs.

6. The application of leeches to the pudenda, perinœum and the inner surface of the thighs.

7. Very hot and cold baths alternately.

The massage of the uterus through the abdominal wall is very likely to result in abortion, but the other kinds of violence, however severe they may be, very often do not produce the desired effect, and are, therefore, followed up by the administration of drugs; or women are murdered to avoid further worry and disgrace. On the 14th January 1911 a Hindu female about 30 years old was brought to the Agra Medical School mortuary with the police report that she was found in a well in the jurisdiction of the Aharan Police Station. On *post-mortem* examination a big gaping incised wound was found across the back of the neck cutting the third cervical vertebra and a twig of an *arhar* plant about 3″ long with some stuff applied to one end was found lying in the os uterus. It appeared that an attempt was first made to procure abortion, but she was then murdered, and thrown into the well.

B. **The internal use of Drugs.**—There are practically no drugs which, when administered by the mouth, act on the healthy uterus, and expel its contents, unless they are given in very large doses as to have deleterious effects on the woman herself.

The drugs that are generally administered for this purpose may be classified as—

1. Those acting directly on the uterus.
2. Those acting reflexly through the genito-urinary channel.
3. Those acting reflexly through the gastro-intestinal canal.
4. Those having poisonous effects on the system generally.

1. Those acting directly on the Uterus.—These are ecbolics and emmenagogues. The ecbolics increase the uterine contractions; the chief of these are ergot, quinine, and cotton root bark. Ergot is the most commonly used for procuring criminal abortion. It acts as a true ecbolic,

but better, if administered when the uterus is contracting. It frequently fails during the earlier months of pregnancy. Quinine is supposed to have an ecbolic action, but is very doubtful. The cotton root bark or gossypium is supposed to resemble ergot in its action.

The emmenagogues promote the menstrual flow, but do not act as abortifacients, unless administered in large and frequently repeated doses. The chief of these, that is most frequently used criminally, is savin in the form of oil of savin or a decoction or infusion of its leaves. Its abortifacient action is doubtful. Very often it causes death from the gastro-intestinal irritation. Borax is also frequently used, but it is very doubtful in its action.

2. Those acting reflexly through the Genito-urinary Channel.—These are the diuretics, but they are very mild, and generally fail in their action.

3. Those acting reflexly through the Gastro-intestinal Canal.—These are the emetics and purgatives given in large doses. The emetic that is chiefly used is tartar emetic, and the purgatives that are commonly used for this purpose are croton oil, gamboge, colocynth, aloes and elaterium.

4. Those having poisonous effects on the System generally.—These are the animal, vegetable and metallic irritant poisons. Among the metallic poisons lead is the only drug which requires special mention. It is used in the form of pills made from diachylon paste consisting of lead oxide and olive oil. Sometimes aloes is mixed with them, and the pills are coated with boracic acid. It acts successfully in producing abortion, but produces the symptoms of chronic lead poisoning. If abortion does not occur from the use of these pills, and if pregnancy is carried to full term, it often happens that the child dies shortly after birth.

The drugs that are chiefly used in India for the purpose of

procuring criminal abortion are the seeds and the unripe fruit of Carica papaya (*papita* or *papayya*), the unripe fruit of pine apple, the seeds of Daucus carota (*Gajar ka bij*), the milky juice of Calotropis gigantea (*madar*, *ak*), the bark of Plumbago rosea (*lal chitra*), Randia dumentorum (*main phal*), Cuscuta reflexa (*Ghagarbel*), Celastrus paniculata (*malkangani*), Anethum graveolens (*sowa*), Cucumis trigonus (*karit*), Momordica charantia (*karela*), Morynga pterygosperma (*shajna*, *saragwa*), Caryophyllus aromaticus (*Lavang*), Myristica fragrans (*Jayfal*), Crocus sativus (*Zafran*, *kesar*), Trigonella fœnum-græcum (*Methi*), sal ammoniac, and copper, arsenic and mercury salts.

ACCIDENTS FROM CRIMINAL ABORTION.

When abortion has been caused by rupturing the membranes by the introduction of abortion sticks, excoriations, lacerations or perforations are usually produced in the upper part of the vagina or in the uterine walls. Death may occur immediately from shock and hæmorrhage from these injuries, or subsequently from septic pelvic peritonitis or septicæmia or even from tetanus.

In the case of death occurring from hæmorrhage the defence may raise a plea that the hæmorrhage was due to menstruation, and not the result of criminal abortion. The uterus and the pelvic organs are most probably found congested, if death took place during a menstrual flow, but they are pale and anæmic, if hæmorrhage occurred as a result of criminal abortion.

If death does not occur, the subinvolution of the uterus may result with concomitant symptoms of displacements, menorrhagia, leucorrhœa, etc.

When the act has been accomplished by injecting some fluid into the vagina or uterus, death may take place suddenly from the entrance of air or fluid into the uterine sinuses,

or septic peritonitis; or metritis may occur leading to the adhesions of the ovaries and uterus.

When drugs have been used to produce abortion, death may result from their poisonous effects, as most of the reputed abortifacients are irritant poisons. If death does not occur, the woman may show the signs of chronic gastro-intestinal disturbances, nervous prostration and chronic ill-health.

EVIDENCE OF MISCARRIAGE.

The evidence of miscarriage can be determined by examining the woman alleged to have aborted, and the material alleged to have been expelled from the uterus.

Examination of the Woman—a. *During Life.*—The signs of recent delivery are found. These are more marked, if pregnancy has advanced to nearer full term. In the earlier months of pregnancy the signs are likely to disappear very soon after abortion, and the woman should, if possible, be medically examined within twenty-four hours after its occurrence. The usual sign in such cases is the bloody discharge from the vagina which is relaxed and dilated. On examining the vaginal canal with the speculum, excoriations, lacerations or wounds of the mucous membrane of the vagina may be discovered. The os and cervix are patulous, with or without fissures, tears or lacerations. The uterus may be found enlarged by bimanual examination or by passing the uterine sound. The enlarged breasts and other signs of pregnancy are the valuable points for diagnosis.

b. *After Death.*—In addition to the signs of pregnancy and the lesions caused by general violence, the vaginal canal should be carefully examined for the presence of punctures or lacerations, the marks of inflammation and corrosion on its mucous membrane. The uterus and its appendages with the vagina attached should then be carefully dissected out,

and laid on the table for minute inspection. The condition of the os and cervix should be examined as to the presence or absence of fissures, lacerations or the existence of a foreign body. The uterus should then be cut open, and its increased size, the attachment of the placenta and the presence of blood clots or of the product of conception should be noted. The ovaries should be examined for the existence of the corpus luteum. The alimentary and urinary organs should also be examined for the evidence of irritant poisoning.

In all the cases of abortion the uterus and its appendages with any foreign matter found in the genital canal, as well as the stomach, etc., should always be preserved for chemical analysis, if there is the least suspicion of a drug having been used locally or internally.

The material alleged to have been expelled from the Uterus.—When a substance alleged to have been expelled from the uterus as a product of conception is sent to the medical man for his opinion, he should thoroughly wash it in water to determine, if it is a fœtus or merely a blood clot, shreds of dysmenorrhœal membrane, a polypus, or a fibroid tumour. Very often I have examined blood clots wrapped up in a piece of cloth alleged to be a fœtus, and brought by women, who reported that they had aborted as a result of an assault or a kick on the hypogastrium. In the early months of pregnancy if the embryo is not found, the presence of chorionic villi found under a low power of the microscope will decide the fact of abortion. It should be remembered that during the first three months of pregnancy the fœtus is expelled with its membranes en masse, but after this period the fœtus is born first, and then after a time the placenta is detached and expelled, a portion of which may remain adherent to the uterus. If the placenta is sent along with the fœtus, it should be examined to ascertain, if it is entire or torn at any place, and if there are any degenerative changes on its surface.

If it is a fœtus, it is necessary to determine its probable intra-uterine age, its viability and the presence or absence of wounds or injuries inflicted on the body.

DEVELOPMENT OF THE FŒTUS AT DIFFERENT PERIODS OF GESTATION.

First Month (Fourth Week).—At the end of the first month the ovum is greyish in color, about $\frac{3}{4}$″ in diameter and is roughly equal to a pigeon's egg in size. Its weight is about 40 grains. The embryo is about $\frac{1}{3}$rd inch long, and is attached to chorion with a very short cord. The umbilical vesicle is present. It has two extremities, the head being a thick swelling and the tail, slender and well-marked. Two dark spots indicate the eyes, the mouth is represented by a cleft, and the limbs, by bud-like processes. Being very small and minute, it can hardly be detected in abortions, when surrounded by blood clots.

Second Month (Eighth Week).—At the end of the second month the ovum is $1\frac{3}{4}$ inches long, about the size of a hen's egg, and weighs two to five drams. The embryo measures $\frac{3}{4}$″ in length. The mouth and nose are separated, the umbilical vesicle has disappeared and the generative organs are apparent, but the sex is indistinct. The anus appears as a dark spot. The cord is longer, and the placenta has commenced to form. The centres of ossification have begun in the mandible (lower jaw), clavicle, ribs and bodies of the vertebræ.

Third Month (Twelfth Week).—At the end of the third month the fœtus is 3 to 4 inches long, and weighs about one ounce. The placenta is developed and chorionic villi have atrophied. The cord is much longer, and has a spiral twist. The head is more rounded and separated from the body by the formation of the neck. The eyes and the mouth are closed. The nails in the form of thin membranes appear on the fingers and toes. The sex is still indistinguishable. The heart is divided into two chambers, and the alimentary canal is situated within the abdominal cavity.

Fourth Month (Sixteenth Week).—Towards the end of the fourth month the fœtus is 4 to 6 inches in length, and is 2 to 4 ounces in weight. The sex can be differentiated. The skin is rosy and firmer. Down begins to be formed on the body. The head is one-fourth of the length of the body. The convolutions of the brain are commencing to develop. The membrana pupillaris is visible. The skull bones are partly ossified, but the sutures and fontanelles are very widely apart. The gall-bladder

is forming, and meconium is found in the duodenum. The umbilicus is situated near the pubes. The points of ossification are present in the lower segments of the sacrum, and the ossicles of the ear have ossified.

Fifth Month (Twentieth Week).—The fœtus of the fifth month is 7 to 10 inches long, and weighs about eight ounces. Light hair is seen covering the head which is about $\frac{1}{3}$rd of the length of the fœtus. Lanugo is quite distinct on the body. The nails are distinctly marked, but are very soft. The germs of the permanent teeth begin to appear in the jaw. The position of the umbilicus recedes upward. The points of ossification are present in the os pubis, os calcis, and ischium. Yellowish bile-stained fluid is found in the small intestine, and meconium of a yellowish green color at the commencement of the large intestine.

Sixth Month (Twenty-fourth Week).—Towards the end of the sixth month the fœtus is 9 to 12 inches long, and weighs 16 to 24 ounces. The body is cinnbar red in color, and the skin has a wrinkled appearance for want of fat in the body, though a small degree of fat is beginning to deposit in the subcutaneous cellular tissue. Cerebral hemispheres cover the cerebellum. The eyelids are adherent, and the membrana pupillaris still exists. The eyebrows and eyelashes are beginning to form ; the umbilicus is situated farther from the symphysis pubis The testicles are lying close to the kidneys. Dark meconium is found in the upper part of the large intestine. The centres of ossification are present in the four divisions of the sternum.

Seventh Month (Twenty-eighth Week).—The fœtus is 13″ to 15″ long, and weighs 2 to 4 pounds. The skin is dusky red, thick and fibrous, and covered with vernix caseosa, which is a white fatty substance formed of epidermal scales, lanugo and the secretion of the sebacious glands. The eyelids are open, and the membrana pupillaris has almost disappeared. The nails are thicker, but do not reach the ends of the fingers. Meconium occupies nearly all the large intestine. The testicles are in the act of descent, and are found in the external inguinal ring. The centre of ossification is in the astragalus.

Eighth Month (Thirty-second Week).—At the end of the eighth month the length of the fœtus is about 15 to 17 inches, and the weight from 3 to 5 pounds. The skin is rosy, coverved with soft hair, and is not wrinkled in appearance, as there is more subcutaneous fat under it. The hair of the scalp is denser, and the lanugo has almost disappeared from the face. The membrana pupillaris is no more visible ; the nails have reached the ends of the fingers. The left testicle has already descended

in the scrotum, but not the right. A point of ossification is found in the last vertebra of the sacrum. This is the most important month from a medico-legal point of view as the child becomes viable at the end of the thirtieth week, i. e., at the 210th day.

Ninth Month (Thirty-sixth Week).—At the end of the ninth month the fœtus is about 18 inches long, and weighs 5 to 6 pounds. There is no more senile appearance of the face. The scalp is covered with hair, while the down on the body has disappeared. The scrotum contains the testicles, and is wrinkled. The vulva is closed. Vernix caseosa is found in the flexures of the joints. Meconium is found at the termination of the large intestine. A centre of ossification commences to form in the lower epiphysis of the femur from the commencement of the ninth month.

Tenth Month (Fortieth Week).—The fœtus presents the signs of a mature (full term) child. The length is from 19 to 20 inches, and the weight from 6 to 7 pounds. The scalp is covered with hair about 1 to 2 inches long, which is generally dark. Lanugo is no where seen except on the shoulders. The skin is pale, and covered with vernix caseosa. The nails project beyond the ends of the fingers but reach only the tips of the toes. The cartilages have formed in the nose and ears. The umbilicus is situated in the central part between the pubes and the ensiform cartilage. The testicles are contained in the scrotum. The labia majora cover the nymphæ and clitoris. The rectum contains dark brownish, green or nearly black meconium, which is voided within a few hours after live-birth. The centre of ossification is found in the lower epiphysis of the femur and measures from $\frac{3}{4}$ths of a line to 4 lines in diameter. The centre of ossification is also present in the cuboid.

DISTINCTION BETWEEN NATURAL AND CRIMINAL ABORTION.

When abortion has been actually proved to have taken place, the defence cannot deny it, but may raise a point that it was induced spontaneously and not criminally. In such a case it is not always easy for the medical man to give a definite opinion simply from examining the woman or the contents of the uterus. Natural abortion occurs generally in women, who are week, irritable and unhealthy, and when the embryo or the fœtal membranes are diseased. The medical man is,

therefore, justified in pronouncing it as criminal abortion, if he were to find the lacerations in the vagina and on the cervix, or marks of violence on the abdomen of a healthy woman, or wounds on the fœtus or membranes, otherwise free from disease. The occurrence of septicæmia is highly suggestive, but not conclusive of criminal abortion. Septic peritonitis or metritis occurs more frequently in criminal than natural abortion, but it may occur in the latter, if proper antiseptic precautions are not taken in its after-treatment, whereas it may not occur in criminal abortion, if proper attention is paid to asepsis while inducing it.

The question, whether the marks of injuries on the vagina and the cervix were due to criminal interference, or due to traumatism by the passage of the fœtus during spontaneous abortion, can be determined by noting their site, extent and appearance, and the physical development of the fœtus.

CHAPTER XVIII.

INFANTICIDE.

Definition.—Infanticide means the murder of a newly born infant. The law considers an infant "newly born" up to fifteen days after its birth. The legal bearing on infanticide is the same as in homicide, except that the law presumes that every child is born dead, unless the contrary can be proved by medical or other evidence. To substantiate the charge of infanticide it is required to prove that the child was born alive, and that it died from criminal violence inflicted after its birth.

Owing to certain social customs prevailing in the different communities of India, infanticide was formerly very common but, with the spread of education and restrictive actions by Government, is now rare except in the case of illegitimate children born of widows who are not allowed to remarry. Whereas in Europe and other countries it is the unmarried girls who commit infanticide to get rid of children begotten of illicit intercourse, since they do not have early marriages among them as in India.

In cases of infanticide the medical man is required to examine the woman—the alleged mother of the child—and the dead body of the child. He has to examine the woman to determine, if she has been recently delivered of a full-term child. With reference to the child he is called upon to solve the following questions raised by the police, when the body is sent for *post-mortem* examination :—

I. Was the child still-born or dead-born ?
II. Was it born alive ?
III. If born alive, how long did it survive the birth ?
IV. What was the cause of death ?

I. WAS THE CHILD STILL-BORN OR DEAD-BORN ?

To avoid confusion, the distinction must be drawn between the terms *still-born*, and *dead-born*. This distinction is specially important in civil cases. A child is still-born, if it is born alive, but does not attempt to breathe, although the heart is still beating, and dies without respiration having taken place. In such a case it is incumbent on the medical attendant to try to resuscitate the child by a reflex stimulus or by artificial respiration. A child that is still-born can be recognised by raising the upper eyelids which will be closed on removing the pressure. Still-births occur more frequently among illegitimate and immature male children than among legitimate, mature and female children, and more often in primiparæ than in multiparæ. A child is regarded as dead-born, if it does not manifest any sign of life, when completely born. A child that has died before birth shows—

1. Signs of ante-partum rigor mortis at the time of birth.

Or

2. Signs of maceration, which is the most usual change following the death of the fœtus in utero. This occurs when the dead child remains for some time in the uterus surrounded with liquor amnii, but with the exclusion of air. The body of a macerated fœtus is soft, flaccid and flattened, and emits a sweetish, disagreeable smell, which is quite different from that of putrefaction. The skin assumes a red or purple tint, but never green as in putrefaction. Large blebs resembling pemphigus and containing a red serous or sero-sanguineous fluid are raised, and the epidermis is easily peeled off leaving moist and greasy patches. The tissues are generally œdematous, and a turbid reddish fluid collects in the serous cavities. The sutures of the cranial

bones are separated, and hence the skull bones are freely movable over each other. The brain substance is converted into a greyish red, pulpy mass. All the viscera become infiltrated and lose their anatomical features, but the lungs and the uterus remain unaffected for a long time. The umbilical cord is red, smooth, softened and lacerable. If the membranes are ruptured after the death of the fœtus, air gains admission into the liquor amnii, and the fœtus undergoes putrefaction instead of maceration.

Or

3. Signs of mummification, by which the fœtus is dried up and shrivelled. Such a condition results, when the death of a fœtus occurs from a deficient supply of blood, when the liquor amnii is scanty and when no air has entered into the uterus.

II. WAS THE CHILD BORN ALIVE?

Live-birth, according to the English law, means a child completely born external to the mother irrespective of the attachment or severance of the cord and manifesting some sign of independent life. Scientifically this definition does not seem to be correct, as it is absurd to call a child not born, when one foot remains in the vagina, the rest of its body has been born and it has been breathing and crying for some time. To prove the charge of murder in such a case, it is not possible for a medical man to say definitely that the child was completely born before it was assaulted, unless he was present at the time of delivery, and thus there is always a chance of miscarriage of justice. Hence the definition held by the Indian law is more correct and appropriate. It constitutes live-birth, if, only a part of a living child is born.

The Evidence of Live-Birth—In civil cases, the feeling, seeing or hearing of the heart-beat, muscular movements—

even a slight twitching of the lips or eyebrows—or the cry, are sufficient to establish the proof of live-birth. It is said that the mere "crying" of a child, though a very strong evidence of live-birth, cannot be relied on as a positive proof, for it is possible for the child to cry before complete birth, while the head is still in the uterus (vagitus uterinus), or in the vagina (vagitus vaginalis), but in such a case there has been extensive artificial manipulation, which may admit air into the uterus and so lead to crying. Hence there should always be proof of such interference.

In criminal cases the Judge requires the medical man to prove from *post-mortem* examination that the child showed the signs of life as a separate existence after it was completely born. The most important sign of such an existence is the establishment of respiration which can be determined from examining the chest and the lungs.

The appearances which show whether respiration has taken place or not are—

1. The shape of the chest.
2. The position of the diaphragm.
3. The changes in the lungs.
4. The changes in the stomach and intestines.
5. The changes in the kidneys and bladder.
6. The changes in the middle ear (Wredin's test).

1. The Shape of the Chest.—The chest is flat before respiration is established, but it expands and becomes arched or rounded after full respiration.

2. The Position of the Diaphragm.—The abdomen should be opened before the thorax, and the position of the diaphragm should be noted by passing the finger up into its concave arch, the highest point of which is found at the level of the fourth or fifth rib, if respiration has not taken place, but the arch becomes flattened and depressed, and descends to the level of the sixth or seventh rib after respira-

tion has been conpletely established. The position of the diaphragm may, however, be affected by the gases of decomposition.

3. The Changes in the Lungs.—These are considered with reference to their (*a*) volume, (*b*) consistence, (*c*) colour, and (*d*) weight.

(*a*) *Volume.*—Before respiration has taken place, the lungs are small, with sharp margins, lie in the back part of the chest on either side of the vertebral column and are hardly seen on opening the chest, as the cavity is filled up by the heart and the thymus. After complete respiration the lungs increase enormously in volume, have rounded margins and occupy the cavity covering more or less the thymus and the heart.

(*b*) *Consistence.*—Before respiration, the lungs are dense, firm, non-crepitant and liver-like. After respiration, they are spongy, elastic and crepitant.

(*c*) *Colour.*—Before respiration, the colour of the lungs is uniformly reddish-brown like that of the liver, the surface of the lobules being marked with shallow furrows, but not with a mottled appearance. On section frothless blood exudes. After respiration, the collapsed air-cells first become distended with air, usually on the edges and concave surface of the upper lobe of the right lung, and then on the remaining portions of the lungs. These air-cells are polygonal or angular in outline, arranged more often symmetrically in groups of four or five, though occasionally scattered irregularly, and are slightly raised above the surface. They are more or less mottled or marbled in appearance with circumscribed rose-coloured patches. This mottled appearance is due to the blood vessels being filled with blood, and is characteristic of the lungs that have breathed. On section forthy blood exudes from the cut surface. The fœtal lungs may assume a more or less rosy colour on exposure to the air after death, but the air-cells can never be distended but by the entrance of air into

the lungs. This condition cannot be simulated by artificially inflating the lungs, as their colour is then cinnabar red, without any mottling.

(*d*) *Weight.*—As regards the weight of the lungs two tests are applied ; *viz*, the static test obtained by taking the absolute weight of the lungs, and the hydrostatic test which depends on their specific gravity.

Static Test.—In order to weigh the lungs, they are removed along with the windpipe and bronchi after ligaturing the pulmonary vessels and separating them from the heart and the thymus gland. The weight of the fœtal lungs varies from 450 to 600 grains, while, owing to the increased flow of blood into the lungs, their weight is increased after respiration. It is from 900 to 1000 grains. This varies in proportion to the weight and development of the child, and for obvious reasons it is not possible to weigh the lungs before and after respiration in any one case; hence another test has been devised, in which the ratio of the weight of the lungs to that of the body is taken into consideration to establish the fact of live-birth. This is known as *Ploucquet's test*, as Ploucquet was the first to ascertain that the proportion of the weight of the lungs to that of the body is 1 : 70 before respiration, and 1 : 35 after respiration, but this test also has no medico-legal value as the ratio of the weights is mostly variable.

Hydrostatic Test (Docimasia Pulmonaris).—This is the most reliable and valuable test and should, as a rule, be performed before an opinion is given as to whether respiration has taken place or not. It is based on the fact that the specific gravity of the unrespired lungs varies from 1040 to 1056, and that of the respired lungs is 940, owing to their volume being increased due to the presence of air. The fœtal lungs, therefore, sink in water, and those, that have breathed, float.

The Method of Test.—The method of performing the test is to remove the lungs as far as the trachea along with

the heart and thymus after securing the large vessels, and to place them in a glass jar or vessel about twelve inches high and eight to ten inches in diameter, filled with tap water or preferably with distilled water, and to note whether they float or sink. The lungs are then separated from the heart and thymus by tying a ligature on the bronchi, and dividing them above it, when each lung individually is placed into the vessel to note its buoyancy. Each lung is then cut into twelve equal pieces, which are again to be tested as regards their flotation. If these pieces float, they are each squeezed between the thumb and the index finger under the surface of water to see if any bubbles of air are given off, and if they still persist to float ; or they are taken out of water, wrapped in a piece of cloth and placed on the floor between two cardboards, when firm and equable pressure is applied by putting a heavy weight, or by standing on the upper card board, without any jerky movement. The pieces are once more placed in water, and if they continue to float even after the application of this pressure, the medical jurist is justified in affirming that respiration has been established. If the lungs sink separately, or if they float, but the pieces sink after pressure, it means that respiration has not taken place. If some of the pieces float while others sink, it shows feeble respiration owing to the partial penetration of air.

Objections.—The two following objections have been raised against the hydrostatic test but, on close scrutiny, none of them diminishes the value of the test :—

1. The expanded lungs may sink from disease or from atelectasis.

2. The unexpanded lungs may float from the presence of putrefactive gases or from artificial inflation.

1. *The expanded lungs may sink from—*

(*a*) *Disease.*—The disease may be catarrhal or crupous pneumonia, or it may be congenital tuberculosis or syphilis.

In all these cases the pathological conditions characteristic of the disease can always be easily recognised, and it is not likely that both the lungs will be similarly affected. There will certainly be some portions of the expanded lungs which will escape the disease and consequently float in water. In cases of infanticide it is always necessary to examine the lungs for the evidence of disease to exclude the possibility of their sinking in water due to this cause.

(*b*) *Atelectasis.*—Cases of atelectasis, *i.e.*, non-expansion of the lungs in children born alive and surviving for a few days, though rare, have occurred, but there is no other test by which this condition can be determined, and so the test does not lose its value in its general application. Three explanations for the non-expansion of the lungs have been given as mentioned below :—

1. Owing to the feeble respiration, air may not reach the alveoli, but the aeration of blood may take place through the lining membrane of the trachea and bronchi.

2. Air which entered the lungs may have been entirely absorbed by the blood after respiration stopped, if circulation continued. It is a fact that the heart of a newly born infant may continue pulsating for half an hour or more after the stoppage of respiration, or when the infant is in a state of asphyxia.

3. If the respiratory movements are very feeble, it is quite possible for more air to be expelled from the lungs during expiration owing to the recoil of the lung tissue than it is taken during every act of inspiration, and thus the lungs may be emptied of all the air, and may subsequently return to the fœtal condition.

2. *The unexpanded lungs may float from—*

(*a*) *The Presence of Putrefactive Gases.*—For the putrefactive gases to be the possible cause of floating the lungs, they should show the signs of decomposition,

which should also be evident in other parts of the body.

The putrefied lungs are soft and greenish in colour, and the putrefactive gases collect under the pleuræ and in the connective tissue in the form of air bubbles of different sizes, which can be squeezed from place to place, and can be expelled on the application of pressure after cutting the lungs into pieces, so that they will sink when placed in water. Whereas the air due to the establishment of respiration cannot be expelled from the air vesicles after the application of pressure, unless the force is so great as to disintegrate the lung tissue. However, the medical jurist should never venture an opinion, if the lungs are too far advanced in putrefaction for the performance of the hydrostatic test.

(*b*) *Artificial Inflation.*—It is extremely difficult to artificially inflate the lungs, though it is possible to do so by passing a tube, a canula or a catheter into the trachea, by the mouth to mouth method, or by Schultze's method (swinging the body) in resuscitation, when the stomach and intestines are usually filled with air as well. Even in these cases, if all the alveoli have not been inflated, air can be removed from them by pressure, and the pieces of the lungs thus treated will sink. However, if all the alveoli have been inflated without rupturing them, the cut pieces of the lungs will float even after pressure, but they can be distinguished from the normally expanded lungs by their cinnabar colour, the absence of the marbled appearance of the surface, and the absence of blood exuding from them on section.

Besides, the possibility of inflating the lungs artificially in criminal cases should never be countenanced, as inflation can only be practised by the medical man or the mother to save the child, but one who wants to destroy a newly-

born infant, will presumably try to prevent respiration rather than induce artificial inflation of the lungs.

In conclusion the medical man is justified in affirming that the child had lived during and after its birth, if he finds the following appearances on the *post-mortem* examination of the body of a newly-born infant :—

1. A full-term mature fœtus judged from its length, weight and other characteristics, especially the centres of ossification in the lower epiphysis of the femur and in the tarsal cuboid bone.

2. The diaphragm standing at the sixth or seventh rib.

3. The lungs occupying more or less the thoracic cavity and covering a portion of the heart and thymus gland.

4. The marbled or mottled appearance of the lungs.

5. Bloody froth exuding from the cut surfaces of the lungs on slight pressure.

6. The lungs responding to the hydrostatic test.

When is the Hydrostatic Test not necessary ?—The medical man need not perform the hydrostatic test, if he finds that—

1. The fœtus is born at less than 180 days of intra-uterine life, when it cannot be viable.

2. The fœtus is a monster, who is incapable of viability owing to congenital malformations.

3. The fœtus shows signs of intra-uterine maceration.

4. The umbilical cord has separated and the umbilicus has cicatrized.

5. The stomach, on dissection, contains coagulated or half-coagulated milk as a result of the active digestive function.

4. Changes in the Stomach and Intestines.—The stomach and intestines sink in water, if the child has not breathed, but they float in water, if respiration has taken place. This is known as *Breslau's second life test.* It is a

corroborative test rather than a conclusive one. The practicability of this test is useful especially when air has been prevented from entering into the lungs by foreign bodies or by occlusion of the bronchi.

The stomach will also contain mucus with air bubbles and saliva, if respiration has been established, whereas it will contain only mucus, if a child has not breathed. The presence of food in the stomach, such as partly digested milk or starch is a very strong evidence that the child was not only born alive, but had lived for some time after birth. The absence of meconium from the bowels is not the absolute proof of live-birth, as it may be voided in breech presentation even if the child is still-born. Under ordinary circumstances meconium is passed immediately after, or within twenty-four hours after, birth.

It may be necessary to recognize the stains of meconium on the clothing. They are brownish green and stiffen the fabric, but do not penetrate deeply into its texture. When dissolved in water meconium forms a green solution, which is acid in reaction and is not affected by boiling.

5. Changes in the Kidneys and Bladder.—The deposits of uric acid in the form of brownish yellow crystalline streaks found in the pelves of the kidneys has been regarded by some authorities as a positive proof of live-birth, but this sign is not reliable as the crystals have been found even in still-born children.

The absence of urine in the bladder is not at all diagnostic of live-birth, as urine may not pass for some hours after birth, or it may be passed mechanically during labour, and the child may be subsequently born dead.

6. Change in the middle Ear (Wredin's Test).—Dr. Wredin of Petrograd has observed that the gelatinous embryonic connective tissue, which fills the middle ears during fœtal life, disappears after birth, and is replaced by

air, if respiration has taken place. This is not a valuable sign, since the gelatinous mass may disappear during fœtal life, or may not disappear until twenty days after birth.

III. IF BORN ALIVE, HOW LONG DID IT SURVIVE THE BIRTH?

The child is usually murdered in the first few minutes after birth, to prevent the neighbours from hearing the cry. One or two deep breaths fully distend the lungs. It is not possible to determine the exact length of time that a child has lived after its birth, but an approximate idea may be formed from carefully considering the following changes in the external and internal appearances of the body:—

1. **Changes in the Skin.**—The skin of a newly born infant is bright red, and covered with vernix caseosa chiefly in the axilla, inguinal region and folds of the neck; the vernix is not easily removed, and persists for a day or two, but it is possible for a child to be born with little or no vernix. After birth the skin changes its colour, and becomes darker on the second or third day; it then becomes brick red, and finally yellow. It assumes its normal colour in about a week's time The exfoliation of the skin, chiefly on the abdomen, occurs during the first three days after birth. The exfoliation has to be distinguished from the detachment of the cuticle due to intra-uterine maceration.

2. **The Presence of Caput Succedaneum**—Caput succedaneum is a valuable sign. It is formed on the presenting head during delivery. It is an effusion of blood in the scalp and not serum. It is nothing but a bruise; hence it undergoes the colour changes during absorption, and lasts about seven days.

3. **Changes in the Umbilical Cord.**—The changes in the umbilical cord begin to appear from the cut end to its base at the umbilicus soon after birth, when it has been

divided. Clotting sets in the cut end at the end of two hours. The portion of the cord attached to the child shrinks, and dries within twelve to twenty-four hours, and an inflammatory ring of redness forms at its base from thirty-six to forty-eight hours. This should not be confounded with a line of redness seen round the umbilicus at the time of birth. This line is merely red without any sign of a swelling or inflammation. By the second or third day it shrivelles up, mummifies, and falls off on the fifth or sixth day leaving a slightly suppurating ulcer, which heals and cicatrizes within ten to twelve days. In rare cases the cord may drop off as early as the second day or as late as the tenth day. The mere mummification of the cord is not of any value as a sign of extra-uterine life, as it occurs in the dead body of a newly-born child if exposed to the air, but the separation of the cord with the formation of a cicatrix is a sure sign of survival of the child after birth.

The mummification of the cord does not occur, if the child is submerged in water immediately after birth. Similarly a cord, which has already dried and withered, may become soft and supple though tough, if the body is lying in water, or wrapped in wet clothes.

4. Changes in the Circulation.—These occur after birth. The umbilical vessels, ductus venosus, ductus arteriosus and the foramen ovale, which were necessary to carry out the fœtal circulation, are no longer required to perform their functions after the birth of the child and are, therefore, obliterated. Thus the umbilical arteries begin to contract in about ten hours after birth, and are completely closed by the third day. The umbilical vein and the ductus venosus are the next to contract. For the first three days the contraction is rather slow, but complete obliteration occurs on the fourth or fifth day. The ductus arteriosus begins to contract first at the aortic end, is reduced to the size of a crow-quill by the seventh

day and usually closes completely by the tenth day. The closure of the foramen ovale generally occurs by the eighth or tenth day. Some times it may remain patent up to the second year, while in a few cases it remains open throughout life giving rise to cyanosis, a condition known as *Morbus Cœruleus.* In rare cases the foramen ovale has been closed at birth.

IV. WHAT WAS THE CAUSE OF DEATH?

The death of the child may occur from natural, accidental or criminal causes.

NATURAL CAUSES.

1. Immaturity.—If the child is prematurely born, it generally dies immediately after birth. In the case of the premature birth of a child the question may arise as to whether the birth was criminally induced or not, for, according to section 315 of the Indian Penal Code the criminal induction of premature labour is an offence, but not culpable homicide, though by the English law a person is guilty of murder, if he does an act by which a child is born prematurely, so that it is not capable of living, and dies in consequence of its exposure to the external world.

2. Debility.—The child may be of full term, and yet may die after birth from debility due to the want of general development. In such a case no disease is detected, but some portions of the lungs may be found in a state of atelectasis from feeble respiration.

3. Congenital Diseases.—These are syphilis, and specific fevers, such as small-pox, plague, etc., attacking the mother, or the diseases of the child's internal organs, viz., the lungs, heart and brain.

Syphilis is the usual cause of the death of the fœtus. Specific fevers cause the death from the toxæmic condition of its blood produced by the attack on the mother, or from

the attack on the child itself. Of the diseases of the internal organs, hepatization and tubercle of the lungs are common. The heart affections are rare, while the diseases of the brain may destroy life without leaving any traces behind.

4. Hæmorrhage.—This may be from the natural openings of the body ; e. g., the rectum or female genital organs.

5. Malformations.—These are acephalous and anencephalous monsters, or children born with congenital abnormalities of the blood vessels, the heart, or the alimentary canal. It must be remembered that monstrosity or malformation is no justification for taking the life of an infant. Again it must be remembered that monsters do not necessarily die soon after birth.

6. Disease of the Placenta.—Disease of the placenta or its accidental separation from the uterine wall may cause the death of the fœtus. This can be detected by examining the placenta or by examining the uterus, if the mother is dead and her body is available for *post-mortem* examination.

7. Spasm of the Larynx.—This may occur from mucus or meconium being aspirated into the larynx or from the enlargement of the thymus gland.

8. Placenta Prœvia or Abnormal Gestation.—Any of these conditions may cause the death of the fœtus.

ACCIDENTAL CAUSES.

Accidents causing the death of the child may occur during or after birth.

During Birth.—1. Protracted Labour.—Prolonged labour may cause the death of the child by causing extravasation of blood into the meninges or on the brain substance with or without the fracture of the skull bones owing to severe compression of the head. In such cases it is not usual to find any external injury on the scalp. Sometimes the child may

die from exhaustion on account of prolonged and difficult labour.

2. Pressure on, or Prolapse of, the Funis.—In such cases death occurs from asphyxia, and on *post-mortem* examination blood, meconium, liquor amnii, or vernix caseosa, may be found in the bronchial tubes. These may be examined by a lens, or vernix caseosa may be stained with gentian and violet solution, and then examined under the low power of the microscope.

3. Knots of the Cord or its Twisting round the Neck.—The child is sometimes strangled before birth by the knots or loops of the cord being tightened, or the cord being coiled round its neck during delivery. Similarly the spasmodic contraction of the os round the neck or body of the child may result in its death by suffocation.

4. Injuries.—Accidental injuries on the abdomen of the mother may cause in utero fracture of the fœtal bones, such as cranial bones or bones of the extremities, or rupture of the internal organs.

5. Death of the Mother.—When the mother dies in the act of delivery, the question arises as to how long a child may live in utero after her death. The time depends upon the cause of the mother's death. If death occurs slowly from hæmorrhage, there is very little chance of saving the child, but it may be saved, if an attempt is made to extract it soon after the death of the mother from some accident, if she was previously in good health. Dr. Harris, of Philadelphia, who has made many investigations regarding this point, is of opinion that a living fœtus may be extracted within two hours after the death of its mother.

After Birth.—1. Suffocation.—The child may die from suffocation after birth, if it is born under a *caul*, *i. e.*, with membranes over the head, thus covering the mouth and nostrils. The child may also die from suffocation, if it is pressed

accidentally in the clothes, or submerged accidentally in the discharges, such as blood, liquor amnii or meconium.

2. Precipitate Labour.—Owing to precipitate labour the child may die from suffocation by falling into a privy pan containing fæces, or from drowning by falling into a chamber pot containing urine. Similarly if a woman was standing up right at the time, the child may die from a fall on a hard floor or pavement. In such a case the parietal bone, especially the left, is usually fractured, and the cord is found torn with ragged margins. Hæmorrhage from the cord may also be so profuse as to cause the death of the fœtus, even though there be no fracture of the skull.

Precipitate labour is possible in multiparæ with a roomy pelvis, but is extremely rare in primiparæ. In connection with precipitate labour it will not be out of place to mention here that unconscious delivery is possible in multiparous women who have roomy pelves, and relaxed soft parts. This is more likely to occur if the fœtus is small, and if the woman is in a fit of hysteria at the time of delivery owing to uterine pains. Women may also be unconsciously delivered during profound sleep, as also when they are under the influence of narcotic drugs, or when they are suffering from syncope, asphyxia, coma or eclamptic convulsions.

CRIMINAL CAUSES.

These may be—

A. The acts of commission, e.g., the use of mechanical violence and poisoning.

B. The acts of omission or neglect.

A. ACTS OF COMMISSION.

Mechanical Violence—1. Suffocation—This is the commonest form of infanticide. Newly-born infants are very

easily suffocated by pressing them face downwards on bedclothes or by covering their mouth and nostrils with the hand, pillows, handkerchiefs or by the mother intentionally overlaying the child. Sometimes mud, rags, or cotton is forced into the mouth of the child. The mother may force her finger into the mouth of the child to prevent it from crying after birth, and thus suffocate it to death. In such a case scratches or lacerations may be found in the mouth or the throat. During the *post-mortem* examination of the dead bodies of infants the mouth and the throat should be examined for the presence of some foreign matter which, if detected, should be preserved, and sent in a sealed packet to the superintendent of police. The lips and the nose should also be examined for the presence of bruising or other injury.

2. Strangulation.—This is also a common form of child murder. Very often, during the act of strangulation great mechanical violence is used, and severe marks of abrasions and contusions with extravasation of blood in the soft tissues are usually found on the neck. In one case a thick rope was used to strangulate a child, and an *izarband* (a tape of pyjama) was used as a ligature round the neck in another case. This child with an *izarband* twisted round its neck and wrapped in a pyjama was found in the lavatory of a third class compartment of a railway train at the Agra Fort Station. Not unfrequently the child is murdered by passing the umbilical cord as a ligature round the neck. In such a case, the plea put up by the defence is that the child was strangled accidentally by the cord coiling round the neck during delivery. In an accidental case of this nature there is most probably a broad continuous grove, livid or red in colour, without any excoriation, and the death being due to the stoppage of circulation, the lungs are generally found in a fœtal condition.

Rarely the natural folds of the skin in the neck of fat

children may resemble the cord mark or marks caused by strangulation but in that case no marks of abrasions or any extravasation of blood will be visible on the neck.

In the case of throttling, in addition to the bruises of the fingers or scratches of the finger-nails found on the neck, the rupture of the muscles and tracheal cartilages may be detected, as undue violence is used in throttling infants.

3. Drowning.—This is a rare form of child murder. As recorded by Chevers the submersion of the child's face into milk (*Dudh pita karna*) used to be a common method of infanticide in Benares and other neighbouring places. Nowadays the usual custom is first to kill an infant and then to throw it into a cesspool, well, tank or river. The putrefactive changes occurring in water are similar to those of intra-uterine maceration, if the child be thrown into water immediately after birth.

4. Fracture of the Cranium.—The fracture of the cranial bones results from a fall, from a blow on the head with a blunt weapon, or from the head being firmly pressed under the leg of a bedstead (*charpoy*). Great violence being used in such cases, depressed and extensive fractures of the skull bones with contusions or contused wounds of the scalp are usually noticed. Ordinarily a drop of 30 inches is sufficient to cause fracture of the skull bones, but a fall of 18 inches may fracture them as well.

A newly-born child which was found lying dead on a railway line near Achnera Station showed, on *post-mortem* examination, a fracture of the occipital bone with extravasation of blood on the under surface of the scalp on its posterior aspect. It was presumed that the child was thrown out of a window of a railway carriage of a running train, as it was found soon after the train had passed.

The defence is usually based on the plea of precipitate labour in those cases where the cause of death is due to

fractures of the skull bones. Precipitate labour is likely to occur in a woman with a roomy pelvis and with an old laceration of the perinœum, or the woman may have the perinœum ruptured recently, if examined soon after delivery ; but the recent rupture of the perinœum may be seen in primiparæ, even if the delivery was normal. Again in a case of precipitate labour the placenta may be born along with the child, or the umbilical cord may show the torn and ragged ends due to its spontaneous rupture owing to the sudden jerk and strain. The rupture occurs more frequently at the fœtal end than at the placental end of the cord, but does not occur in its middle. Sometimes the amniotic sheath of the cord may remain in tact, but the vessels contained in it may be torn at both ends. If the cord has been intentionally torn, it is usual to find the rupture of the liver caused by the forcible strain put upon the child's abdomen during the process of traction of the cord The length of the cord, if available, should always be measured at the time of the *post-mortem* examination.

5. **Wounds.**—The child may be killed by the penetrating wounds into the heart, brain, medulla, or other internal organs produced by needles, pins or scissors.

Poisoning.—Poison is rarely used for the purpose of infanticide though, sometimes crude opium is put on the tongue of the child, or it is smeared on the nipple of the mother's breast, which is then given to the child to suck. Other poisons, such as arsenic, *madar*, *dhatura*, and tobacco are also used for destroying newly-born infants. In suspicious cases the stomach and other necessary viscera must be preserved for chemical analysis.

B. ACTS OF OMISSION OR NEGLECT.

The law presumes that a woman, who is about to be confined, should take ordinary precautions to save her child,

after it is born. She is guilty of criminal negligence, if she fails to do so. Thus the acts of omission or neglect constituting the crime under the law are—

1. **Omission** to take the necessary help of a midwife or a skilled physician, so that proper arrangement may be made to save the child after its birth. A married woman or one who has borne children, is presumed by law to know her duty by her new-born child. As soon as she gets labour pains, she must inform her friends of her condition, and must send for medical aid. If she has failed to take any of these precautionary measures she may raise a plea that she fainted away owing to the sudden onset of violent labour pains, and did not know what followed next. To subtantiate this plea it would be necessary for her to prove precipitate labour.

2. **Failure** to ligature the cord after it is cut so that the child may bleed to death after live-birth. Hæmorrhage may also occur, if the cord is ligatured but not too tightly.

3. **Omission** to remove the child from the mother's discharges, so that it may not be suffocated. In the absence of a medical man or any other attendant the question about the capacity of a woman after delivery may be raised. It is not easy to answer this question. Many women have been known to have carried the child for a long distance soon after delivery, while other women may get so much exhausted as not to be able to move at all. It depends much upon the strength of the woman, and whether she is a primipara or a multipara. A weakly primiparous woman may faint away after delivery from mere exhaustion, or may be incapable of attending to the child from mere ignorance. The question has to be decided on circumstantial evidence.

4. **Omission** to protect the child from cold or heat. Exposure of a newly-born child to cold or heat may destroy its life without leaving any marks of violence suggestive of the cause of death, except perhaps the cerebral congestion.

5. Omission to supply the child with proper food according to its age. The starvation of a child constitutes slow death. The stomach and intestines must be examined for the presence of food. If the child is immature, it is very difficult for the medical man to say whether the death was due to natural causes owing to feebleness, or was due to starvation. The case depends chiefly upon circumstantial evidence.

THE ABANDONING OF INFANTS.

Very often a newly-born infant, after it is born alive is abandoned in a street, when the mother is prosecuted under section 317, I. P. C. (Appendix IX), but she is tried for murder or culpable homicide, as the case may be, if the child dies as a result of exposure.

CONCEALMENT OF BIRTH.

In cases where infanticide is not proved, the mother is charged with a lesser offence of *concealment of birth* for secretly disposing of the dead body of a newly-born infant in accordance with section 318 of the Indian Penal Code. For the purpose of the above section a fœtus is considered a child, if it has attained so much maturity as to be capable of maintaining a separate existence.

CHAPTER XIX.

INSANITY AND ITS MEDICO-LEGAL ASPECT.

Definition.—Insanity, lunacy, madness, unsoundness of mind, mental derangement, mental disorder, mental aberration or alienation, are all synonymous terms used for the disordered state of the mind, which depends on the proper working and development of the brain. It is not easy to give a succinct definition of insanity, and the physician should never venture to do so, inasmuch as the law requires of him to affirm whether a particular person is by reason of insanity, incapable of acting, thinking and speaking in accordance with the education he has received, or the dictates of the society in which he moves.

In the cases of insanity brought up before courts, the following terms are very often used in evidence, and hence the students should be well acquainted with the distinguishing points between them :—

Illusion.—An illusion is objective, and is a false interpretation by the senses of an external object or impulse. For example, a man may imagine a string hanging in his room to be a snake, or may mistake the stem of a tree standing on the road side for a ghost in the dark but, on closer examination, the intellect will soon correct the wrong impression.

Hallucination.—A hallucination is subjective, and is a faulty perception without any external object or stimulus. It may affect any or all the special senses, such as sight, hearing, taste, smell, as well as the general sensibilities or sensations; but the hallucinations of sight and hearing are the most common, and generally occur in delirium tremens. For instance, a person may imagine rats and mice crawling into

into his bed, when there are none, or may suspect a tiger coming to devour him, where there is no tiger. He may also hear the voices of persons in his room, when there is absolute silence. A person possessing hallucinations cannot be called insane, if he can reject them after proper reasoning.

Delusion.—A dulusion implies a disordered intellect, and means a perversion of the judgment due to a false perception or idea. It may be either personal or impersonal. The personal delusion indicates insanity, as it refers to the reasoning faculties. A person may imagine himself some exalted personage, either a king, or a great general, or even God himself. Conjoint with this form, there may be a delusion of persecution, which may lead the patient to commit suicide or homicide. The impersonal delusion does not constitute insanity, as it may exist in sane persons and it may be due to a perversion of the judgment in relation to some fixed idea. For instance an orthodox Hindu may think others to be unclean.

Lucid Interval.—This is a period occurring in the course of mental disease, during which there is a complete cessation of symptoms of insanity, so that the person can judge his acts soundly, and becomes legally liable for his actions; but in criminal cases it is always safer not to regard such a person responsible for his deed, inasmuch as it is sometimes very difficult to judge, whether he was suffering from some mental aberration at the time or not.

The lucid interval mostly occurs in mania and melancholia lasting for a shorter or longer period.

Somnambulism.—This is an abnormal mental condition, and means walking during sleep. In this condition all the mental faculties are in abeyance except one particular train of ideas, and so a somnambulist is capable of performing most remarkable and incredible pieces of work which should have been impossible to be done during his waking hours. A

somnambulist may, thus, solve a very difficult problem, or may commit theft or even murder. The law does not regard him responsible for any act done during the state of somnambulism; but it must be proved that the sleep-walking was not feigned, and that the man was subject to it.

Semisomnolence or Somnolentia.—This is half way between sleep and walking, and is very often called sleep-drunkenness. If a person is suddenly aroused from deep sleep, he may commit some horrible and illegal deed on account of his mind being in a state of confusion, especially if he was dreaming at the time. He is not criminally responsible for such acts. This condition is very often allied to a mental condition occurring immediately after an epileptic fit.

Delirium.—This is a disordered state of the mind occurring during some illness, such as fever, sunstroke, etc., or during intoxication by some such drug as alcohol. It generally manifests itself in action or speech, and is characterized by incoherent speech, illusions, hallucinations, delusions, restlessness, wakefulness, purposeless actions and inability to fix the attention. A delirious person is not legally responsible for his deeds, if he has lost consciousness in such a way as to prevent him from knowing the nature of the act; but delirium brought on by alcoholic intoxication does not exonerate him from the responsibility of his act, if he has taken alcohol voluntarily. If, however, voluntary drunkenness causes a disease, which produces such incapacity, then the man is not responsible for his actions, though the disease may be of a temporary nature. Again he is not reliable for his actions if intoxication was the result of alcohol administered to him by others against his will, or without his knowledge.

Hypnotism or Mesmerism.—This is a sleep-like condition brought on by artificial means, and is allied to somnambulism. During a hypnotic trance, though unconscious of

surrounding objects, a person is capable of performing acts suggested by the hypnotiser and thus, may commit offences cognizable by law. Sometimes the suggestive influence may last beyond the period of the trance. In such a case the person is not held responsible for his acts.

CAUSES OF INSANITY.

The causes of insanity are classified as *predisposing* and *exciting*.

Predisposing Causes.—These are again subdivided into *general* and *special* or *individual*.

General Causes.—1. Race.—It is believed that insanity occurs chiefly in highly strung, nervous people who, on account of modern civilization, have to struggle hard for existence, and have to flock to cities to dwell in over-crowded and insanitary houses. Thus it is less common among the Indians than among the western nations, as the majority of the former pass simple life, are fatalists, and also dislike hustle and humdrum of a so-called busy life.

2. Education.—Education imparted on the right lines acts as a preventive of insanity, but bad education or over-education, which leads to the development of the mind at the expense of or with the neglect of, the body, is certainly conducive to insanity, especially when it is combined with insufficient exercise and bad hygeinic surroundings.

3. Sex and Age.—Both the sexes are liable to suffer from the attacks of insanity but, in India, a small number only of females are known to be affected. This is probably due to the fact that the cases of insanity among the females are scrupulously concealed, and are rarely admitted into asylums.

Various forms of insanity are manifested at the period of puberty in both the sexes and at the menopause in women. Men who have arrived at the middle age are more prone to the disease than those above or below that age.

4. Climate.—Owing to a strain of hot weather cases of insanity occur more often in summer than in winter.

Special or Individual Causes.—1. Heredity.—This is the most frequent cause of insanity. The tendency to inherit insanity depends largely on the condition of the parent at the time of procreation. It is inherited more through the mother than through the father, and may show atavism as in other diseases. Hence persons of weak intellect, or those who have any family history manifesting mental aberration, should not be allowed to marry.

2. Marriages.—Child marriages are very often conductive to insanity owing the nervous and physical strain of premature sexual indulgence. Consanguineous marriages are liable to produce insanity, as they contribute largely towards the perpetuation of hereditary influences.

3. *Religion.*—Religious formalism is frequently a cause of insanity among those of a nervous temperament, especially at the time of religious revival.

4. *Politics.*—Excitement due to political events or ideas is a fruitful source of the loss of mental equilibrium.

5. *Occupation.*—Occupations, which are of a monotonous nature or which cause mental worry, exhaustion and general break-down, are favourable to the development of mental unsoundness.

Exciting Causes.—The exciting causes may also be subdivided into *psychical, physical, physiological* and *specific.*

1. *Psychical Causes.*—These are domestic troubles, emotions and imitations. Domestic troubles, such as the loss of relatives and friends, or grief caused by the loss of money, may cause insanity. Emotions, such as love, hatred, passion, disappointment, etc., are usually controlled by education and the restrictive customs of society, but they manifest themselves in a form of insanity as soon as self-control is lost.

Insanity may occur among those of neurotic temperament as a result of imitation and suggestion, when they are brought into contact with insane persons.

2. *Physical Causes.*—The physical causes leading to insanity may be—

1. Local due to the diseases of the brain owing to some traumatism or some pathological changes as in cerebral hæmorrhage, tumour, multiple sclerosis, tabes, epilepsy, chorea, etc.

2. General due to masturbation and constitutional diseases, such as anæmia, syphilis, fevers, and diseases which diminish the excretion from the skin, intestines and kidneys.

3. *Physiological Causes.*—Menstruation, pregnancy in the earlier months as well as in the later months, puerperium and lactation may cause insanity of a maniacal type by producing nervous disturbances.

4. *Specific Causes.*—The specific causes are known as "drug toxæmia", and are due to the excessive uses of certain drugs, such as cannabis Indica in various forms, opium, morphia, cocaine and alcohol. These produce nervous excitement or depression with various delusions and hallucinations of the special senses.

INDICATIONS OF INSANITY.

Though the symptoms of insanity are usually gradual, they may come on suddenly. These are characterized first by disorders of conduct. The relatives and friends of the patient notice that he is not the same, as he used to be. He is different in his habits, manners, dress, expression, speech and in dealing with the other people. He does not mind the social conventionalities, and becomes very irritable even from trifling worries. These are followed by an alteration in his emotions. His affections for his wife and others are changed into dislike and hatred, and his interests in business and other matters cease altogether. Later on, his

memory fails him, the power of self-control is lost. He is no longer able to manage his own affairs. The power of reasoning is interfered with, and the judgment becomes weak and faulty. At this stage he usually suffers from some sort of delusion, which the patient tries to conceal. It is generally believed by lawyers that there must be some sort of delusion in every kind of insanity, but it is not always the case.

Along with the personal changes of an insane, his surroundings are often very characteristic. The house or the room in which he lives, is apparently filthy and untidy, and the furniture is not unoften arranged in some fantastic manner.

Stigmata of Degeneration.—In addition to the above symptoms, an insane may exhibit physical peculiarities, known as stigmata of degeneration. These are—

1. *Changes in the Skull.*—The skull may be much smaller or larger in all its dimensions than that of the average healthy sane individual, or it may show inequality in the shape of both the sides. The frontal or the occipital may also appear to be fattened and the vault may, therefore, look extended backwards and upwards in a very prominent manner.

2. *Changes in the Face.*—The face shows an irregular contour so that the nose appears to project on one side and the mouth to be tilted at one corner. In some cases the nose may be distorted, and stunted at the root. The ears are unusually large or small, and very often present a hæmatoma, which is known as the *asylum* or *insane ear.* The teeth are also set irregularly, and separated widely. The canine teeth are not unoften unduly prominent. The palate is highly arched, narrow, and unequal on both the sides. The pupils are irregular, and there is very often a high degree of myopia, or the presence of pterygium in one or both the eyes.

3. *Anomalies of the Extremities.*—These are manifested by unduly long arms, the occurrence of supernumerary fingers or toes, flat feet and the absence of hypothenar and thenar eminencies.

4. *Sexual Abnormalities.*—There may be hairiness of the whole body and, due to the precocious development of the penis, the patient may get into the habit of self-abuse.

VARIETIES OF INSANITY.

The chief varieties of insanity are—

Amentia.
Dementia.
Mania.

AMENTIA.

Amentia is also called *dementia naturalis* by lawyers, and is due to the defective development of the mental faculties. It includes idiocy, cretinism, imbecility and feeblemindedness.

Idiocy.—This is a congenital condition due to the defective development of the brain. All grades of this condition exist from a helpless life of a mere vegetable organism to one, which can be compared to the life of young children as far as mental development is concerned. An idiot is filthy in his habits, has no concern to what he eats or drinks and is, sometimes, cruel to animals. He is usually quiet and gentle, though can be easily irritated. In some cases he is able to recognize his friends, and learn with great difficulty. There is always some bodily deformity or peculiarity, such as a small, misshapen head, cleft palate, hare-lip, etc. Death usually occurs at an early age.

Cretinism.—This is endemic, and is prevalent in the hilly districts. It is usually associated with goitre and other affections of the thyroid gland, and the arrested development

of the body. The figure is squat, and dwarfish with short thick limbs and clumsy movements. The complexion is sallow, the eyelids are swollen, and the lips and tongue are thickened. The skin is rough and pigmented.

Imbecility.—This is a minor form of idiocy, and may or may not be congenital. Imbeciles are able to speak, but unable to reason and distinguish right from wrong. They are easily roused to passion, and may, consequently, become dangerous. They may commit theft or even murder.

A peculiar type of microcephalic imbeciles, commonly known as "Shah Daula's *Chuha* (mice)" is prevalent in the Punjab. They are so named from their fanciful resemblance to mice owing to their flattened skull and prominent ears, and are dedicated to the shrine of Shah Daula, whose tomb is in Gujrat (Punjab). They have no other deformity except the peculiar shape of the head, though most of them are deaf-mute, and have a squint in the eye. They are capable of learning simple employments, are usually modest and decent.

Feeblemindedness.—This may be congenital, or may be acquired at an early period after birth. It is a lesser type of imbecility. Feebleminded persons are unable to acquire knowledge in ordinary schools, and are unable to take care of themselves.

DEMENTIA (FATUITY).

This is a form of insanity, which is produced by the degeneration of mental faculties after they have been fully developed and, hence it is not congenital, but occurs at any period of life. This is a condition of mental torpor as against mental excitement, which is usually seen in mania.

Types.—These may be acute and chronic. The acute type usually affects young persons or adults of both sexes,

the chief causes being over-work, mental shock and over-indulgence in sexual passions. The acute type, may, sometimes, follow an attack of acute fevers, sun-stroke or injuries to the brain, when the recovery is, as a rule, common. The onset is usually sudden, and the patient may become listless and apathetic, or may develop imbecility or idiocy.

The chronic type usually follows mania, epilepsy, hemiplegia, melancholia, cerebral tumours and over-indulgence in alcohol, or sexual passion. The symptoms in this type appear gradually.

Senile dementia may be described as a separate type. It is the result of senility, not necessarily due to old age. In this form the patient is forgetful, unable to fix attention to any one subject, is dirty in his habits, and erotic in his tendencies. He is usually quiet, but may become excited, and very often exhibits delusions. Recovery is possible, though, very rare.

Paretic Dementia (General Paralysis of the Insane).—This is seen more frequently among urban than rural populations, and affects men between thirty and fifty years of age more often than women. It is occasionally seen among the Europeans and Anglo-Indians, but it is said to be very rare among the Indians. However, Overbeck Wright has seen some cases among the Indians in the Agra asylum, and is of opinion that it is much more prevalent among them than it is now believed.

The causes are syphilis, alcoholism, sexual excess, mental worry and overstrain. The symptoms are both mental and physical. In the beginning of the disease there is a marked exaltation, followed by a stage of depression and finally dementia. The patient becomes careless, or forgetful, restless, irritable and neglectful of his wife and children, and suffers from delusions of an exalted nature, such as grandeur, greatness and wealth. The question of medico-legal importance

arises when, owing to these delusions, the person picks up an article, that does not belong to him.

The physical symptoms are muscular tremors; the gait becomes unsteady or tottering. The pupils are unequal. The patient gets convulsions or fits resembling those of epilepsy and later on, paralysis. Death occurs from pneumonia, or from blood poisoning due to cystitis or bed sores.

MANIA.

This is caused by a morbid condition of the brain, and is characterized by mental excitement and loss of control.

There is a period of incubation, during which there may be mental exaltation, or gloom or despondency. Along with these signs the general health suffers. The liver becomes sluggish. The bowels are loose or constipated and, sometimes, there is slight fever also.

The patient gets violently excited, and begins to shout or sing. He suffers from insomnia, and has a tendency to tear or destroy his clothes and bedding. He is very dangerous owing to homicidal tendencies. The symptoms may subside, followed by a period of quiescence, called *lucid interval.* The symptoms may again recur at a later period without any warning.

Acute Mania.—The onset is slow, and follows an attack of acute fevers, inflammation of internal organs, operations, accidents, or poisoning, such as belladonna. All the three forms of mental aberrations, such as illusions, hallucinations and delusions, are usually met with. There is a tendency to indecent actions, and the patient may commit murder under the false belief of being persecuted or poisoned by others. Lucid intervals are common. It may end in recovery, or may develop into chronic mania.

Transitory Frenzy.—This comes on all of a sudden without any premonitary symptoms. In this condition a

violent mental excitement lasts a few hours, during which the patient may commit crimes, of which he has no recollection afterwards. The stage of excitement is, as a rule, followed by deep sleep. Very often it does not recur. The common causes are mental anxiety and physical exhaustion.

Melancholia.—This form of insanity is included in general intellectual mania, and is characterized by marked mental depression, and delusions with suicidal tendencies, with or without any cause.

In the beginning the physical condition is manifested by marked anæmia, loss of sleep and loss of appetite with constipation. The pupils are frequently dilated, and the pulse is slow and feeble. The patient feels gloomy and miserable, and is always thinking of some impending ruin to him or to his family. He also imagines that he is suffering from some incurable disease. Later he develops hallucinations and delusions mostly of the nature of persecution or religious matters. Suicidal tendencies are frequent, though the patient may develop homicidal tendency, and may kill his wife and children to save them from the supposed utter ruin, or may kill some person, who, he believes, is giving him and his family all the imaginable trouble of the world.

Sometimes the patient becomes so much agitated or excited that he keeps on moving incessantly, or rocking to and fro. The face exhibits great misery.

On other occasions the patient passes, as it were, into a condition of stupor. During this stage the patient keeps on wringing his hands for hours, or sits silent and in the same position for a long time.

Melancholia may alternate with an attack of mania with a lucid interval intervening between the two. This alternating form of the disease is called circular insanity or *folie circulaire.*

Monomania (Partial Intellectual Mania).—This

is a rare though important disease, and is also known as delusional insanity or paranoia. It affects males more than women, and is slow in its growth and onset. In this form of mental unsoundness the patient gets a delusion formed by a morbid idea regarding one subject or a group of subjects but, in every other way he is quite sane, with perfect memory and good judgment without any emotional disturbance, and is able to manage his own affairs, unless the delusion is connected with the management of his business.

The delusions generally refer to systematized persecution or to grandeur, and the patient may develop a suicidal or homicidal tendency, when he may have to be kept under proper control. Sometimes the delusion may be of a ridiculous nature as he may believe himself to be made of glass, or believe himself to be dead, and thus may refuse to eat any food arguing that the dead cannot eat.

During the early stage of the disease the patient succeeds very ably in concealing his delusion, but later on he does not lose any opportunity to bring it in prominence before others, and becomes demented or maniacal.

Epileptic Insanity.—This is usually of a chronic type, and affects those who have acquired epilepsy during childhood or after puberty. It gradually leads to progressive dementia alternating with periods of insanity. In some cases acts of insanity are committed only before or after the epileptic fit, or are replaced by the fit itself; otherwise the patient is quite sane. Epileptic insanes are deprived of all moral sensibility, are given to the lowest forms of vice and sexual excesses, and are, sometimes, dangerous to themselves, as well as to others. Hence they have to be kept under control.

Moral Mania.—This is known as *mania sine delirio*, because in this form, there are no delusions, and the reasoning faculties are quite normal, though the moral nature is perverted and the patient has no control over himself.

It is divided into *general moral mania* and *partial moral mania.*

General Moral Mania.—This type of insanity affects persons who have a hereditary tendency, and display signs of a previous maniacal attack, or injury to, or disease of the brain. At the commencement of the disease the changes in passion may be attributed to mere eccentricity, but later his hatred and cruelty towards his children and his altered propensities for drunkenness and voluptuousness may be traced to something more than eccentricity, viz., unsoundness of mind. However, such a person does not have any delusions, and possesses sound reasoning faculties.

Partial Moral Mania.—In this form morbid propensities are limited to one or more particulars, instead of being general. The following different names have been given to it according to the perverted condition which is most prominent.

Kleptomania.—This means an uncontrollable impulse to steal without any motive or reason. Such an unfortunate person steals articles of even little or no value, of which he has no use, and which he can afford to purchase, if he so desires. Very often he steals from the same individual. Thus, a rich man of high social position may steal a silver spoon or some other trifling article every time he walks into a jeweller's shop, if he is obsessed by an impulse to theft.

Dipsomania.—This means an irresistable craving for alcohol, which may be persistent or periodic in its manifestations. The patient may abhor such a craving, but has no control over it while the fit lasts, though he is mentally quite sound. This condition occurs ordinarily in adults of the nervous temperament with a bad hereditary tendency. Such patients have lost all moral sense, and will lie, steal, beg, or ruin themselves to obtain a drink.

Pyromania.—This is defined as a tendency to conceal fire,

and burn anything irrespective of the result and consequences. This is common at the time of puberty, though it may occur at the other periods of life. Hysterical and epileptic girls are known to suffer from this malady.

Though it is regarded by most European authors as a separate disease, called true *impulsive insanity*, it is most commonly a symptom of other mental disorders. In India it is met with among melancholiacs of a milder type.

Erotomania.—This means an uncontrollable desire for sexual intercourse. It is known as *nymphomania*, when present in a woman, and *satyriasis* in a man. Very often it is periodic, lasting for a few days or weeks. The wretched victims of this disease not infrequently express a great abhorrence to their condition, and sometimes commit suicide to escape from it.

Suicidal Mania.—The propensity to commit suicide may occur among the neurotic, epileptic, maniacal as well as the melancholiac. It is not true that suicide always indicates insanity, for sane persons do destroy their lives owing to some motive, as the fear of disgrace or the loss of money in some speculation. Thus I have seen in Agra cases of suicide among those who had lost in gambling during Dewali holidays, or among those who had lost in opium speculation. Suicide, or *Harakari*, is regarded as a religious duty among the Japanese, and that is the reason why General Nogi and his wife committed suicide, when they heard of the death of the late Mikado.

In England in the case of death occurring from suicide the coroner's jury always brings in a verdict of "committed suicide while in a temporary state of insanity," but in India it is not necessary to refer to the mental condition of the deceased for, according to the law, the cause and manner of death have only to be found out in such cases.

Homicidal Mania.—This is also called homicidal monomania. In this form of insanity there is a strong and uncon-

trollable impulse to homicide. It usually occurs in degenerates and neurasthenics. It has to be distinguished from monomania (delusional insanity), in which the patient commits murder on account of the existence of a delusion of persecution.

In this form the patient may kill several innocent persons, chiefly his wife, children and relatives, for whom he may have had the greatest affection. Sometimes he gets a sudden desire to kill, and murders any person that comes in his way; he then repents of his action, when he cools down.

In the case of a murder a common plea to be put forth by the defence is homicidal mania. The following points should, therefore, be taken into consideration before deciding whether the murder was due to homicidal mania or not:—

1. *The personal history of the murderer.*—He may be eccentric, melancholic, degenerate, neurasthenic, etc.

2. *The absence of a motive.*—The act is done in opposition to all human motives. Usually the motive for murder by a sane person is jealousy, revenge, hatred, previous quarrel, money, land or woman. Sometimes it is possible that a motive may not be traced, though there may be one.

3. *The absence of concealment of the act.*—The murderer, if he happens to be insane, does not try to conceal the body of his victim, nor does he attempt to evade the law by destroying the evidence of his crime or by running away.

On the 10th January 1918 a girl twelve years of age murdered a male child three years old in the Agra District, inflicting about twenty-six wounds on the body with a *gandasa*, out of which one on the neck was fatal, and the rest were all more or less simple. The motive as alleged by the police was the theft of brass wristlets worth some four or six annas worn by the child, but the girl did not make any attempt to conceal these wristlets or to run away from the scene of the murder. It was argued in the sessions court that

the girl had probably a homicidal tendency, and at my suggestion the learned Sessions Judge ordered the girl to be kept under observation in the Agra asylum for six months.

4. Multiple murders.—Usually a sane person murders only a person against whom he has a grievance or enmity, and does not shed more blood unnecessarily, but an insane person will kill several persons, mostly his near relatives for whom he has great regard and affection. However it is possible for an insane person to have only one as his victim.

5. Want of preparedness or prearrangement.—An insane person does not make any prearranged plan to kill any body, but a sane person, as a rule, makes all necessary preparations previous to committing the crime.

6. Want of accomplices.—An insane person has no accomplice in the act. Lunatics in the asylum never conspire to escape or to kill the doctor or the warder.

DIAGNOSIS OF INSANITY.

Sometimes it is very difficult to form a correct diagnosis as to whether an individual is sane or not, especially when he has no permanent delusion, and when he is just on the border line between sanity and insanity. Under such circumstances it is always advisable to carefully note the following points before a definite opinion is given :—

1. Family History.—Insanity being mostly hereditary, it is very important to inquire into the mental condition of the patient's parents, uncles, grandparents, brothers, sisters and other relatives as to whether any of them ever showed mental excitement or depression, or mental weakness, or suffered from nervous diseases, such as chorea, epilepsy, etc. It is also necessary to find out, if any of them committed suicide, or were attacked by cerebral affections, gout, rheumatism or syphilis.

2. Personal History.—While listening to the history of the patient, the medical man should always try to be sympathetic, so as to win his confidence. The history should be as thorough and complete as possible, noting all the characteristic details from childhood likely to give a clue to the disease. Questions should be asked about his personal habits with reference to the excessive use of any intoxicating drugs, such as cannabis indica, alcohol, cocaine or opium, sexual excess, masturbation, any morbid propensity at the time of puberty, occupation, mental strain or shock, injury to the head or any brain disease, and chorea, epilepsy, convulsions, or any other nervous affections. It should be ascertained from his relatives and friends, if they noticed of late any change in his conduct and behaviour towards them, if he was cleanly in his habits or filthy and disgusting, and if he was restless and passed sleepless nights, or if he looked excitable or depressed at times. Lastly it should be found out, if this was the first attack, or there had been any attack previous to it.

3. Physical Examination.—The patient's manner of dressing and walking, as well as his bearing and gestures, should be carefully noted, when he comes to the physician. The presence of deformities and malformations in the head or body, as also the power of speech and articulation should be observed. The pulse and temperature should be taken, as both might increase in insanity. The tongue should be examined to find out if it is foul or furred due to constipation. All the organs should be carefully examined. The skin would be dry, mottled and wrinkled, and the hands and feet would be moist with sweat.

4. Mental Condition.—The mental capacity should be found out by first testing his memory, and then the power of his reasoning and sound judgment.

While testing the memory he should be asked to give the

dates of common incidents, that occurred in his family, or to recite the names of his relatives, or the days of the week, or answer such other simple questions. The questions put to him should not be too complex or difficult as not to be easily answered by an average man of his culture and education.

The power of his reasoning and sound judgment should be detected by discussing with him on various subjects. During discussion an attempt should be made to find out a delusion. An insane person tries to conceal his delusion; hence it may be necessary to watch him for days before his condition can be certified.

Lastly handwriting will show the mental confusion, the misspelling, the omission of letters or phrases and the muscular tremor, if the educated insane person is asked to write.

FEIGNED INSANITY.

There is always some motive to feign insanity. For instance, a criminal pretends insanity to escape the punishment for his offence. In civil practice an individual feigns insanity to try and avoid the results of business transactions or deeds which he may have executed. Similarly policemen and soldiers do so, when they want to leave the service, or when they know that they are likely to be punished very severely for some gross neglect of duty.

The detection of this is one of the duties of the medical officer. Ordinarily it is easy to detect the fraud, but at times it is very difficult, when an individual may be kept under observation for at least ten days, before an opinion is given. During this time the physician has to watch him carefully, and to visit him daily, at unexpected hours and without his knowledge. Sometimes it may be necessary to conceal the identity of the medical man to find out the truth.

The following are the distinguishing features between feigned and true insanity :—

1. Feigned insanity always comes on suddenly, and not without some motive, while true insanity, as a rule, comes on gradually without any motive.

2. In feigned insanity the individual tries to pass as insane by putting forward incoherent maniacal symptoms, while a true insane person tries to conceal his condition, and becomes very indignant if he is called insane.

3. In feigned insanity the symptoms are not uniform and one or two types of insanity are mixed up, but not so in true insanity. If the malingerer pretends melancholia, he may say he wants to commit suicide, but he makes a fuss when you help him to put a noose round his neck. He may cover himself with a blanket to avoid cold at night, while in genuine melancholia the man is quite indifferent.

4. In feigned insanity delusions are daily variable, but in true insanity, there is, usually, one fixed delusion.

5. In feigned insanity violent exertion occasioned by imitating maniacal frenzy will bring on exhaustion, perspiration and sleep, but a really insane person can stand exertion for very many days without sleep and fatigue. Again the injection of morphia will send the malingerer to sleep, but will have no effect on a genuine lunatic.

6. The malingerer is not, as a rule, dirty in his habits. He may smear his room with fæces and other filth, if he has seen a genuine lunatic doing so. But he will keep a clear space for sleeping, and will spare his person. He also resents having his food served in a soiled dish.

7. In feigned insanity there is no peculiarity in the expression of the face or no congenital defect, but both may be present in true insanity.

8. The dry, harsh skin and lips, the furred tongue, constipation, want of appetite, a rise of temperature and the frequent pulse are all physical manifestations of true insanity.

These are usually absent in feigned insanity, as they cannot possibly be imitated by a malingerer.

THE RESTRAINT OF THE INSANE.

If an insane person is dangerous to himself or to others, or if he is likely to injure or squander his property or that of others, he can be lawfully kept under restraint, which may be immediate under the personal care of attendants, or removal to an asylum.

Immediate Restraint.—Immediate restraint under the personal care of attendants may be imposed either by the consent of the lawful guardian of the insane person, or without his consent, if there is no time to obtain it without fear of injury to his person or to the persons of others; but the restraint should last so long as the danger exists. Such a restraint can also be imposed on persons suffering from delirium due to disease, or from delirium tremens. In this case the restraint must cease with the subsidence of the symptoms.

Removal to an Asylum.—By an asylum is meant an asylum for lunatics established or licensed by Government. The following procedure as laid down in the Lunacy Act of 1912 has to be adopted for removing a lunatic to an asylum :—

1. In the case of a *private lunatic*, the husband, wife or a near relative makes a petition for a reception order for his admission into an asylum to the Magistrate within whose jurisdiction the lunatic ordinarily resides. If the relative is a minor, or if there is no relative, any of his friends can send a petition giving the reasons for having done so, provided he has seen him (lunatic) personally within the last fourteen days. The petition must be in the form (Appendix X) prescribed by the Indian Lunacy Act of 1912 with a statement of particulars signed and verified by the applicant,

and must be supported by two certificates (Appendix X) given by two registered medical men, one of whom must be a gazetted officer. These two medical men must not be relatives or partners, or must have no connection, or concern with the asylum to which the alleged lunatic is going to be sent. Both the medical men should examine the alleged lunatic independently of each other and at different times, and they should certify that the individual is a lunatic and a proper person to be taken charge of, and detained under care and treatment, after they have formed an opinion from the facts observed by themselves and the facts narrated to them by his near relative.

To avoid legal action for wrong certification the medical man must be very careful in giving a certificate of lunacy for admission into an asylum, as he is responsible for having sent an alleged lunatic to an asylum, but his responsibility ceases on the latter's admission into the asylum.

On receipt of the petition, the Magistrate holds enquiry in private, and personally examines the alleged lunatic, unless for reasons recorded in writing he thinks it unnecessary or inexpedient to do so. If he is satisfied, he forthwith issues a reception order (Appendix X). If he is not so satisfied, he fixes a day for the consideration of the petition, due notice being given to the petitioner, and to any other person to whom in the opinion of the Magistrate notice should be given and he makes such further inquiries concerning the alleged lunatic as he thinks fit. In the meantime he may pass necessary orders for the safe custody of the alleged lunatic, until the enquiry is concluded.

On considering the petition the Magistrate may grant a reception order, which holds good for seven days, or he may refuse the petition, when he has to give the reasons in writing, a copy of which has to be supplied to the petitioner.

The reception order can be made under petition, when

a lunatic is dangerous, and unfit to be at large, unless the Magistrate is satisfied that the person in charge of an asylum is willing to receive the lunatic, and the petitioner or some other person engages in writing to the satisfaction of the Magistrate to pay the cost of maintenance of the lunatic.

2. In the case of *poor and wandering lunatics* a police officer in charge of a police station arrests or causes to be arrested a person, who, he has reason to believe, is a lunatic and dangerous by reason of lunacy, within the limits of his station, and places him forthwith before a Magistrate. If the Magistrate thinks fit, he makes further inquiries, and orders the alleged lunatic to be examined by a medical officer (Civil Surgeon). If the medical officer certifies to his lunacy, the Magistrate issues a reception order for the admission of such lunatic into an asylum. In such cases a certificate from only one medical officer is necessary.

In the Presidency towns, or Rangoon, the Commissioner of Police issues reception orders instead of the Magistrate, and any police officer not below the rank of an Inspector can execute the powers of an officer in charge of a police-station.

If the medical officer cannot make up his diagnosis all at once, he can, on the written authority of the Magistrate, detain him for a period of ten days, and can get it extended for further periods not exceeding ten days if necessary, but the total period should not exceed thirty days.

3. In the case of a *European subject to the provisions of the Army Act*, he can be admitted into an asylum on a reception order signed by an administrative medical officer, if he thinks fit, provided he has been declared a lunatic in accordance with the provisions of the military regulations in force for the time being.

4. In the case of a person declared lunatic by *judicial inquisition*, he may be admitted into an asylum by a District

Court or by the High Court, under whose jurisdiction he may have been for the time being. In such cases the Court passing the order allows the payment of the cost of maintenance of the lunatic in the asylum on the application of the officer in charge of the asylum, and directs the recovery of such sums from the estate of the lunatic, or of any other person who is his legal guardian. If the lunatic or his guardian is too poor to pay the cost, the Court has to certify to that effect.

5. In the case of a *lunatic going direct to the asylum*, the person in charge of an asylum, with the consent of two of the visitors of the asylum may receive, and lodge such a person on his written application, if he is desirous of being treated in the asylum.

6. In the case of *criminal lunatics*, they are to be admitted into an asylum on the order of the presiding officer of a court in accordance with section 466 or 471 of the Code of Criminal Procedure, 1898 (Appendix VIII) or according to section 30 of the Prisoners Act of 1900, after the medical officer has certified to their lunacy.

Sections 464 to 475 of the Criminal Procedure Code, 1898 (Appendix VIII) deal with the criminal lunatics who may be divided into three classes as under :—

1. Those who are unable to stand their trial from reason of being of unsound mind, and incapable of making their defence.

2. Those who committed the crime, but were acquitted on the ground of being of unsound mind at the time of committing the crime.

3. Those who contracted the disease after they were imprisoned in a jail.

Discharge of Lunatics from an Asylum.—Three of the visitors of whom one must be a medical officer can discharge, by a written order, all lunatics except criminal

and military European lunatics. The superintendent of the asylum must be careful in giving discharges of lunatics. Lunatics with suicidal or homicidal mania should not be discharged.

Escape and Rearrest of Lunatics.—A lunatic escaping from an asylum may be taken back without any reception order or a medical certificate, if arrested within one month of his escape, except in the case of criminal and military European lunatics, but the same formalities have to be gone through once more, if arrested after the expiry of one month.

Illegal Detention.—According to section 93 of the Indian Lunacy Act of 1912 any unauthorized person who receives or detains a lunatic or alleged lunatic in an asylum, or for gain detains two or more lunatics in any place not being an asylum, is liable to imprisonment for a term not exceeding two years, to a fine, or to both.

CIVIL RESPONSIBILITY.

Management of Affairs.—The law protects the person and property of a lunatic, and hence a civil court will place a lunatic under "interdiction" according to chapters IV and V of the Indian Lunacy Act of 1912, if it is proved on the application of a person related, by blood or marriage, to the alleged lunatic, or on the application made by the Advocate General that he, by reason of lunacy, is incapable of managing his own affairs.

The medical man while giving his opinion in such cases should not simply mention that the individual is insane, but he should certify that insanity is of such a degree as to render him incapable of managing his own affairs. He must be very careful in giving his opinion, as an individual may be insane, and yet capable of looking after his own

property. In the case of doubt it is always safer to give an opinion in favour of *sanity* rather than *insanity*.

Contracts.—According to section 12 of the Indian Contracts Act (Act IX of 1872) a contract is invalid, if one of the party at the time of making it, was, by reason of insanity, incapable of understanding it, and forming a rational judgment as to its effect upon his interests.

A lunatic, however, is responsible for the payment of necessaries purchased by him in accordance with his social position and status, it being immaterial whether the vendor knew his condition or not ; but he is not responsible, if the order is grossly extravagant and beyond his means or, if the vendor has taken advantage of the fact of his insanity in selling those necessaries to him. Again a person, who is usually of unsound mind, but occasionally of sound mind, may make a contract, when he is of sound mind. Similarly a person who is usually of sound mind but occasionally of unsound mind, may not make a contract, when he is of unsound mind.

Marriage being regarded as a contract by the English Law may be declared null and void, if it could be proved that one of the party was, by reason of unsoundness of mind at the time of contracting marriage, unable to understand the nature and responsibilities of the marriage.

Evidence.—According to Section 118 of the Indian Evidence Act (Appendix VII) a lunatic is not competent to give evidence, if he is prevented by his lunacy from understanding the questions put to him and giving rational answers to them. However, he is competent to give evidence if the insane person is in the stage of lucid interval, or if he is suffering from monomania, though it rests with the judge and jury to decide whether or not they should give credence to it. Again deaf-mutes can give evidence by signs made in open courts.

Consent.—A consent is not valid, if it is given by a person who, from reason of unsoundness of mind, is unable to understand the nature and consequences of that to which he gives his consent (Appendix IX. Section 90, I. P. C.).

The question of invalidity of consent may arise in cases of rape, causing death, hurt or grievous hurt, and abetment of suicide.

Testamentary Capacity or Capacity to make a Valid Will.—A civil court can invalidate a will, if it is proved that the testator, at the time of making his will, was of such a degree of unsoundness of mind that he was unable to understand the nature and consequences of his act, and if it is satisfied that he disposed of his property in a way which he would not have done under normal conditions.

If a medical man has to examine a person as to his fitness to make a valid will, he should, before testifying, make the testator enumerate the amount of his property, the names of the relatives and others to whom he has left his legacies, and should make him repeat the main provisions of the will, enquiring reasons for any disposal of property which seems unjust or out of the common, or for any legal heirs being omitted. He should also find out, if he knows the nature of the will and realises its consequences, and if he is not influenced by any insane delusions in disposing of his property.

If the medical man has reason to suspect that he is under the influence of some other person, it is better that he should see him alone and encourage him to speak out freely.

People suffering from motor aphasia, agraphia, or any other nervous disease not affecting the brain, may be able to make perfectly valid wills.

CRIMINAL RESPONSIBILITY.

The law holds every person responsible for his actions. Hence no person can escape legal punishment for an offence committed by him on the mere ground of insanity unless, at the time of committing the offence, it was of such an extent as would render him unable to know the nature of the act or that he was doing what was either wrong or contrary to law (Appendix IX, Section 84, I. P. C.). But a person who, though of unsound mind, knows that in killing another, he is committing a wrongful act, is responsible for his crime. However, an idiot or lunatic, even if he is conscious of his act, has no capacity to know its nature and quality, and is therefore, not responsible.

The loss of self-control at the time of committing the crime cannot be brought as a plea for defence, unless it was due to insanity which incapacitated him and rendered him unable to understand the nature of the act and that it was wrong or contrary to law.

CHAPTER XX.

LIFE ASSURANCE.

Definition.—By *Life Assurance* or *Insurance* is meant a contract by which a person, whose life is insured, agrees to pay to an insurance company, a certain sum of money, called a premium, annually or by periodical instalments, for a specified number of years or for life, so that he or his heirs may get a stipulated sum from the company at a certain age or after his death. The written document or contract specifying the terms which the company undertakes to fulfil is called a policy.

FORMS OF POLICY.

Various companies issue prospectuses showing the tables of rates payable at different ages according to the form of policy taken out by the insurer. The chief forms of policy are—

1. **A life policy**, according to which an insured person has to pay an annual premium until death.

2. **A terminable policy** by which an individual pays the premium for a limited number of years, the policy being payable at death.

3. **An endowment policy**, by which a person agrees to pay for a number of years, say up to fifty-five, when he receives the amount of money for which his life was insured.

4. **Investment Policy.**—According to this policy a limited number of premiums is paid, and every paid premium secures a fixed and definite benefit according to the table given in the prospectus, so that the payments may be discontinued at any time without forfeiture of the policy.

THE MEDICAL EXAMINER.

In order that they may not run the risk of insuring bad or undesirable lives, insurance companies usually appoint a medical man as their officer to examine the proposer medically in towns and cities, wherever their offices or agencies are situated.

MEDICAL EXAMINATION OF A PROPOSER.

A person, who proposes to have his life insured against death, accident, or sickness, is introduced by the agent of the company to their medical officer at his consulting room who is supplied with a printed form of querries, which he must fill up in his own handwriting after the careful medical examination of the proposer. He is required to send this form with his opinion and recommendation regarding the life of the person direct to the general agents of the company without showing it to any one else.

The medical examiner is paid by the company for the examination, and is bound to look to their interest, but he must not show any partiality. He should try to be absolutely fair to the company as well as to the applicant. If he happens to be an ordinary medical attendant of the proposer and if he knows that the latter suffers from disease, which renders him incapable of being insured, he should refuse to examine him, and inform the company accordingly.

The examination must be made in private where no other person should be permitted to be present except in the case of a female, when her relative or friend may be requested to be present. The examination should always be made in the day-time, and the applicant should be stripped to the waist.

During the examination the inquiries which the medical examiner is expected to make relate to —

A. The Personal History.
B. The Family History.
C. The Personal Examination.

A. THE PERSONAL HISTORY.

Under this heading careful inquiry should be made about the applicant's occupation, residence, personal habits and past diseases, since all these points are very important to determine whether the life can be regarded as worth insuring or not.

The applicant must be cautioned to tell the whole truth and nothing but the truth, as concealment of any material fact may subsequently render the policy null and void, and the premiums paid may be forfeited.

Occupation.—Certain occupations involve special risk, *e.g.*, engine drivers, mechanical engineers, spinning and weaving masters, miners, makers of explosives, soldiers, sailors, and medical men who are always exposed to the dangers of infection. Farmers and clergymen are the most long lived among professional men.

Residence.—The residence in a tropical climate is more conducive to ill-health than in a temperate climate and so, some companies always put an extra premium on the rate which an applicant will have to pay, if he were to remain all his life in a temperate region.

Personal Habits.—The question of his habits is one of great importance, though it is very difficult for the medical man to get the correct information as he has to depend on the truthfulness of the applicant himself, unless the medical man happens to be personally acquainted with him. However, an experienced medical man can find out if the applicant is addicted to alcohol by observing the condition of the tongue and conjunctivæ, the presence of tremors of the hands, the dilated capillaries of the cheeks and the rosy tip of the nose. The application should be declined, if there is the least suspicion of intemperance. Similarly excessive smoking can be inferred from tremors of the hands, tachycardia, indigestion and constipation. Cancer of the lip, tongue or throat is more common among smokers than among non-smokers.

It should be enquired whether the applicant is habituated to the use of opium or *bhang*, and the quantity which he uses. It should also be ascertained, if the applicant is taking any exercise or leading a sedentary life. In the case of exercise, whether it is in excess or not. A professional athlete is not assurable, as he is always open to risks and his heart is usually hypetrophied.

Past Diseases.—While recording the past illnesses the examiner should try to obtain as complete a statement of each of the diseases from which the applicant may have suffered with a view to determine if any of those diseases has left any permanent ill-effects on his constitution or to discover any tendency to disease in the future. An applicant should never be recommended for assurance, if he is suffering at the time from any ailment however slight it may be, or if he has recently recovered from an acute disease.

The diseases which are chiefly required to be inquired into from a life assurance stand-point are—

Phthisis and Hæmoptysis.—The applicant should be rejected, if he gives the history of having suffered from phthisis or hæmoptysis in the past, and at the same time if he comes from a stock of consumptives and that he has feeble physique and light weight. He may be accepted with an addition of ten years or so to his actual age, if he has not shown any symptoms of phthisis, or if he has had no attack of hæmoptysis within the last ten years and if he is at least thirty-five years of age and living in healthy surroundings. However, he should under no circumstances be

insured if he is addicted to the use of alcohol, for rightly it has been said that "alcoholism makes the bed for tuberculosis."

Pneumonia and Pleurisy.—No person can be regarded as insurable for six months after an attack of pneumonia, as it may lead to tuberculosis. An attack of pleurisy should always be looked upon with suspicion as it has a tendency to lead to tuberculosis. A person who has suffered from empyema can be accepted at the ordinary rate, if six months have elapsed since his complete convalescence.

Asthma.—The applicant should be rejected if he gives the history of recent asthma. However, he may be accepted with an addition of a few years to his age, if he had a last attack some years ago, and if his lungs were not particularly emphysematous.

Discharge from the Ears.—The applicant having a discharge from the ears is not insurable as it is likely to lead to performation of the tympanum, middle ear disease, and to an abscess of the brain.

Blindness.—If the applicant is otherwise all right, ten years may be added to his actual age for the calculation of the premium.

Dysentery.—If the attacks have been frequent, the possibility of a liver abscess must not be lost sight of.

Hernia.—The application must be rejected, if no truss is worn. An addition of one or two years is quite sufficient in the case of a reducible inguinal hernia, provided a well-fitting truss is used. A person with a partially reducible hernia should be rejected, especially if he is engaged in hard laborious work. A femoral hernia is more dangerous than an inguinal one and should, therefore, be rated very highly. An applicant with an umbilical hernia should, as a rule, be rejected. In all the cases of hernia, the risk is enhanced very much if the applicant lives in an outlandish place, where he is not likely to get the surgical aid, when necessary.

Stricture of the Urethra.—If the stricture is of a slight degree it requires an increased rating, but the more severe forms should be declined.

Varicose Veins.—In the case of varicose veins the proposal may be accepted after an operation is performed, but it should be rejected if an operation is not agreed to, or if there is a danger of their rupture and fatal hæmorrhage, or of embolism if they are very large. However, the life may be accepted with an addition of some years, if the varicose veins are not very large.

Skin Diseases.—Chronic skin diseases, such as psoriasis and eczema, as a rule, leave no adverse influence on the average expectation of life ; but the existence of chronic eczema may sometimes lead to an attack of

nephritis, and thus would require to add some years, before the proposal is accepted.

Gout.—The death rate of persons suffering from gout is usually heavy between fifty-five and sixty-five. Hence cases of this class should be insured for endowment policy with an addition of at least five years. There is a greater risk of suffering from diseases of the heart and kidneys, if an individual gets an attack of gout in the earlier age.

Acute Rheumatism.—If the attacks have been severe compelling the patient to be in bed each time for two or three weeks and leading to heart complications, the applicant should be rejected altogether ; otherwise five or ten years may be added to the actual age for rating the premium.

Syphilis.—If a man is suffering from syphilis, the date and character of the primary chancre must be mentioned. It should also be mentioned, if he had had an attack of secondary or tertiary syphilis, as also the nature and the duration of the treatment adopted by him and when it was finally discontinued. If any signs of the active disease are visible on the body, the proposal should be postponed. On the contrary it can be accepted with an addition of about 5 years, if the applicant is above thirty years, has been carefully treated for the disease and has had no symptoms for the last two years.

Fevers.—If the applicant gives the history of having suffered from malarial fever, he should be thoroughly examined for the presence of an enlarged liver or spleen and for the existence of a cachectic appearance. An attack of an ordinary fever should not affect the proposal, provided some months have passed since the last attack.

Epilepsy.—An applicant suffering from epilepsy should not be insured, if there is history of the disease in the family, or if he has acquired it after thirty years of age when it is very often due to syphilis. However, in the absence of family history, the proposal may be accepted with an addition of some five to ten years, if there has been no attack within the last ten years.

Nervous Diseases.—Hemiplegia, paraplegia, locomotor ataxy and many other nervous diseases are a bar to assurance.

Insanity.—Persons who have suffered from insanity are usually not accepted by insurance offices.

B. THE FAMILY HISTORY.

The inquiry about the family history is necessary to determine, if there is any hereditary influence, which is likely to interfere with the longevity of

the applicant. In addition to an inquiry about the general health of the living relatives, such as the father, mother, brothers, sisters, or any other near relatives, or the age at which, and the disease from which, any of them died, questions should be asked of the applicant to determine if any of them ever suffered from one of the following diseases, as they are liable to hereditary tendency :—

1. Phthisis.
2. Gout.
3. Cancer.
4. Diabetes.
5. Insanity.
6. Rheumatism.

The insurance company usually rejects all those cases, which give history of a hereditary disease, but, in some cases, may accept them after loading them with a higher rate of premium by adding five to ten years to their actual age.

C. THE PERSONAL EXAMINATION.

The personal examination must be carried out with minuteness and great care. The following is the order in which it has generally to be done :—

Identification—It is very essential to describe some physical peculiarity, scar, or any other mark, which would serve the purpose for future identification of the applicant, if necessary.

Age.—In connection with age, a mention should be made as to whether the applicant looks younger or older than the avowed age. In addition, the determination of age is necessary for the calculation of *the expectation of life*, i. e., the average number of years which he may be expected to live at that particular age.

The Rule for Calculating the Expectation of Life.—The expectation of life is calculated from life tables made up from census returns, but the rough and practical methods for the purpose of calculating this are two formulæ as given by Walford and Willich.

Walford's Formula.—The formula given by Walford is tolerably accurate for deducing the expectation of life. It is obtained by subtracting the actual age of the proposer from ninety-six, the fixed number between the ages of twenty and forty-five, and dividing the remainder by two. Between twenty and thirty the result hardly comes up to the average, and

over forty it is slightly above the average. For ages above forty-five, ninety should be taken as a fixed number instead of ninety-six.

Willich's Formula.—An approximate result between the ages of twenty-five and seventy-five may be obtained from Willich's formula which is $\frac{2(80-A)}{3}$, where "A" represents the age of the proposer. For example, at the age of forty-four, the expectation of life would be, according to this formula, $\frac{2(80-44)}{3}=\frac{72}{3}=24$ years.

General Appearance.—Under this heading the figure and personal formation of the applicant should be described together with the height, weight and circumference of the chest and abdomen. All these dimensions should be carefully measured and not guessed. In taking the height and weight the applicant should be asked to take off his boots or shoes and necessary clothes. However, he may be allowed to keep his clothes on, if his height is measured with his boots on, as the heels of the boots will almost counterbalance the clothes in calculating the proportion between the height and weight. To estimate this the following table for the age of 30 should be taken into consideration :—

HEIGHT.	STANDARD WEIGHT.	CIRCUMFERENCE OF CHEST.
Ft.-in.	lbs.	inches.
5-0	112	33½
5-1	116	34
5-2	126	35
5-3	133	35½
5-4	139	36
5-5	142	37
5-6	145	37½
5-7	148	38
5-8	155	38½
5-9	162	39

HEIGHT.	STANDARD WEIGHT.	CIRCUMFERENCE OF CHEST.
Ft.-in.	lbs.	Inches.
5-10	169	39½
5-11	174	40
6-0	178	40½
6-1	182	41

A margin of fifteen to twenty per cent. is allowed either way under ordinary circumstances. For men over or under thirty, half a pound for every year may be added or deducted as the case may be. After fifty it is not necessary to make any addition as normally there should be very little change in build after this age.

The standard weight of Indians can be calculated from the height by Buchanan's formula by taking 100 lbs. as the average weight for a height of five feet and adding 3 lbs. in weight for every inch above that, *e. g.*, 5 feet 1 inch = 103 lbs., 5 feet 2 inches = 106 lbs., and so on. Twenty per cent. has to be allowed either way, if there is good family history, and all the organs are quite sound and healthy. But more allowance can be made, if the weight happens to be in excess over the standard weight, provided everything else is all right as the well-to-do Indians have the habit of consuming rich food containing too much fatty and starchy substances.

The circumference of the chest should be taken by a tape measure at the level of the nipple, when the applicant is breathing normally, when he has taken forced expiration, and on full inspiration. The chest measurement should not be less than half the height and a variable proportion of more than fifteen per cent. should be regarded as suspicious. The difference between forced expiration and full inspiration should not be less than two inches for a height of five feet, and three inches for six feet height.

The girth of the abdomen at the level of the umbilicus must not be more than the chest measurement.

Internal Organs.—A careful examination of the internal organs should be made by palpation, percussion and auscultation where necessary. Any deviation from the normal should be at once described without any reservation. The urine should be passed in the presence of the examiner

to avoid fraud, and to obtain a fresh specimen to examine for the presence of albumen, sugar, blood or any other abnormal constituents.

OPINION.

Lastly the medical examiner has to give his opinion as to whether the life should be accepted at ordinary rates (first class), at enhanced rates with a certain amount of loading (2nd class), or it should be rejected altogether (third class) after he has fully considered the general state of the health, the condition of all the different organs, the constitution and personal habits of the applicant and his family history.

THE MEDICAL REFEREE.

In addition to the medical examiner, the insurance companies appoint a medical man as their chief medical officer or referee, who examines candidates for life assurance at the head office, reads and criticises the reports sent in by the medical examiners from all the branch offices, and advises the board of directors to accept the proposed lives or to refuse them. He may also decide, after consulting the actuary, to add any extra premium, if necessary. In certain cases he may send for further information from the medical examiners, if he finds that any point is ambiguous, or not clear.

THE PROOF OF DEATH.

On the death of an assured person, the insurance company, before paying the amount of money in terms of the policy to the heirs of the deceased, requires the proof of his death from the physician who attended him during his last illness, because fraudulent cases of death have been recorded to practise deception on the companies. Thus, sometime ago, a case occurred in Benares, where an assured person disappeared to defraud an insurance company, after having first fabricated evidence of his own death. He, as well as his associates, got convicted and were sentenced to imprisonment by a court of law. The companies, usually, value the certificates of registered medical practitioners only.

Sometimes the question may occur as to whether death was due to an accident or not, especially if the life was insured against an accident. Death is said to be due to an accident, when caused by external and violent means, owing to unexpected and unforeseen occurrences.

CHAPTER XXI.

LAW IN RELATION TO MEDICAL MEN.

The Medical Act.

In order that persons requiring medical aid should be enabled to discriminate between qualified and unqualified practitioners, an act called the Medical Act of 1858, was passed by the Parliament in 1858, which came into force from the first day of October one thousand eight hundred and fifty-eight. This act created the General Medical Council, consisting of persons appointed by the different Universities and Licensing Bodies of Great Britain and Ireland, a certain number of representatives elected by the registered medical practitioners and six persons nominated by the Crown with the advice of the Privy Council.

This Council maintains the Register of medical men practising in Great Britain and Ireland, has the controlling power over the discipline of the profession and over the curricula and examinations of medical schools and colleges. It also publishes the British Pharmacopœia.

By part II of the Medical Act of 1886 medical graduates of Indian Universities are entitled to be registered on the payment of a fee of five pounds as colonial practitioners in the medical register, but their names will be entered in a separate list known as the Colonial List.

PRIVILEGES OF REGISTERED PRACTITIONERS.

It is incumbent on every medical practitioner in the British Isles to have his name registered as, by the act of registration, he is entitled to practise medicine in all its branches in the United Kingdom and in any other part of His Majesty's dominions over seas, to get certain official appointments, to grant medical certificates required by an Act of Parliament, to be exempted from serving on juries and inquests or in the militia, to use certain professional titles, and to recover professional fees by legal procedure, unless he happens to be a fellow of a Royal College of Physicians, since its fellows are prohibited from taking legal proceedings for the recovery of their professional fees.

In India, owing to the want of uniformity of standard in preliminary education and the medical courses in schools and colleges, and owing to the prevalent Ayurvedic and Unani systems no Medical Act had been passed till recently to control or to restrict the medical practices. In 1916 the Government of India passed the Indian Medical Degrees Act, known as, Act no VII of 1916, to regulate the grant of titles implying qualifications in Western medical science, and the assumption and use by unqualified persons of such titles.

Within the last few years the Local Governments of India have passed the Medical Act for the registration of certain medical practitioners in their own provinces, but it is very necessary that the Government of India should pass an Act on some such lines as the Medical Act of 1858 so as to have the uniformity of qualifications and to confer almost the same rights and privileges on the registered practitioners as in Great Britain and Ireland.

DISCIPLINARY CONTROL.

Section 29 of the Medical Act (1858) provides that—

If any registered medical practitioner shall be convicted in England or Ireland of any Felony or Misdemeanour, or in Scotland of any Crime or Offence, or shall after due inquiry be judged by the General Council to have been guilty of infamous conduct in any professional respect, the General Council may, if they see fit, direct the registrar to erase the name of such medical practitioner from the register.

Infamous Conduct.—What constitutes infamous conduct has very often been a controversial point in a court of law. Sir Donald Mac Alister in 1892 defined it as follows :—

"If it is shown that a medical man, in the pursuit of his profession, has done something with regard to which it would be reasonably regarded as disgraceful or dishonourable by his professional brethren of good repute and competency, then it is open to the Council to say that he has been guilty of infamous conduct in a professional sense." The offences which fall within the meaning and scope of this definition are—

1. A conviction for a criminal offence, unless of a very trivial nature, *e. g.*, foolish conduct under the accidental influence of alcohol.

2. Immoral relations with a patient, whom the doctor has been professionally treating.

3. Granting of false, misleading or improper medical certificates under one's own signature.

4. Covering an unqualified practitioner. According to this a registered medical practitioner who administers an anæsthetic for an unregistered dentist (dentists have to be registered according to the Dentists Act of 1878), or who co-operates with, or assists, an unqualified or unregistered person in the treatment of patients or engages him as his assistant, is liable to be judged as guilty of infamous conduct in a professional respect. But according to section 26 of the United Provinces Medical Act of 1917 the adoption by a registered medical practitioner of a theory of medicine and surgery not in accordance with the accepted theory for the time being or his association with a vaid, hakim, or homœopath or a unregistered practitioner holding one of the qualifications specified in the schedule is not regarded as constituting infamous conduct.

5. Advertising, canvassing or touting for patients and acting as a medical officer to a society which systematically advertises and canvasses for patients.

The decision of the General Medical Council when given after due inquiry and without malice is final but, according to section 27 of U. P. M. C. Act, an appeal shall lie to the local Government from every decision of the Council under sections 24 or 26.

DUTIES OF A PHYSICIAN.

A medical man when he is registered to engage in the practice of medicine and surgery after he has obtained a necessary degree or diploma from a university or a licensing body is presumed by law—

1. To use the necessary skill, care and attention in the treatment of his patients.

2. To continue to treat them and to pay them visits as long as is necessary, unless he has given due notice for discontinuing his treatment or visits, or the patients themselves have signified their intention of changing the doctor or where he is convinced the illness is an imposture and he is being made a party to a false pretence.

3. To furnish them with proper and suitable medicines, if he is in the habit of dispensing his own medicines.

4. To use clean and proper instruments and appliances.

5. To keep inviolate the secrets of his patients communicated to him by them or discovered by him at the time of the medical examination (Vide Appendix XI. for Hyppocratic and Vedic oaths). However, he has to divulge them under the court's orders in a judicial proceeding provided he is not incriminated by so doing. He should not answer inquiries addressed to him by an insurance company respecting a person who may

have consulted him without having obtained the patient's consent which, if possible, should be in writing. But, if he is a medical examiner, he must furnish all the information acquired by him without reservation, even though it may be detrimental to the interests of his client.

PHYSICIAN'S RESPONSIBILITY IN CRIMINAL MATTERS.

Ordinarily it may be presumed that a medical man should at once communicate to the police any information about a criminal act that might have come to his knowledge in his professional work, but this is not always the case. He should not play the part of a detective, but use his own discretion. Thus he should hand over to the police a man, whom, from the nature of his injury he may suspect to be an assailant in a murder case. If he happens to treat a person who has attempted to commit suicide, he is not bound by law to report him to the proper authorities, but he has to inform the police if he happens to die. If the friends or relatives of the suicide undertake to carry the information to the police, he must see that they do so. Similarly, if he is called upon to treat a case of an attempted abortion, he need not go off to the police to tell them that he is treating such a case, but he should treat the case as an ordinary case of abortion though, it is better for him to consult a brother practitioner just to save his own skin. However, if he happens to know that abortion was induced by some professional abortionist, he must at once send a report to the police so as to lead to the arrest of such a person. If the woman is about to die, or is dead from the result of abortion, he must give information to the police or a magistrate for necessary action.

DUTIES OF A PATIENT.

When a patient employs a medical man for the treatment of his ailment, he may be reasonably expected to supply

his doctor with full information concerning the facts and circumstances of the case, to allow him full opportunity for his own treatment, to obey his instructions and carry out his directions to the very letter as regards his diet, medicine, mode of life, and to pay him the reasonable fee for his services.

MALPRAXIS.

Malpraxis, malapraxis or malpractice is defined as want of reasonable care and skill, or wilful negligence, on the part of a medical man in the treatment of a patient so as to lead to his bodily injury or to the loss of his life. The law relating to malpraxis is contained in sections 52, 80, 81, 83, 88, 89, 90, 91, 92, and 304 A of the Indian Penal Code.

The question of malpraxis arises in civil courts, when a patient raises it as a plea for not giving the fees to his physician who files a suit against him for their recovery, or when the patient brings an action for damages against his doctor on account of negligence or incapacity in his treatment; or in criminal courts when an assaulted person dies after a surgical operation was performed on him. In such cases the medical man should be able to prove that he used reasonable and ordinary care in the treatment of his patient to the best of his judgment. He is, however, not liable for an error of judgment. The court expects a duly qualified man to use that degree of skill and care which an average man of his qualifications ought to have, but does not expect him to perform a cure or bring the highest possible degree of skill in the treatment of his patients. Thus a medical man will be exonerated from malpraxis, if it is proved that he consulted, or suggested the consultation of, a brother practitioner in the diagnosis of, or treatment of, a case or that he examined, or suggested the examination of an alleged fractured or dislocated limb by X rays. But

no new treatment in the form of an experiment can be adopted without the consent of the patient or his guardian, if he happens to be a minor. Again the medical man is guilty of malpraxis, if he has a sore or infection, and dresses his patient, and consequently infects him or does not warn a dresser with infection. It is also advisable to inform the patient, if he is suffering from an infectious disease, such as plague, small-pox, etc.

A physician or surgeon may be charged with manslaughter or negligence, when a patient dies from the effects of anæsthesia, an operation, or some other treatment, if it could be proved that the death was the result of malicious intention, or gross negligence on the part of the medical attendant. It is, therefore, necessary that, to prove that he had taken reasonable care and used necessary skill, the medical man should take the following precautions before he undertakes to administer an anæsthetic or perform an operation :—

1. The administration of an anæsthetic or the performance of an operation should not be undertaken without the consent of the patient, or his guardian if he is a minor or unconscious, after the nature and consequences of the operation have been explained to him or to his guardian. In cases where the surgeon is not sure as to what he would have to do during the operation owing to some obscure signs, he should obtain a written authority to use his discretion in doing what appears to him to be in the best interests of the patient.

2. In cases of criminal wounding an operation ought not to be performed, unless it is absolutely necessary. In such cases care should be taken to keep an accurate record of the state of the patient before it is performed. It is also better, before performing any operation, to get the opinion and help of another surgeon, if possible.

3. An anæsthetist should be a duly qualified man, and he

should always administer a generally accepted anæsthetic, after he has examined the heart, urine, etc., of the patient to prove that he had used reasonable care and skill in administering it.

4. In the case of death from anæsthesia, the surgeon or the anæsthetist should at once report the matter to the police for holding a public inquiry.

RESPONSIBILITY OF A MEDICAL MAN FOR NEGLIGENT ACTS OF NURSES OR STUDENTS.

The medical man is responsible for the negligent act of a nurse employed by him to look after his patient or of a medical student working in the hospital under his instructions, if the act was committed in his presence and to which he aquiesced; but he is no more responsible, if it was done in his absence and the student or nurse had traversed beyond his instructions in committing that negligent act. Similarly the managers of the charitable hospitals are not responsible for the neglectful work of the hospital staff, if they have taken proper care in appointing properly qualified persons on the staff.

MALINGERING OR FEIGNED DISEASES.

Malingering or shamming a disease or injury or exaggerating its effects is very common in India and is usually practised by soldiers or policemen to evade their duties, by prisoners to avoid hard work, or by beggars to excite the sympathy of charitable people. Similarly an assaulted person tries to aggravate the effects of injuries or simulates them when he has none, so as to mislead the medical jurist; or a man charged with an offence of rape may pretend to be impotent. A medical man who has any experience of medico-legal or police work in India must have come across such cases of feigned diseases and injuries.

The number of diseases shammed by a malingerer is legion. Ophthalmia, dyspepsia, intestinal colic, diabetes, spitting of blood, ulcers, burns, feigned abortion, rheumatism, lumbago, neurasthenia, nervous diseases,

such as aphasia, sciatica, vertigo, headache, epilepsy, insanity, paralysis of the limbs, and feigned bruises and injuries of the internal organs, are very common. In some cases it is quite easy to find out the deception, but in others it is difficult to find out whether an individual is shamming or not. In such cases the medical man should bear in mind the following hints before he decides the question of malingering :—

1. Keep the patient under observation and have him carefully watched without his knowledge.

2. Pay him several unexpected visits before you decide on the case.

3. Hear patiently the history of the case and compare the symptoms, if they refer to a particular disease or a group of diseases and find out if there are any discrepancies in his description of the symptoms of the disease which he simulates.

4. Have all the bandages and dressings removed. Very often an injured person comes to the medical man with the application of turmeric *(haldi)* on the body. It should be thoroughly washed and wiped out to ascertain, if there are any abrasions or bruises on the body.

5. Try to find out the motive of deception in each case.

6. Be chary in giving credence to the story of the by-standers or the relatives of the malingerer.

7. Examine each and every organ carefully and thoroughly.

8. Suggest in the presence of the patient some heroic method of treatment as the application of the actual cautery or some severe operation. In one case, where an assaulted man pretended aphasia, he started speaking, when he was laid down on the operating table and a big amputation knife was shown to him to open his skull to find out the injury on his brain. Very often I have succeeded in making the malingerers admit their deception by applying strong currents of electricity, Liston's long splint or by administering some nasty drug, such as castor oil, etc.

9. Give chloroform, if necessary.

FITNESS FOR GOVERNMENT SERVICE.

The medical man, especially the civil surgeon, has to give a certificate of fitness before a person is recruited into government service. The age limit, under ordinary circumstances, is twenty-five, but in some cases it is twenty-eight and in exceptional cases the Local Government may waive the question of age in the favour of their employee, if he happens

to be over age. The diseases which may render an individual unfit for Government service—civil or military—are syphilis, phthisis, hernia, hydrocele, varicocele, varicose veins, diseases of the eyes constituting colour blindness, or short sight beyond—4, or some organic disease, such as optic atrophy, etc.

WILLS.

Ordinarily a medical man has got nothing to do with the drawing up of a will, as the proper person to write a will is a legal adviser of the patient but, on occasions, the medical man may be consulted about the making of a will, when the patient is lying at the point of death (*in extremis*), or when the patient wishes to make his medical attendant his legatee, a witness or an executor. In the latter case the question of using undue influence on the patient by the medical man may be disputed in court to invalidate the will.

The following hints in connection with the making of a will are necessary to be followed :—

1. Any person of twenty-one years of age and of sound mind can make a will to dispose of his property.

2. The medical man should find out that the testator, at the time or making his will, is in full possession of his intellect to understand what he is doing.

3. If the testator bequeathes his property to the medical man or his wife, he should consult his legal advisers, if he has the least suspicion that the question of "undue influence" will be raised later in court.

4. In drawing up a will it is not necessary to use legal technicalities, but a plain and simple language must be used.

5. The will should be begun with "This is the last will and testament of me.....of.....", and should be ended thus "and hereby I revoke and make void all former or other wills and codicils."

6. The name of the place and the date, month and year should be entered at the end before the testator signs the will.

7. Any alterations, if made in the will, should be initialed by the testator and witnesses.

8. No scratches, erasions or alterations must be made after the will is executed.

9. A clause appointing an executor should be inserted thus : "And I do hereby nominate, constitute and appoint $\frac{\text{executor}}{\text{executrix}}$ of this my will.

10. Two witnesses, present at the time, must sign the following attestation at the end of the will after the testator has affixed his signature "signed by the said $\frac{\text{testator}}{\text{testatrix}}$ and acknowledged by $\frac{\text{him}}{\text{her}}$ to be $\frac{\text{his}}{\text{her}}$ last will and testament in the joint presence of us, and subscribed by us as witnesses in the presence of the said $\frac{\text{testator}}{\text{testatrix}}$ and of each other. It should be bourne in mind that a witness to a will may not be a beneficiary. If the patient left a sum of money to his doctor and the doctor had signed as a witness, this part of the will would be invalid.

11. The occupation and address of the witnesses should be given after their signature.

SECTION II.—TOXICOLOGY.

CHAPTER XXII.

POISONS AND THEIR MEDICO-LEGAL ASPECT.

Definition.—A poison may be defined as a substance of the nature of a drug which, if administered, in a way and in an amount in which it is likely to be administered will produce deleterious effects of a serious nature. This, however, only applies to the term as usually employed. It does not cover the poisonous gases, which are not substances of the nature of a drug. But they are not often used criminally, except by the Germans, or in suicide by means of charcoal.

Law relating to Poisons.—In cases of criminal poisoning in India the law does not insist on the precise definition of a poison, since Sections 284, 299, 304A, 324, 326 and 328 of the Indian Penal Code concerned with poisoning are self explanatory. Again, the law takes cognizance of malicious intention of the individual, who administers a drug or other substance with a view to cause injury or death, irrespective of the quantity or quality of the substance.

Sale of Poisons.—In England the laws restricting the sale of poisons are strictly enforced. Hence it is very difficult to obtain poisons. Legally qualified druggists are alone allowed to sell or dispense poisons. According to the Pharmacy Act passed in 1868 and amended in 1908 the druggist can only sell certain poisons to a person known to him, or introduced by some one known to him, and has to

make an entry in the register regarding the name and quantity of the poison sold, the name and address of the person to whom it is sold, the purpose for which it is sold, and the date of sale. The entry has to be signed also by the purchaser, as well as by the introducer. But in India the laws are not strict enough. Poisons can be bought at any chemist or druggist. In fact there was no law restricting the sale of poisons in the whole of British India, until the Poisons Act was passed in 1904 by the Governor-General-in-Council providing for regulating the possession and sale of all poisons in certain local areas and the importation, possession and sale of white arsenic without a license throughout the whole of British India. This Act further provides that no person shall sell any powdered white arsenic, except in special cases, unless it is mixed with half an ounce of soot, indigo or Prussian blue to at least every pound of the white arsenic. (Vide Appendix XII. for the Poisons Act and Rules in United Provinces.)

The rules regarding the custody and dispensing of poisonous drugs in all hospitals and dispensaries provide that all the poisonous drugs shall be issued by the Government Store-keeper with labels printed on red paper with the word "Poison" in large printed English and Vernacular characters affixed to all bottles, vessels, etc., containing such articles, that they shall be kept separate from all others in an almirah, box or drawer to which the word "Poisons" shall be affixed, that all written prescriptions containing poisons shall be compounded by the Assistant Surgeon or Sub-Assistant Surgeon in charge of a dispensary and not by a compounder, and that a copy of these rules pasted on stiff paper or board shall be suspended in every apartment where medicines are dispensed.

Errors in the Dosage of Poisons in Prescriptions.—The dispenser or the druggist is liable to punishment for any harm accruing to a patient from a prescription con-

taining an unusually large dose of a poison, if it is dispensed by him It is, therefore, necessary that he should always bring the errors of such over-doses to the notice of the prescriber by writing a private letter to him before the medicine is dispensed.

Poisoning in India.—Human poisoning, as well as cattle poisoning are both prevalent in India.

Human Poisoning.—Both suicidal and homicidal cases of poisoning are much more common in India than in England owing to the facility with which poisons can be had in any *bazar.* Again, accidental cases of poisoning are not unfrequently met with on account of the carelessness with which the earthen pots containing innocuous and poisonous roots and drugs are indiscriminately mixed up in a so-called grocer's shop.

The poisons that are chiefly used for suicidal purposes are opium and arsenic.

The poisons that are usually selected for the purposes of homicide are arsenic, pounded glass, mercury, copper, aconite, oleander, nux vomica, and *madar.* Opium is sometimes used to kill children or intoxicated persons.

Datura is used, not as a rule with homicidal intent, but for the purpose of stupefying persons to facilitate robbery or rape. In rare cases Cannabis indica is also used for the same purpose.

Cattle Poisoning.—This is resorted to by *Chamars*, who deal in hides. The poison employed to destroy cattle is often arsenic and sometimes aconite. A common mode, in which the arsenic is administered to the animal is to make a small quantity of white arsenic into a paste with some fluor dough, and then to wrap it up in some fresh grass or stems of the grain plant. The other poisons, that are also used, though rarely, are the seeds of abrus precatorius, croton, yellow oleander, nux vomica and the snake venom.

CLASSIFICATION OF POISONS.

Poisons are classified according to the chief symptoms which they produce on the body. Hence they are classified as :—

I. Corrosives—Strong acids and Alkalies.

II. Irritants.—A. Inorganic.—

Non-metallic.—Phosphorus, Chlorine, Bromine, Iodine.

Metallic.—Arsenic, Antimony, Mercury, Copper, Lead, Zinc, Silver, etc.

B. Organic.—

Vegetable—Castor oil, Croton oil, *Madar*, Aloes, etc.

Animal—Snake and insect bites, Cantharides, Ptomaine poisoning, etc.

C. Mechanical—Diamond dust, Powdered glass, Hair, etc.

III. Neurotics—

1. Affecting the brain (Cerebral)—

a. Somniferous—Opium and its alkaloids.

b. Inebriant.—Alcohol, Ether, Chloroform.

c. Deliriant.—Datura, Belladonna, Hyoscyamus, Cannabis indica.

2. Affecting the spinal cord (Spinal)—Nux Vomica, Strychnia, Brucia, Gelsemium.

3. Affecting the heart (Cardiac)—Aconite, Digitalis, Tobacco, Hydrocyanic Acid.

4. Affecting the lungs (Asphyxiants)—Poisonous irrespirable gases, e.g., Carbon-dioxide, Carbon-monoxide, coal gas, etc.

5. Affecting the peripheral nerves (Peripheral)—Conium, Curara, etc.

The Methods of administering Poisons.—The following are the methods by which the poisons may be administered into the system :—

1. By the mouth.
2. By inhalation through the air passages.
3. By absorption through the skin and serous membrane.
4. By hypodermic injection. The dose that acts as poison by this method may be taken as one-third less than that which is required when administered by the mouth.
5. By introduction within the spinal membranes.
6. By injection into a blood vessel.
7. By introduction into an open wound.
8. By introduction into the natural orifices, such as rectum, vagina, urethra, ears, etc. The dose to act as poison per rectum is probably double that required by the mouth.

The Channels of Elimination.—Poison after it is absorbed into the system is eliminated by the kidneys, intestines, lungs, bile, milk, saliva, mucous membrane and the skin.

ACTION OF POISONS.

The action of poisons on the animal system is—

1. Local.
2. Remote.
3. Both, *i*, *e.* combined.

1. Local.—The local action of a poison by coming in to direct contact with the part may consist in—

a. Chemical destruction by corrosives ; e. g., strong acids and alkalies.

b. Congestion and inflammation by irritants ; e. g., weak acids, arsenic, tartar emetic, or cantharides.

c. An effect on the nerves of sensation or motion ; e. g., tingling of the skin and tongue by aconite, and dilatation of the pupils by belladonna or datura.

2. Remote.—Remote action is produced either by shock acting reflexly through severe pain caused by corrosives, or by the poison being first absorbed into the system through the blood and then exerting a specific action on certain organs. For instance, cantharides acting on the kidneys produces nephritis, arsenic acting on the stomach and intestines causes vomiting and diarrhœa, and opium acting on the brain produces narcosis.

3. Both, i. e. combined.—Certain drugs, such as carbolic acid, oxalic acid, phosphorus, etc., act locally by producing irritation and inflammation of the parts with which they come into contact, and then produce remotely serious symptoms, after they have been absorbed through circulation.

CAUSES MODIFYING THE ACTION OF POISONS.

The causes which modify the action of poisons are four in number :—

1. The quantity.
2. The form.
3. The mode of administration.
4. The condition of the body.

1. The Quantity.—The natural presumption is that a large dose of a poison will produce death more rapidly by causing severe symptoms than a smaller one, but, in some cases, the evil effects are mitigated by vomiting excited by a large dose of a poison, as it may occur with copper sulphate. Again the action of the poison varies with the quantity of the dose. For instance, a very large dose of arsenic may produce death by shock without causing irritant symptoms, while a smaller dose than a lethal one may produce its therapeutic action, as it happened in the case of the late Mr. Fulham of Agra, when he was being poisoned by small doses of arsenic. Similarly oxalic acid, when administered in a large dose, produces a local corrosive action, and may result in instanta-

neous death from shock, but in a smaller dose it may prove fatal by acting on the heart, while in still smaller doses it acts on the spinal nervous system and the brain.

2. The Form.—Under this head will have to be considered—*a.* Physical state ; *b.* Chemical combination ; *c.* Mechanical combination.

a. Physical State.—Poisons administered in the form of gases or vapours act at once and most energetically. Poisons in the form of solutions act much more rapidly than the powders. Poisons in the form of solids act very slowly, because they are difficult to be absorbed and, in some cases, prove quite harmless.

b. Chemical Combination.—The action of a poison depends upon the solubility or insolubility resulting from a chemical combination. Thus silver nitrate and hydrochloric acid are both strong poisons, when taken separately but, when combined, form an insoluble salt of silver chloride which is almost innocuous. Similarly baryta (barium dioxide) and sulphuric acid act as poison if administered separately but, in combination, form an insoluble salt, barium sulphate, which has no poisonous effects on the system. In the same way strong acids and alkalies, when administered together, are rendered inert by their neutralizing effect.

c. Mechanical Combination.—The action of a poison may be altered very much if mechanically combined with inert substances. For instance, a small dose of a concentrated mineral acid produces a corrosive action, but the same dose can be taken internally with impunity, if largely diluted with water. A heavy poisonous powder, when mixed with water, will settle down at the bottom of a vessel, and the victim fails to take it ; while it would have been swallowed had it been taken with a fluid of nearly the same specific gravity as that of the powder. For this reason arsenic is usually mixed with milk, tea, coffee or cocoa, when administered for

homicidal purposes. Again alkaloids when taken with animal charcoal are rendered more or less inert.

3. The Mode of Administration.—The rapidity of the action depends on the mode with which it is introduced into the system. Thus it acts most rapidly, when inhaled in gaseous or vapourous form, or introduced into the blood current by injection into a vein by subcutaneous injection or by application to an open wound. Next in rapidity is the action of a poison which is applied to a serous surface, next when introduced into a cellular tissue, and next when applied to a mucous membrane. The least rapid is the action of a poison when applied to the unbroken skin. In this case a drug dissolved in oil acts more rapidly than a watery solution.

A poison when ingested into the stomach acts more rapidly than when injected into the rectum, since the absorptive power of the stomach and small intestine is greater than that of the large intestine and rectum. Again, if the poison is eliminated as rapidly as it is absorbed, no poisonous symptoms are likely to occur. On the contrary if the rate of absorption is greater than that of elimination, the poison tends to accumulate in the system, and has a cumulative action. For example, mercury, lead, etc., are cumulative poisons.

The absorption in the stomach may be delayed, if it is full of food at the time of taking the poison. However, in some cases, absorption may be hastened, if the nature of the stomach contents is such as will dissolve the poison. Thus the action of phosphorus will be hastened, if oil is taken immediately it is swallowed, as it dissolves in all oils except in turpentine.

4. The Condition of the Body.—Under this head will have to be considered:—*a.* Age; *b.* Idiosyncrasy; *c.* Habit; *d.* The state of health; *e.* Sleep and Intoxication.

a. Age.—Ordinarily poisons have greater effect at two

extremes of age. However, certain drugs such as belladonna and calomel are better tolerated by children than by adults.

b. Idiosyncrasy.—This means natural susceptibility or toleration of an individual towards certain drugs, such as arsenic, mercury, potassium iodide, etc., as also towards various articles of diet, such as shell-fish, pork, pulses, vegetables, etc., which may be harmful to others. Thus a medicinal dose of arsenic or mercury may produce alarming symptoms in susceptible persoms, while even a very large dose of the same drug may be tolerated by other individuals without any deleterious effects. The same is the case with certain kinds of food. Hence the proverb "one man's meat is another man's poison."

c. Habit.—By a long continued use of such drugs as opium, alcohol and arsenic, people establish the habit of tolerating very large doses which, under ordinary circumstances, are liable to prove fatal.

d. The State of Health.—Broadly speaking a healthy person is less likely to succumb to the effects of poison than one, who is enfeebled by disease. But in some diseases larger doses of certain drugs can be given with impunity without causing any harmful effects; as, for example, opium in tetanus, delirium tremens and mania, and strychnia in paralysis; while in other diseases certain drugs cannot be given even in small doses without producing deleterious effects, e. g., opium in granular kidney and apoplexy, and mercury in chronic Bright's disease. Similarly digitalis, tobacco and tartar emetic may produce symptoms of syncope, when given to a person having a weak or a fatty heart.

e. Sleep and Intoxication.—During sleep all the bodily functions are languid. Hence the action of a poison is delayed, if a person goes to sleep soon after taking it. The action is also delayed, if one takes a poison when in an intoxicated condition.

DIAGNOSIS OF POISONING.

This has to be made in the living, as well as, in the dead.

1. In the Living.—The medical man's task becomes very difficult in diagnosing a case of poisoning as, in order to avoid police investigation, no body is willing to supply him with the true and correct history of the case. However, he can, to a certain extent, be able to diagnose a case of poisoning from the following characters of the symptoms exhibited by the patient :—

1. The onset is usually sudden in a previously healthy individual except in chronic poisoning, where the symptoms develop gradually, and may be easily mistaken for a disease. At the same time it must be remembered that in some such diseases, as cholera, apoplexy, gastro-enteritis, etc., the symptomps may appear suddenly.

2. The symptoms usually commence within an hour after food, drink or medicine has been taken ; but the poison will have no connection with food, if it is given per rectum or vagina.

Again the effects of some diseases, such as cholera, apoplexy and rupture of the stomach, may appear all of a sudden soon after taking a meal or drink.

3. Symptoms are uniform in character, and steady in their progress either ending in death or recovery. Sometimes remissions may occur as in opium poisoning, and certain poisons may leave sequellæ of long duration.

4. All the persons partaking of the same food or drink containing poison will suffer from the similar symptoms of poisoning.

5. The detection of a poison in food, medicine, vomit or urine is a strong proof of poisoning. Hence, in suspicious cases these articles must be preserved in clean glass stoppered bottles for chemical analysis.

TABLE SHOWING INSTANCES OF SIMILARITIES OF SYMPTOMS PRODUCED BY POISONS AND DISEASES.

Symptoms.	Poison.	Disease.
1. Coma.	Opium, morphine, chloral, alcohol, camphor, chloroform.	Apoplexy, brain injury, uræmia, diabetes, epilepsy, fever.
2. Collapse.	Corrosives, arsenic, antimony, aconite, tobacco, lobelia, antipyrine, exalgine etc.	Diphtheria, cholera, fever.
3. Delirium.	Belladonna, hyoscyamus, cannabis, alcohol, camphor.	Pneumonia, phthisis, meningitis, fevers, acute mania.
4. Paralysis.	Conium, aconite, gelsemium, physostigmine, arsenic, lead.	Injury to cord or brain, apoplexy, hysteria.
5. Convulsions.	Nux vomica, arsenic, antimony.	Tetanus, hysteria.
6. Cyanosis.	Anilin, antifebrin, exalgin.	Valvular heart disease.
7. Dilated Pupils.	Atropine, hyoscyamus, aconite (alternate dilatation and contraction), alcohol, chloroform, conium.	Paralysis of 3rd nerve, Irritation of sympathetic.
8. Contracted Pupils.	Opium, eserine, chloral.	Irritation of 3rd nerve. Paralysis of sympathetic.
9. Dry Skin.	Belladonna, hyoscyamus.	Fever, pneumonia.
10. Moist Skin.	Opium, aconite, antimony, tobacco, lobelia, alcohol.	Acute rheumatism.
11. Vomiting.	Corrosive and irritant poisons generally.	Gastric ulcer, acute gastritis, etc.
12. Diarrhœa.	Irritant poisons, digitalis, colchicum.	Dysentery, cholera, typhoid, tubercle.
13. Colic.	Lead, copper, arsenic.	Volvulus, obstruction.
14. Cramp.	Lead, arsenic, antimony.	Cholera, diarrhœa.

II. In The Dead.—Diagnosis in the dead has to be made from—

A. *Post-mortem* appearances.
B. Chemical analysis.
C. Experiments on animals.
D. Moral evidence.

A. POST-MORTEM APPEARANCES.

Before holding a *post-mortem* examination on the body of a suspected case of poisoning it is advisable that the medical officer should read the police report and endeavour to get as much information as possible from the relatives of the deceased regarding the quantity and quality of the poison administered, the character of the symptoms with reference to their onset and the time that elapsed between the taking of the poison and the development of its first symptoms, the duration of the illness, nature of the treatment adopted, and the time of death ; so that he may be in a position to make a probable guess of the poison, and look for its characteristic *post-mortem* appearances. However, in most of the cases he will find that the account supplied by the police and the relatives is very meagre, or incorrect, and misleading. Hence his task is much more difficult, inasmuch as many of the poisons except corrosives and irritants do not show any characteristic *post-mortem* appearances, and very often the bodies are in an advanced state of decomposition, when taken to the mortuary. But he must carry out, in all the cases of suspected poisoning, a thorough examination of the body both external and internal, as far as is possible.

External Examination.—Some poisons, such as hydrocyanic acid, or opium give off a peculiar smell on opening the body. Hence no odorous disinfectant, that is likely to mar such smell, should be used. The surface of the body and the clothes may show stains or marks of vomit, fæces

or the poison itself. The skin may be jaundiced as in phosphorus poisoning, or yellow as in acute copper poisoning.

The natural orifices, such as the mouth, rectum and vagina, may show the presence of poisonous material, or the signs of it having been used.

It must be borne in mind that the presence of wounds or disease sufficient to account for the death does not contra-indicate the use of a poison. It is, therefore, necessary to preserve viscera in all the cases of suspected poisoning, even if there are no positive *post-mortem* signs of poisoning.

Internal Examination.—The alimentary system should be chiefly examined, as the signs of irritant and corrosive poisons are likely to be found in the œsophagus, stomach and intestines.

The changes produced by irritant and corrosive poisons in the digestive tract, especially the stomach are—

1. Hyperæmia.
2. Softening.
3. Ulceration of the mucous membrane.
4. Perforation.

These have to be differentiated from similar appearances caused by disease and putrefaction.

1. **Hyperæmia.**—The hyperæmia (redness) caused by an irritant poison is generally marked at the cardiac end and greater curvature of the stomach, and may be found either in patches or so diffused over its whole surface as to give it a velvety appearance as in arsenical poisoning.

Instead of redness some other discolouration may be found due to poison or fruit juice. For instance, yellow patches may be due to arsenic, blue or green coloration to copper and blackening may be due to sulphuric acid poisoning. Discoloration produced by staining of fruit juice is uniform, and is not marked by the signs of inflammation.

The hyperæmia caused by disease is uniformly spread

over the whole surface, and not in patches; besides the ridges of the mucous membrane are more likely to be involved in poisoning than in disease. The redness produced by *post-mortem* hypostasis is limited to the posterior wall, the most dependent part. In this case there is no thickening of the mucous membrane, nor is there any glairy mucus on its surface.

2. Softening.—Softening of the mucous membrane of the stomach, especially at its cardiac end and greater curvature, is usually caused by the action of corrosive poisons, chiefly the alkalies. It is also observed in the mouth, throat and œsophagus.

Some corrosive poisons, such as carbolic acid, produce hardening and shrinking of the mucous membrane instead of softening.

Softening caused by putrefaction commences at the most dependent parts, and affects all the coats of the stomach without the detachment of its mucosa, and the softened patch is not surrounded by an inflamed area as is the case in corrosive poisoning.

3. Ulceration.—Ulceration caused by corrosives is generally found at the greater curvature of the stomach, and presents the appearance of an erosion with thin, friable margins and surrounded by the softened mucosa due to intense inflammation. An idiopathic gastric ulcer is situated frequently on the lesser curvature with sharply defined, but thickened and indurated edges. The mucous membrane is reddened only in the neighbourhood of the ulcer; while the redness extends up to the duodenum and small intestine, when the ulcer is due to a corrosive poison.

4. Perforation.—Perforation of the wall of the stomach or small intestine resulting from corrosive poisoning is very rare, though it may be met with in the case of sulphuric acid poisoning. Perforation caused by poisoning must be distin-

guished from one caused by disease or by the *post-mortem* action of the gastric juice.

In perforation caused by poisoning the aperture is large, ragged and irregular with the torn edges. The tissues round the margins are disintegrated beyond the edges of the aperture. The stomach in such a case is very much charred owing to the severe corrosive action.

If perforation has been the result of a chronic ulcer due to disease, its margins are more or less punched out, and the stomach does not show the signs of charring, but it shows chronic adhesions to the neighbouring organs. Very rarely perforation may follow an ulcer caused by irritant poisoning, when its appearance will be similar to that produced by the idiopathic ulcer.

In perforation produced after death by the auto-digestion of the stomach by the gastric juice, there is no inflammation or any blackening of the stomach, but the surrounding mucous membrane is often softened and gelatinous.

B. CHEMICAL ANALYSIS.

The most important proof of poisoning is the detection of a poison in the excreta (vomit, urine etc.,) during life, and in the contents of the stomach and bowels, as well as other tissues of the body after death. The finding of a poison in food, medicine or any other suspected substance is a corroborative, but not a conclusive proof ; for the poison may have been added to any of these substances just to substantiate a false charge against an enemy. In such cases of *feigned* poisoning it is advisable to elicit from the patient the poison he suspects to have been administered to him, so as to note if the symptoms complained by him are referable to the same poison. The medical man should also preserve for chemical analysis only those portions of the vomit and urine ejected in his presence.

When the poison has been detected in the stomach contents, the defence pleader may argue that it may have been introduced after death, or the contents may have been preserved in an unclean vessel. Both these arguments are quite futile and worthless, if the poison has also been detected in one or more of the solid viscera, such as the liver, spleen, kidneys and, if the clean china plates and glass bottles free from contamination have been used for examining and preserving the stomach and other viscera.

It is not necessary to lay any stress on the amount of a poison actually recovered except in those cases in which it may be alleged that the poison may have been administered as a medicine, or it may have been present owing to the deceased being habituated to its use, or it may have been a natural constituent of the body or a normal constituent of some article of food, or it may have been produced in the body during the process of decomposition, e.g., leucomaines and ptomaines.

It is also possible that death may occur from the effects of poison, and yet none may be detected on analysis of the viscera, if all the poison has been evaporated or eliminated by vomiting, purging, or by urine. Again certain organic poisons may not be detected in viscera as they have no reliable tests, or they may be split up into other bodies by oxidation during life or by putrefaction after death, though in such cases they may often be found in the vomit. It has, therefore, been wisely held by Christison that, in cases where a poison has not been detected on chemical analysis, the judge, in deciding on a charge of poisoning against an individual, should weigh in evidence the symptoms, *post-mortem* appearances and moral evidence.

Examination of the Viscera and their Contents.—A medical man who has no experience of chemical analysis should never undertake the analysis, nor should he ever make

any guess from the nature of the stomach contents etc.; but he should always send these articles to the Chemical Examiner for analysis. The Chemical Examiner has got the most responsible work, as his findings are always final, because he is not liable to cross-examination vide Appendix VIII).

The Chemical Examiner or his assistant who receives the articles for analysis from civil surgeons first verifies the seals, and compares the labels with the invoice list of materials sent, and then opens the bottles, etc. He then places the contents in separate shallow porcelain basins after weighing and measuring them according to the nature of the material.

A careful visual inspection of the contents of the stomach and its mucous membrane is now made by means of a lens, if necessary, making a note of the colour and reaction of the contents. Any foreign substance, such as seeds, crystalline particles or fragments of leaves, roots etc., should be picked up and examined on a slide under the microscope. The inner wall of the stomach should be washed with distilled water, and the washings added to the contents. A little of the stomach contents may be taken on a slide, rubbed up with a drop or two of glycerine and when, examined under the microscope, may show fragments of *datura* seeds or *bhang* leaves, if they are present.

For chemical analysis the contents of the stomach are diluted with water, and the solid viscera are finely chopped up, and macerated in water. If the Chemical Examiner has any clue or indication of the nature of the poison, he begins by searching for it. If not, he usually divides the mixtures into three parts for the examination of volatile, vegetable and mineral poisons.

1. Volatile Poisons.—Volatile poisons, such as alcohol, ether, hydrocyanic acid, benzene, nitro-benzene, aniline, carbolic acid, bromine, iodine and phosphorus are separated

by distilling the first portion of the mixture acidulated with tartaric acid, but to separate ammonia, nicotine and volatile bases the mixture has to be rendered alkaline by the addition of magnesia.

2. Vegetable Poisons.—The detection of the vegetable poisons depends on the isolation of their alkaloids and glucosides from the stomach contents or organs of the body and the suspected articles of food and their identification by the application of chemical and physiological tests.

These alkaloids may be grouped under three heads : (1) those derived from pyridine, e. g., atropine, conine, (2) those derived from quinoline, e. g., cinchonine, narcotine, and (3) substituted amines and amides. Most of the vegetable alkaloids belong to the first two groups. They are mostly solid, crystalline and colourless, except a few, such as conine, nicotine and pilocarpine which are liquid. They are insoluble in water, but soluble in ether, while with acids they form salts, which dissolve in water, but not in ether. This fact of solubility is made use of in separating them from organic mixtures for which the following processes are adopted :—

a. Stas's Process.—The second part of the original mixture is acidulated with tartaric or citric acid, and digested with alcohol in a glass flask by allowing it to stand for 3 days. The alcoholic extract is then strained off, and evaporated at a low temperature to a syrupy consistence. The extract may now be examined for the presence of opium, but, in the absence of opium the extract is treated with cold alcohol, and again evaporated, treated with water acidulated with acetic acid and filtered. The filtrate is neutralized with sodium carbonate, shaken up with ether, chloroform or amyl alcohol, and separated in a separating funnel ; the extract is then evaporated to dryness in glass dishes. The dry residue is now ready for the detection of alkaloids.

b. Otto's Process.—This is a modification of Stas's

process, and has the reputation of being simpler, and at the same time equally accurate. In this method the alkaloid is converted into a salt, such as a sulphate, by the addition of an acid. The salt is then formed into a solution, dissolving it in water. The solution is shaken up several times with ether which removes all foreign fatty matters. The solution, which is now comparatively pure, is rendered alkaline by adding caustic soda. Ether is now added to the alkaline solution so as to dissolve the alkaloid, which may be separated from it by evaporation.

C. Dragendorff's Process.—Dragendorff has elaborated a modified form of Stas-Otto process for the separation of alkaloids, glucosides and vegetable principles from each other.

The mixture is digested with water slightly acidulated with sulphuric acid at a temperature of 40° to 50°C. for some hours, and is then filtered, the filtrate being collected. The process of extraction and filtration is repeated two or three times, and the filtrates thus collected are combined, evaporated to a syrupy consistence, and are heated for about twenty-four hours with alcohol. The alcoholic extract thus formed is filtered and evaporated to dryness. The residue is dissolved in a half per cent. solution of acetic acid and filtered. This acid filtrate is shaken with the following solvents to dissolve out the undermentioned substances :—

1. Petroleum ether to dissolve out carbolic acid, picric acid, camphor, aconitine, capsicin and piperin.

2. Benzene to dissolve out cantharidine, colchicine, colocynthin, digitalin, absinthin, elaterine, santonine and thiene.

3. Chloroform to separate papaverine, picrotoxin, digitalin, cinchonine, helleborin, saponin and jervine.

The acid solution is then rendered alkaline by the addition of ammonia, or a solution of caustic potash or soda, and the

following solvents are added with shaking to separate the undermentioned substances :—

1. Petroleum ether to dissolve out valatile alkaloids and aniline, as also strychnine, brucine, conine, nicotine. etc.

2. Benzene to dissolve out strychnine, brucine, aconitin, quinine, atropine, veratrine, codein, narcotine, thebaine, physostigmine, etc.

3. Chloroform to dissolve out narceine, morphin, papaverin, etc.

4. Amyl alcohol to dissolve out morphin, solanin, salicin, and saponine.

5. Chloroform after the residue is evaporated to dryness, when curarine will separate out.

d. Hankin's Process.—Dragendorff's process is far too elaborate to suit the requirements of an Indian Chemical Examiner. Hence Dr. E. H. Hankin, M. A. Sc. D., Chemical Examiner of Agra, has modified it in the following manner :—

a. The viscera are chopped into small pieces with a pair of scissors, and placed in a large beaker or flask with the rectified spirit in which they have been preserved.

b. After adding a few drops of acetic acid the beaker is boiled by standing it in a water-bath. In cases of suspected aconite poisoning, it is advisable not to heat the viscera above 65°C.

c. After this digestion, the material in the beaker is filtered, and the solid portion left in the filter should be again extracted with alcohol. The alcoholic solution should be filtered off and added to the first portion of the filtrate.

d. These mixed filtrates contain most of all the alkaloids present, though with impurities. They are to be evaporated almost dry over a water-bath in a current of air.

e. When the filtrate has thus been converted to syrupy consistency, 20 c. c. of water should be added slowly while stirring it. It should then be filtered by using a funnel and an ordinary thin filter paper. It may be necessary to centrifuge it in case the liquid does not filter easily.

f. This watery extract is placed in a separating funnel and tested with a litmus paper. The reaction should be acid. If not, acetic acid should be added. 50 c. c. of ether is then added and shaken violently for one minute.

g. The separating funnel is fixed in a stand and allowed to rest for at least an hour, when the ether separates out and floats in the form of a layer on the surface of the watery liquid. If the two liquids have not separated by this time the addition of a further quantity of ether and shaking will cause separation. In rare cases it may be necessary to submit the mixed liquids to a strong and powerful centrifuging machine. In about five minutes a dense layer of glutinous matter forms, separating the two layers of ether and the watery liquid.

h. After the liquids are separated, the separating funnel should be held in the mouth of a second separating funnel to allow the watery liquid to flow into the latter. The ethereal layer (the acid ether extract) contains impurities, and may contain some rare poisons which are not ordinarily required to be looked for in India. Hence it may be discarded. If the ethereal layer is strongly coloured, the watery liquid has to be treated with chloroform. In testing for certain poisons, such as strychnia, it is desirable to submit the liquid

to further alternate and repeated washings with ether and chloroform. Chloroform should be shaken with the acid liquid with the help of a shaking machine. It is easy for chloroform to separate out, if the glutinous layer does not exist ; otherwise it may be necessary to use a centrifuge.

i. The acid watery liquid in the lower funnel contains the commoner alkaloids. A few c. c. of chloroform, a piece of litmus paper and 50 c.c. of ether should be added to the liquid ; to which a sufficient quantity of ammonia should be added to make the whole mixture alkaline. It should then be shaken up immediately for at least half a minute ; because the alkaloids present are capable of passing readily into the chloroform ether mixture, as soon as they are liberated by the addition of ammonia. They become changed after the lapse of a few minutes, and then pass with difficulty into the ether solution.

j. The separating funnel should be placed in a stand, and should not be disturbed till the liquids have separated. The separation may be hastened by the addition of a few c. c. of alcohol.

k. The liquid now separates into two layers. The upper ethereal layer, called the *alkaline ether extract* contains most of the alkaloids ; and the lower watery layer contains impurities. In cases of opium poisoning this portion of the watery extract contains the substance giving the *meconic reaction.*

l. The watery liquid should be tapped off and discarded.

m. The ethereal liquid should be received into a porcelain basin.

n. A few drops of half a percent. solution of acetic acid in water should be added to the ethereal solution in the basin.

o. This should be evaporated on a water-bath, until two or three drops of the dilute acid are left. In the case of aconite poisoning it should be evaporated at a temperature below the boiling point. The evaporated dilute acid should now be tested for different alkaloids.

General Tests for Alkaloids.—1. *Wagner's Reagent.*—Iodine dissolved in a solution of iodide of potassium gives a reddish-brown precipitate, if added to most alkaloids.

2. *Mayer's Reagent.*—Biniodide of mercury gives a yellowish white precipitate with an alkaloidal solution. Biniodide of mercury is prepared by adding a solution of iodide of potassium to one of mercuric chloride, when a scarlet precipitate is formed, which is just dissolved by a further addition of either of the two.

3. *Sonnenschein's Reagent.*—Phospho-molybolic acid gives a yellow precipitate with alkaloids.

4. *Scheibler's Reagent.*—Phosphotungstic acid has the same reaction as no. 3.

5. *Platinic Chloride.*—A solution of platinic chloride gives a brown precipitate with alkaloids.

6. *Tannin, Picric Acid, or Mercuric Chloride.*—Each of these, when added to alkaloids, precipitates them.

3. Mineral Poisons.—Two methods, viz., wet and dry, are employed for extracting mineral poisons from organic mixtures.

Wet method.—To oxidize the organic matter add strong hodrochloric acid to the third portion of the original mixture, and heat it carefully with potassium chlorate added in small portions at a time. The resulting solution will be a chloride of a metal, which can be obtained clearer

by filtering it. The solution may then be tested for the presence of metals by the grouping reagents and confirmatory tests.

Dry-Method.—The organic matter in the mixture is destroyed by heat so as to completely incinerate it. To the ashes thus obtained add strong nitric acid. The excess of the free acid should be removed by heat, and the nitrate should be dissolved in water and tested in the usual way. If the mixture is strongly acid in reaction, caustic potash may be added to neutralize it.

C. EXPERIMENTS ON ANIMALS.

The domestic animals may be fed with the suspected food, or with the poison after it is separated from the viscera and the symptoms exhibited by them should be noted. However, the evidence derived in this manner cannot be relied on in all cases, as some symptoms such as vomiting, etc., may be produced without any poison, and some animals may not be affected even with poisons. For example, rabbits are insusceptible to the leaves of belladonna, hyoscyamus, and strammonium ; so are pigeons to opium. But the cat and the dog are affected by poisons almost in the same way as man.

D. MORAL EVIDENCE.

This is furnished by common witnesses, but the medical man should not omit to note the surroundings of the patient, and the nervousness and anxieties of the relatives or some other persons regarding the haste with which they want the body to be disposed of by burial or cremation, if death has occurred.

THE DUTY OF A MEDICAL MAN IN CASES OF SUSPECTED POISONING.

The medical man must be very cautious in giving his opinion about poisoning. On mere suspicion he should never

give a verbal or written opinion lest he might not be a victim for an action of damages brought against him. In suspicious cases, he should collect twenty-four hours' urine, and examine it for the presence of a poison, if possible. It is always advisable to call in one or two brother-practitioners in consultation, or to have the patient removed to a hospital, where the doctor in charge should be informed of the suspicion, and he should not allow any one except the nurses or hospital servants to administer medicine and nourishment.

If the medical man is convinced that it is a case of criminal poisoning, he should communicate the fact to the police and to the patient, as well as to some reliable and trustworthy relative of the patient. The medical man is not bound to supply information to the police in cases of accidental or suicidal poisoning, but all the cases of poisoning of any nature admitted into a government (public) hospital must be reported to the police.

If a suspected poison case happens to die, the medical man should never grant a death certificate, but must insist on a *post-mortem* examination, communicate the fact of his death to the police, and must take charge of all the suspected articles, such as bottles, cups, food, vomit, urine, etc., with a view to send them to the Chemical Examiner.

TREATMENT IN CASES OF POISONING.

The medical man should always have an emergency case ready for cases of poisoning, so that he might be able to adopt immediate treatment without any loss of time.

The treatment should be based on the following principles :—

1. Removal of unabsorbed poison from the body.
2. The use of antidotes.
3. Elimination of poison absorbed into the system.
4. Treatment of general symptoms.

1. Removal of Unabsorbed Poison.—If the poison has been introduced into a wound subcutaneously as a result of bites or stings, a ligature should be applied above the wound, and then it should be excised or sucked provided there is no abrasion or ulcer in the mouth. If the poison has been inhaled into the respiratory passages, the patient must be made inhale pure air. If the poison has been taken into the stomach, it should be removed by washing out the stomach with a stomach tube (syphon tube) or stomach pump. An ordinary rubber tube of about half an inch in diameter and about five feet in length with a glass funnel attached at one end will serve the purpose of a stomach tube. A mark should be made at a distance of twenty inches from the other blunt end (stomach end). The tube should be warmed and anointed with olive or mustard oil, or some other lubricant, and should be passed into the stomach by depressing the tongue with the finger well back into the pharynx, and thus passing it downwards. A mouth gag should be used in cases of unconscious or comatose patients. When the mark on the tube is reached, it has entered the stomach. The funnel should now be held high above the patient's head and about two pints of warm water should be poured down it into the stomach. The funnel should then be lowered below the level of the stomach, when the contents of the stomach will run out of the funnel owing to the tube acting as a syphon. This process should be repeated until a clear fluid comes out. Very often the holes at the blunt end of the tube being too small get blocked, and should, therefore, be enlarged with a pair of scissors.

The stomach tube should never be used in cases of corrosive poisons except carbolic acid, lest the stomach wall being soft and ulcerated might not get lacerated or ruptured. In cases of irritant poisoning the stomach tube should be passed with caution.

When the stomach tube or pump is not available, or when

a patient is conscious, and does not like to have it passed into the stomach, free emesis should be produced by tickling the fauces with a feather, a leafy twig of a tree or the fingers. The following emetics may also be administered :—

1. A table-spoonful of mustard or salt in half a pint of warm water.

2. Copious draughts of warm water alone.

3. Half a dram of sulphate of zinc in a tumblerful of warm water to be repeated in a quarter of an hour.

4. Twenty to thirty grains of ipecacuanha powder, or two to six drams of ipecacuanha wine.

5. Fifteen to thirty grains of ammonium carbonate.

6. Five to ten grains of copper sulphate, but should be rarely used.

7. $\frac{1}{20}$ to $\frac{1}{10}$ grain of apomorphine hypodermically. This is certain to produce vomiting, and can be tried on an unconscious patient, but it causes great prostration and its effects are occasionally greatly prolonged. Hence it must be used with caution.

2. The Use of Antidotes.—Antidotes are remedies which counteract the effects of poisons. These are divided into *mechanical*, *chemical* and *physiological*.

Mechanical antidotes are those which render the poison inert by mechanical action. For instance bulky food is a mechanical antidote for glass, and flour, chalk and other insoluble powder mixed with water for cantharides and phosphorus.

Chemical antidotes are those which counteract the action of the poison by forming harmless or insoluble compounds when brought into contact with it. The examples are acids, for alkalies, alkaline carbonates and magnesia for mineral acids, lime for oxalic acid, sodium sulphate for lead poisoning and tannin for alkaloids.

A very important chemical antidote for organic poisons is potassium permanganate. A solution containing enough

permanganate to give it the colour of wine or even a stronger solution should be used. It is commonly used in opium poisoning, but should be used in all cases of organic poisons, The patient should drink as much as he can of it both before and after vomiting. If this remedy is used, the magistrate should be informed of the fact as its use greatly decreases the chance of the detection by the Chemical Examiner. This, however, should not deter the medical man from using the drug, as his duty is to save life. If in doing so he destroys evidence that might be useful to the police, that is sad for the police, but is no concern of the doctor at all. If without harming the patient he can obtain material of evidential value, then by all means he should do so but not otherwise. Hence, before trying the permanganate, he may wash out the stomach with water and reserve this washing for the Chemical Examiner, if it is possible to do so without causing the patient to undergo any extra risk.

The following is a useful chemical antidote for almost every kind of mineral poison :—

1. 100 parts of a saturated solution of ferrous sulphate.
2. 88 parts of calcined magnesia.
   40 parts of charcoal.
   100 parts of water.

Numbers 1 and 2 should be stocked in separate bottles, and should be mixed when necessary, and used fresh.

Physiological antidotes or antagonists are those which act on the body cells, and produce symptoms exactly opposite to those caused by the poison acting on the cells. Thus a perfect physiological antidote is one which exactly counteracts each evil effect produced by the poison, but most of the known antidotes are only partial in their action, and when pushed to their physiological action are liable to prove dangerous to life. Atropine is an example which,

though it is regarded and used as a physiological antidote of morphia, is liable to cause death by paralysing the motor and sensory nerves just like morphia. Hence caution must be observed while using it. Physostigmine and atropine are two real physiological antagonists.

3. **Elimination of Absorbed Poison.**—The poison which has been absorbed into the system should be eliminated by the natural emunctory channels by giving hot baths, warm packs, diuretics and purgatives when not contra-indicated.

4. **Treatment of General Symptoms.**—Pain should be relieved by demulcents and opium if necessary.

Shock and collapse should be combated by warmth to the surface in the form of friction, a hot bath, or hot bottles, or by hypodermic injection of stimulants in the form of sulphuric ether, minims twenty for a dose, and liquor strychnia in 5 minim doses or sulphate of strychnia in $\frac{1}{50}$ grain doses.

An enema of two pints of a very hot normal saline solution is a very efficient and useful stimulant. If the patient is pulseless, it is advisable to use an intracellular, but still better, intravenous injection of a saline infusion.

Appropriate treatment will be necessary for remote effects of poisons, such as ulceration or contracting cicatrices after corrosive poisoning, and neuritis after arsenic.

CHAPTER XXIII.

CORROSIVE POISONS.

I. Mineral Acids.

The mineral acids have a local chemical action of corroding and destroying the tissues they come into contact with, but have no remote effects on the system.

They act as irritants, when slightly diluted, but act as stimulants, when well diluted and given in the pharmacopœial doses.

Cases of poisoning by corrosives are rare in India, but are more frequent in Europe. They are very rarely used for homicidal purposes, though sometimes cases are met with in which corrosives are thrown on the face out of jealousy or in fits of rage. Accidental cases of swallowing the acids in mistake for some other harmless medicine do occur especially among children. Occasionally a cooly while carrying a jar containing some concentrated mineral acid may accidentally fall down, and break the jar so as to spill the acid which may affect him, as also the passers-by.

A few suicidal cases also occur.

General Symptoms.—The symptoms supervene in the act of swallowing the poison or immediately after taking it. There is intense burning pain in the mouth and œsophagus, extending down to the stomach. The pain is attended with frothy eructations and vomiting of a brownish or blackish matter containing blood, mucus and shreds of mucous membrane. The ejected matter has an intensely acid reaction, stains clothes on which it falls, and effervesces when it comes into contact with the alkaline ground.

Sometimes, when the quantity ingested is very large, the

whole surface of the stomach becomes corroded. In such a case no vomiting occurs, as the stomach is unable to expel its contents.

The thirst is intense, but it cannot be appeased owing to great pain and difficulty in swallowing.

The lips and angles of the mouth become shrivelled, excoriated and blistered with a continuous flow of saliva containing mucus, blood and detached pieces of the corroded mucous membrane, unless the poison has been poured down into the back of the throat by means of a spoon or tube. Sometimes the mucous membrane may become loose, and fall out of the mouth.

The voice becomes hoarse and husky, and articulation becomes painful and difficult. There is also difficulty in breathing due to the tumefaction of the larynx.

The bowels are constipated, though usually there is tenesmus. Rarely there may be loose motions containing altered blood, and shreds of mucous membrane. The urine is scanty or suppressed. There may be difficulty and pain in micturition.

The pupils are frequently dilated, the eyes looking wild and sunk.

There is a general condition of collapse. The skin is cold and clammy, the pulse slow and feeble, but the mind remains clear till death.

Death occurs within a few hours from shock or spasm of the glottis, and within twenty-four hours from collapse due to perforation of the stomach and peritonitis.

If death does not occur within twenty-four hours, reaction may set in, when the pulse becomes full, with a rise of temperature. The process of separation of the sloughs and reparation will follow. Usually death occurs towards the end of the first week from septic absorption, or it may occur after months or years from exhaustion and malnutrition owing to starvation resulting from cicatrization and stenosis of

the œsophagus or of the pylorus, and an incurable dyspepsia due to destruction of the coats of the stomach.

Treatment.—The stomach tube and emetics must never be used. The poison should be neutralized in *situ* by administering carbonate of sodium, carbonate of magnesia or calcined magnesia, mixed with water, or milk and water. But as these are not likely to be at hand, chalk, wall plaster, milk, oil, or soap solution should be given without delay, and should be followed by demulcent drinks, such as barley water, linseed tea, etc.

Pain should be relieved by hypodermic injections of morphia. Neutrient enemata should be given to keep up the strength of the patient. Excoriations on the surface must be treated as burns.

Post-Mortem Appearances.—The conditions found after death depend on the quantity and the strength of the poison used, and the time that the patient survives after taking the poison. If death has occurred in a short time, there will be the signs of corrosion and destruction of the mouth, throat, œsophagus and stomach varying from a few localised patches to extensive destruction. There may be perforation of the stomach with the escape of its contents into the peritoneal cavity, and consequent destruction of the peritoneum and abdominal organs. The tissues beyond the corroded area show the signs of inflammation.

If the patient lived for some days, the signs of repair due to separation of the sloughs will be evident, and the cicatricial tissue will be noticeable, if death did not occur for a very long time.

The marks of corrosion may also be noticed on the skin and clothes.

SULPHURIC ACID (OIL OF VITRIOL) H_2SO_4.

This acid is very largely used commercially in several trades Hence it may be taken easily by workers for suicidal

purposes. Accidental cases have occurred from it having been mistaken for castor oil, glycerine or syrup. It has been used accidentally as an enema, and has been used as a criminal abortifacient.

Vitriol Throwing.—Malicious persons occasionally resort to sulphuric acid to disfigure the face or ruin the clothes by throwing a quantity of it at the hated person.

Properties.—It is a colourless, heavy liquid, which emits no fumes when exposed to the air. When mixed with water it evolves much heat, and is reduced in volume. It chars and blackens the skin, cloth and any other organic matter. The portion of the cloth or paper which comes into contact with the acid is destroyed leaving a reddish brown stain which is usually moist. Similarly the stain on the wood is damp black owing to its charring effect.

Special Symptoms.—In addition to the general symptoms of corrosive poisoning, sulphuric acid sometimes produces diarrhœtic motions containing altered blood, and detached pieces of mucous membrane. Salivation has been observed on the second or third day. In rare cases delay has been caused in the appearance of the symptoms.

The sulphate of indigo produces almost the identical symptoms except that the mouth, vomited matter and urine are coloured blue.

Fatal Dose.—Twenty drops have caused the death of a child one year old. The smallest fatal dose for an adult is one dram, though recovery has followed an ounce of the strong acid.

Fatal Period.—The average fatal period is from eighteen to twenty-four hours. The smallest recorded period is three-quarters of an hour, the longest being forty-five weeks. In children death may ensue instantaneously from suffocation due to the spasmodic closure of the glottis on account of the poison getting into the larynx.

Post-Mortem Appearances.—These are the usual appearances of corrosive poisoning. The lips and sometimes the surrounding skin show brownish corroded areas. The mucous membrane is dark brown or black. There is great disorganization and blackening of the stomach, and its perforation is more frequent. Fatty changes are observed in the liver and kidneys. The coagulated blood is found in the blood vessels.

Chemical Analysis.—The acid can be separated from the organic mixture by filtering, or it has to be separated by dialysis, and the following tests have to be applied for its identification :—

Tests.—1. The strong acid chars wood, while the dilute acid chars a blotting paper especially when heated. 2. Barium nitrate or chloride solution produces a white precipitate, insoluble in hydrochloric acid. 3. If heated with copper filings, mercury or chips of wood, sulphurous acid gas is evolved. 4 On heating and evaporating with veratrine on a porcelain dish, a crimson deposit is obtained.

Stains on Clothing.—The stained cloth should be soaked in alcohol, and the tests applied to the alcoholic solution.

NITRIC ACID (AUQA FORTIS, FUMING SPIRITS OF NITRE), HNO_3.

This is largely used for cleaning nickel ornaments and separating gold from other metals. Cases of poisoning, however, from nitric acid have been very rare.

Properties.—It is a colourless heavy liquid with a penetrating odour. It becomes yellow on standing for sometime. It readily oxidizes organic matter.

Special Symptoms.—The mouth, lips, skin and cloth, which come into direct contact with the acid, become intensely yellow due to the formation of xanthoproteic acid. The

colour of the blood contained in the vomit is yellowish brown. Gaseous eructations are more frequent, and distressing in this poison. The abdomen is more distended and tender. Lock jaw and insensibility are known to have occurred as special symptoms. Injection of nitric acid into the ear has caused death.

The fumes of nitric acid produce irritation of the eyes, cough, and dyspnœa, and may cause death immediately from suffocation, or later from pneumonia.

Fatal Dose—Two drams in the case of adults, but a much smaller quantity will suffice to kill a child from suffocation. Recovery has taken place after half an ounce or more.

Fatal Period.—The average fatal period is from twelve to twenty-four hours. The smallest recorded period is one hour and forty-five minutes, while the longest recorded periods are eight months and two years.

Post-Mortem Appearances.—The skin and mucous membrane are yellow in colour, but the colour of the mucous membrane is greenish, if bile is present. The stomach wall is soft, friable and ulcerated, but perforation is not so common as in sulphuric acid poisoning. There may be corrosion of the duodenum.

Chemical Tests.—1. If a strong ferrous sulphate solution and sulphuric acid are added to a solution containing nitric acid, a brown ring is formed at the junction of the two fluids.

2. Nitric acid forms a blood red colour with brucine and rich orange with morphine.

3. When heated with strong sulphuric acid and copper, reddish brown fumes of nitric oxide are given off, and the solution becomes green.

4. If caustic potash is added to a nitric acid stain on the cloth, the yellow colour changes to orange. The colour

disappears, if caused by iodine, but no change occurs on a stain caused by bile.

HYDROCHLORIC ACID (MURIATIC ACID, SPIRITS OF SALT), HCl.

This acid has been used sometimes for erasing writing from paper in attempts at forgery.

Properties.—It is almost colourless when fresh, but is yellow when old. It gives off fumes, when exposed to the air. The commercial acid not infrequently contains a trace of arsenic, derived from sulphuric acid used in generating it.

Special Symptoms.—It is less active than the other two acids. Hence its symptoms are much milder. It does not stain the skin or mucous membrane, but stains dark cloth reddish brown. Salivation, convulsions, delirium and paralysis of the limbs have occurred as special symptoms in some cases.

The fumes of the acid cause great irritation of the air passages.

Fatal Dose.—Four drams are the usual fatal dose. The smallest dose that has proved fatal in a girl 15 years old is one dram. Recovery has taken place after swallowing one ounce and-a-half.

Fatal Period.—The usual fatal period is from eighteen to thirty hours. The smallest period is two hours. Death has been delayed for several days.

Post-Mortem Appearances.—The mucous membranes acted on by the acid are usually ashy-grey, or black interspersed with erosions. The stomach wall is red owing to acute gastritis. Perforation is very rare indeed.

Chemical Analysis.—It should be remembered that this acid is found in a free state to an extent of 0.2 % or more in the gastric juice. Hence the detection of a minute quantity in the stomach contents is no proof of poisoning by this acid, unless distinct marks of its chemical action are seen on

the throat and stomach. It may be recovered from vomit by distillation, and should then be tested by the following tests :—

1. A solution of silver nitrate produces a heavy, curdy, white precipitate of silver chloride insoluble in excess or nitric acid, but soluble in ammonia. The white precipitate becomes grey on exposure to sunlight.

2. If heated with manganese dioxide, chlorine gas is evolved, known from its greenish yellow colour, irritating smell and bleaching action on vegetable colouring matter.

3. When brought near ammonia, white fumes of ammonium chloride are given off.

HYDROFLUORIC ACID, HF.

This is a colourless gas, which becomes a fuming liquid, when dissolved in water. On account of its etching property on glass it is kept in gutta-percha bottles.

Acute Poisoning-Symptoms.—The fumes of the gas, when inhaled, may cause death from their corrosive power. The liquid acid produces painful wounds by corroding the parts with which it comes into contact. When taken internally, it immediately produces retching and vomiting. The patient is in great agony, collapse sets in and death occurs usually from closure of the glottis with the shreds of mucous membrane.

Fatal Dose.—One to four drams.

Fatal Period.—Thirty-five minutes to one hour.

Treatment.—Ammonia vapour is the antidote, when the fumes are inhaled. Weak alkalies should be administered to neutralize the liquid acid, when taken internally.

Post-Mortem Appearances.—The lips, tongue and mouth may show white patches or may be charred. The œsophagus may show shreds of the denuded epithelium. The mucous membrane of the stomach may be ecchymosed or blackened, but not eroded. The trachea, lungs and other organs are hyperæmic.

Chronic Poisoning.—This occurs from taking beer for a long time, to which sodium fluoride is added as a preservative. The symptoms as described by Holland are neuralgia, weak heart, dropsies, painful urination, and loss of calcium salts from the system, impairing nutrition of the bones.

II. ORGANIC ACIDS.

OXALIC ACID (ACID OF SUGAR), $H_2C_2O_4\ 2H_2O$.

Oxalic acid is largely used in calico printing in the manufacture of straw hats, and in cleaning brass and copper articles, and wooden surfaces. It is also used for removing ink stains and iron moulds from linen, and for removing writing and signatures from paper and parchment documents.

In the form of an oxalate of ammonium, sodium, potassium or calcium, it exists as a natural constituent of several plants and vegetables, such as sorrel, rhubarb, cabbages, lichens and guano.

Properties.—The acid occurs in the form of colourless, transparent, prismatic crystals, and resembles in appearance the crystals of magnesium sulphate and zinc sulphate for which it is sometimes mistaken. The following are the distinguishing tests by which they can be recognised :—

	Oxalic Acid.	Magnesium sulphate.	Zinc sulphate.
Taste.	Sour and acid.	Nauseating bitter.	Metallic bitter.
Reaction.	Strongly acid.	Neutral.	Slightly acid.
Heat.	Sublimes.	Fixed.	Fixed.
Sodium Carbonate.	Effervesces, but no ppt.	No effervescence but a white ppt.	No effervescence but a white ppt.
Stains of ink, or iron moulds.	Disappear.	No action.	No action.

It is soluble in ten parts of cold water and in two and a half parts of alcohol, but very sparingly in ether. It volatilizes completely at 150° without leaving any residue. When heated with strong sulphuric acid it splits up into carbon dioxide, carbon monoxide and water.

Symptoms.—It has both a local and remote action on

the system. The acid acts locally as corrosive when administered in a large quantity and in a solid or concentrated form, but, when taken in weaker solutions or in combination, acts locally as irritant and the nervous symptoms are more evident. It also acts as a poison when applied to a wound.

The symptoms begin immediately or soon after taking a large dose of the concentrated acid. These are very sour acrid taste, thirst, pain and burning in the mouth, throat and stomach, extending over the whole abdomen. Vomiting soon sets in. It very often persists till death. The ejected matter contains altered blood and mucus, and appears greenish brown or black, resembling coffee grounds. Tenesmus is present, but purging is rare unless the case is prolonged for sometime. Great prostration occurs with cold, clammy skin, a feeling of numbness of the limbs, feeble, irregular and rapid pulse, and shallow gasping hurried respirations. The condition of collapse passes into coma, which ultimately ends in death. Sometimes cramps, convulsions, lock jaw and delirium precede death.

Fatal Dose.—The average fatal dose is four drams. The smallest recorded fatal dose is one dram. Recovery has occurred after a dose of one and-a-half ounces.

Fatal Period.—The shortest recorded periods are three minutes in one case, and ten in another. The usual period is one to two hours. Death may be delayed for several days, the longest period known being twenty-one days.

Treatment.—Chalk, calcined magnesia, whitewashing or the plaster of a wall in a small quantity of water or milk. A saccharated solution of lime is considered the best form of treatment. Alkalies and their carbonates must not be administered as they unite with oxalic acid, and form soluble poisonous salts. Large draughts of water should also be avoided as they dissolve the poison, and thus increase its rapid absorption.

After the acid is neutralized in the stomach, vomiting may be promoted by emetics, and the bowels may be relieved by an enema or by a purgative, preferably castor oil. The usual symptomatic treatment must then be followed.

Post-Mortem Appearances.—If the acid has been taken in a concentrated form, marked signs of corrosion are found in the mouth, throat, œsophagus and stomach. Their mucous membranes are white and shrivelled, and are easily detached from the underlying tissues. Besides, the mucous membrane of the œsophagus is corrugated and shows longitudinal erosions. The stomach contains a dark-brown, grumous liquid, acid in reaction. Perforation of the stomach is rare, though the walls are very often softened and easily torn. The stomach may be pale and not corroded, if death has occurred immediately after taking the poison. The intestines generally escape, but the upper part of the duodenum may be affected.

The kidneys are congested and loaded with oxalates.

If the acid is very diluted, there will be the signs of local irritation, viz., redness, congestion and inflammation of the mucous membrane.

If the effects are only narcotic, there will be congestion of the lungs, liver, kidneys and brain, without any local appearances.

Chemical Analysis.—To separate the acid, the organic mixture may be dialysed, or it may be boiled and filtered. To the filtrate is added acetate of lead, when a precipitate of lead oxalate is formed. The precipitate is washed with water and in the watery solution a current of hydrogen sulphide is passed for about half an hour, so that a precipitate of black lead sulphide is thrown down. The black precipitate is now filtered, the filtrate is heated to remove any excess of hydrogen sulphide and is evaporated to dryness, when the crystals of oxalic acid are found which can be tested

by dissolving them in water. There is yet a third method by which the organic mixture is evaporated, and extracted with alcohol acidified with a little hydrochloric acid. The alcoholic solution is then evaporated to dryness, and the residue is dissolved in water to apply the tests for oxalic acid.

Tests.—1. A solution of barium nitrate gives a white precipitate of barium oxalate, soluble in hydrochloric acid or nitric acid without effervescence.

2. A solution of silver nitrate gives a copious white precipitate soluble in ammonia and nitric acid.

3. Calcium chloride or sulphate gives a white precipitate insoluble in acetic acid, but soluble in strong hydrochloric acid.

4. Lead acetate gives a white precipitate soluble in nitric acid, but insoluble in acetic acid.

Medico-Legal Questions.—Oxalic acid has been accidentally swallowed in mistake for a saline purgative of magnesium sulphate. Suicidal cases, though rare in India, have been frequent in Europe. Owing to its taste it has rarely been used for homicidal purposes.

Binoxalate of Potash, $KHC_2O_4, 2H_2O$—This is commercially known as "salts of sorrel" or "essential salts of lemon," and is used for the same purpose as oxalic acid. It is practically as poisonous as the acid itself producing almost the same symptoms. Half an ounce has caused death in eight minutes, though recovery has been recorded after a larger dose.

CARBOLIC ACID (PHENOL, PHENYL ALCOHOL OR PHENIC ACID), C_6H_5OH.

This is obtained from coal tar oil by fractional distillation, and is commonly prepared from acetylene by synthesis.

Pure carbolic acid occurs as long, colourless, prismatic, needle-like crystals, which turn pink on exposure to light, and are deliquescent in moist air. It has a peculiar tarry odour,

and has a burning sweetish taste. It is slightly soluble in cold water, (1 in 14), but freely in boiling water, alcohol, ether, fats and oils. To all these it communicates its characteristic odour.

The crude carbolic acid of commerce is a dark-brown liquid containing several impurities, chiefly cresol.

Poisoning from carbolic acid is known as *carbolism*. The acid acts locally as a corrosive, and remotely as a narcotic.

Symptoms.—Immediately after swallowing the concentrated acid, there is a burning pain in the mouth, throat and stomach, with occasional vomiting. The mucous membranes of the lips and mouth become hard and white. Owing to the rapid absorption of the acid these symptoms are soon followed by giddiness and insensibility, which soon deepens into coma. The lips are livid, the pupils are contracted, the skin is cold and clammy, the pulse is small and thready, and the respirations are slow, laboured or stertorous. Convulsions and lock jaw may be present. The urine is suppressed or scanty. When voided, it is normal in colour, or of a greenish hue, which becomes dark or olive green on exposure to the air, and stains the linen as well. This change of colour is due to the formation of hydroquinone, an oxidation product of carbolic acid, and serves as a warning of the toxic properties of the acid, when used as an antiseptic dressing for some time. This symptom is known as carboluria.

Fatal Dose.—Four drams are the average fatal dose, though an oily solution of one dram has proved fatal. A quarter of a tea-spoonful dissolved in glycerine killed a child six months old. Recoveries have ensued after large doses, as much as four ounces.

Fatal Period.—The usual fatal period is two to four hours. The shortest recorded period is three minutes. Death may be delayed to ten or twelve days.

Treatment.—Ordinary emetics have no action owing to the local anæsthesia. Oils should not be given, as they increase the diffusion of the poison. Pass the soft stomach tube with caution, and wash out the stomach with luke-warm water containing syrup calcis or sodium sulphate, until the contents of the stomach lose their peculiar odour. Sodium sulphate forms the harmless sodium sulphocarbolate. Alcohol is reputed to be a chemical and physiological antidote; hence the stomach should also be washed with equal quantities of alcohol and water. Whisky or any spirit will do, if absolute alcohol is not available. Give demulcents, such as white of eggs and milk. Give atropine sulphate hypodermically, before you administer stimulants. Keep up the external warmth. Carry on artificial respiration, if necessary.

Post-Mortem Appearances.—White or pale yellow staining may be seen on the angles of the mouth and on the chin. The mucous membranes of the lips, mouth and throat are corrugated, sodden, whitened or ash-grey, and partially detached, marked by numerous small submucous hæmorrhages.

The mucous membrane of the œsophagus is tough, white or grey, corrugated and arranged in longitudinal folds.

The stomach is brown and leathery with hæmorrhagic spots and prominent rugæ, or it is sometimes soft and grey in colour. It may contain a reddish fluid mixed with mucus and shreds of epithelium, emiting an odour of carbolic acid. The same changes are observed in the duodenum. The kidneys show hæmorrhagic nephritis in cases of delayed death. The lungs are congested and œdematous. The brain is congested. Blood is dark, and semifluid, or only partially coagulated.

Chemical Tests.—1. *Landolt's Test.*—Bromine water

produces a whitish yellow precipitate of tribromo-phenol which, when treated with an alcoholic solution of sodium amalgam, yields free carbolic acid.

2. Ferric chloride gives a purple or violet blue colour.

3. Heated with ammonia and calcium chloride it yields a blue colouration, which becomes red or yellow on the addition of an acid.

4. *Millon's Test.*—Acid nitrate of mercury gives a bright red or orange red colour. The same result is obtained, if mercury salt is treated with cresol, salicylic acid and hydroquinone.

Medico-Legal Points.—Carbolic acid is largely used as an antiseptic, and as a disinfectant. Owing to it being easily procurable, several cases of accidental and suicidal poisoning have occurred. On account of its characteristic smell it has been very rarely used as a homicide, though it has been sometimes used for the murder of infants. It has also caused death, when used as an abortifacient by injection into the vagina or uterus.

Poisonous symptoms have occurred from swallowing it, from its application to the skin, from injection into an abscess cavity or rectum, as also from the inhalation of its vapour.

Carbolic acid coagulates albumen, and causes necrosis of the tissues with which it comes into contact.

It is eliminated from the system by the kidneys, lungs, salivary glands and liver. It is also eliminated by the stomach, when introduced into the system by means other than the mouth.

It occurs in traces in the urine in the form of phenolsulphonate of potassium, derived from the protein of the body.

Cresol, Creolin (a constituent of Jeye's disinfecting fluid), lysol and izal are all similar in action to carbolic acid,

but they are believed to be less toxic. Several cases of suicide by lysol occur every year, chiefly in Germany.

CREASOTE.

This is obtained from wood tar by destructive distillation, and consists chiefly of guiacol, cresol, and other phenols. It is an oily liquid of burning taste and of very peculiar odour. It is colourless when fresh, but brown on exposure to light. It is slightly soluble in water, but freely in alcohol, ether and glacial acetic acid.

It acts much in the same way as carbolic acid, but it does not give a dark colour to the urine. The chief symptoms are a local corrosive action on the lips and mouth, burning pain in the stomach, nausea, vomiting, diarrhœa, insensibility and convulsions. Fatal cases are rare. Two drams killed an aged woman in thirty-six hours, and twenty-four to thirty drops killed an infant ten days old. Toleration for large doses is established by its continued use.

Treatment is the same as for carbolic acid.

Chemical Test.—Ferric chloride gives a green and brown colour discharged by water.

PICRIC ACID (CARBAZOTIC ACID, TRINITRO-PHENOL), $C_6H_2(No_2)_3HO$.

This is obtained by the action of strong nitric acid on phenol. It exists as yellow crystalline prisms or plates, and explodes under the action of heat or percussion. It is slightly soluble in water, but freely in alcohol. It has no odour, but has a bitter taste, and consequently has been used as a substitute for hops in beer. It is used as a yellow dye for silk and wool.

Poisonous symptoms have resulted from taking it internally, and from the local application of its saturated solution for burns. No fatal case has yet been recorded.

Symptoms.—Pain in the stomach ; severe vomiting of yellow matter ; diarrhœa with yellow stools ; fever ; erythematous rash on the skin, which becomes dark yellow or brown ; dilated pupils ; the urine becomes ruby red in colour without the presence of bile due to picraminic acid ; rapid pulse ; muscular cramps ; drowsiness ; delirium ; stupor and collapse.

It is eliminated in the urine and fæces.

Fatal Dose.—Poisoning has followed thirty grains, but recovery has ensued after a dose of 90 grains.

Treatment. - Wash out the stomach ; Give diuretics and purgatives. Administer morphine to relieve pain. The antidotes are proteins as found in raw eggs and milk.

Chemical Tests.—Ammonio-sulphate of copper produces a green precipitate.

When an aqueous solution of it is warmed with potassium cyanide, a blood-red colouration is produced.

SALICYLIC ACID, $C_7H_6O_3$.

This is prepared by the interaction of sodium carbolate and carbonic acid. It may also be obtained from natural salicylates contained in *gaultheria* and sweet *birch*. It is an odourless crystalline solid, sweetish and acrid in taste, sparingly soluble in cold water (1 in 500), but readily in hot water, alcohol or ether.

Accidental cases of poisoning occur from an over-dose when given in medicine, and from its widespread use in preserving food and liquors.

Symptoms.—These are burning pain in the throat and stomach, difficulty of swallowing, thirst, nausea ; vomiting ; diarrhœa ; headache ; noises in the ears ; flushing of the face ; profuse perspiration ; cold moist skin ; slow, weak, irregular pulse ; confused mind ; delirium ; insensibility and coma. Hæmorrhages occur from the mucous membranes ; *e.g.*, epistaxis, bleeding from the gums, retinal hæmorrhages causing amblyopia, and bleeding from the kidneys giving rise to hæmaturia. Death occurs from the stoppage of the heart or respiration.

Chronic Poisoning.—When minute quantities are taken daily in food, appetite suffers, digestion is impaired, diarrhœa alternates with constipation, eczematous eruptions appear on the skin, the mind is depressed and the urine may be albuminous.

Fatal Dose and Fatal Period.—One ounce has caused death in four days. A less quantity would prove fatal, if the heart or kidneys were diseased.

Treatment.—Emetics, lavage, raw eggs, warmth and stimulants.

Tests.—Ferric chloride gives a violet colour, which disappears on the addition of acetic acid, but the colour yielded by carbolic acid to ferric chloride is permanent.

ACETIC ACID, $C_2H_4O_2$.

This acid occurs in nature in combination with alcohols in the essences of many plants, and is formed during the decay of certain organic substances. It is prepared on the large scale from pyroligneous acid obtained in the distillation of wood.

It acts as a corrosive in the concentrated form, known as glacial acetic acid, but acts merely as an irritant when diluted. Vinegar (*Sirka*), which contains four to five per cent. of acetic acid may cause poisonous symptoms, when taken in a large quantity. Vinegar and acetic acid contain traces of sulphuric acid as an impurity.

Symptoms.—The mucous membrane of the mouth, tongue and other parts of the body, with which the acid comes into contact, are softened and present the appearance of a yellowish white colour. There is intense pain extending from the mouth to the stomach. The other symptoms are vomiting, convulsions, irritable cough and collapse. Symptoms of suffocation are usually more marked, as the acid being volatile affects the larynx and lungs during the act of swallowing.

Fatal Dose.—One dram of the concentrated acid has caused the death of a child, but recovery has been recorded in an adult after taking six fluid ounces.

Fatal Period.—Rapid though variable.

Treatment.—Neutralize the acid by giving magnesia, and then produce emesis by giving emetics. Give demulcents, and allay pain by hypodermic injections of morphia. Laryngeal symptoms may be treated by the application of cold compresses to the throat and by giving the patient pieces of ice to suck. Tracheotomy may be performed, if necessary.

Post-Mortem Appearances.—Erosion or corrosion of the mucous membrane of the mouth, œsophagus and stomach and intestines with ecchymosed patches.

Chemical Analysis.—Acetic acid may be separated from organic mixtures by distillation. If combined, it should be liberated by adding phosphoric acid.

Tests.—It is recognised by its characteristic odour. When heated with alcohol and sulphuric acid, acetic ether (ethylacetate) is formed, which is known by its peculiar aromatic smell.

Ferric chloride added fo its solution, after it is neutralized with ammonia, produces a deep red colour which, when boiled, changes to a red-brown precipitate of ferric subacetate.

TARTARIC ACID, $C_4H_6O_6$.

This acid is a constituent of a large number of plants, and occurs in many fruits, especially grapes. Ordinarily it is not regarded as a poison, but in large doses may act as a poison. A few severe and fatal cases of poisoning have been recorded.

Symptoms.—These are more of a strongly irritant nature than corrosive. There is burning sensation in the throat and stomach, followed by vomiting and diarrhœa. Death may occur from exhaustion.

Fatal Dose.—Two teaspoonfuls in a concentrated solution proved fatal in one case, and one ounce in another.

Fatal Period.—Seven days in one and nine days in another.

Treatment.—Neutralize the acid by giving soda and magnesia. Give astringents and opium.

Post-Mortem Appearances.—Erosions of the mucous membrane of the œsophagus, and inflammation of the greater part of the alimentary canal.

Chemical Analysis.—Tartaric acid forms large transparent crystal, and is readily soluble in water and alcohol, but reasonably in ether. Calcium chloride yields a white precipitate. Boiling darkens tartrates, and potassium permanganate decolorizes them.

CITRIC ACID, $C_6H_8O_7$.

This acid is found free in the juice of the lemon, orange and many other sour fruits. It is prepared by boiling lemon juice and neutralizing with calcium carbonate. It is supposed to be more poisonous than tartaric acid, but no case of poisoning has yet been recorded.

Tests.—Calcium chloride yields a white precipitate. Boiling has no effect on citrates, but potassium permanganate turns them green.

III. ALKALIES.

Like acids, they act as corrosive poisons, when administered in a concentrated form, but act as irritants, when dilute.

Poisoning by alkalies is very rare. If it occurs at all, it is only accidental.

The hydroxides and carbonates of alkalies which act as corrosives are the following :—

1. **Ammonia (Hartshorn)**, NH_3.—Gaseous ammonia, when dissolved in water forms a strong solution of ammonia (Liquor Ammoniæ Fortis) known as spirits of Hartshorn. It is a colourless liquid, having a very pungent odour, and alkaline reaction. The solution is largely employed for domestic purposes, such as washing of clothes, paint, etc. When freshly prepared, the gas is freely given off, and serious poisonous symptoms have occurred from its inhalation, when large ammonia jars or ammonia refrigerators in factories have burst.

2. **Potassium Hydroxide (Caustic Potash)**, *KHO*.—This is usually met with as hard, deliquescent white pencils. It is soapy to the touch, acrid to the taste, rapidly absorbs carbon dioxide from the air, and is very soluble in water. Its solution is known as liquor-potassæ, which has also a soapy feel, and strong alkaline reaction.

3. **Sodium Hydroxide (Caustic Soda)**, *NaHO*.—This occurs as white deliquescent sticks. It is strongly caustic and when dissolved in water, forms a solution, known as liquor sodiæ. It is largely employed in manufactures, but cases of poisoning are rarely met with.

4. **Ammonium Carbonate (Sal Volatile)**, $(NH_4)_2 CO_3$.—This occurs as a white fibrous mass, or as translucent crystalline cakes. Commercial ammonium carbonate is a mixture of hydrogen ammonium carbonate and ammonium carbonate, and smells strongly ammoniacal.

5. **Potassium Carbonate (Pearl Ash**, *Javakhar*), K_2CO_3.—This salt occurs as a white crystalline powder, having a caustic taste. It is highly deliquescent, and very soluble in water. It is used for washing and other cleansing purposes.

6. **Sodium Carbonate (Soda, Washing Soda**, *Sajjikhara*), Na_2CO_3.—This occurs as large, transparent, monosymmetic crystals. When exposed to the air the crystals

soon effloresce, and become white on the surface. They are soluble in water. The impure combined carbonates of sodium and potassium are sold in the bazar as *papad khara*. A mixture of caustic soda and sodium carbonate, known as soap lye is used for washing purposes.

Symptoms.—The usual symptoms of corrosive poisons are present, with the following exceptions :—

1. The taste is acrid and soapy.

2. The vomited matter is alkaline, and does not effervesce on coming into contact with the earth. It is at first thick and slimy and later, contains dark altered blood, and shreds of mucous membrane from the gullet and stomach.

3. Purging, which is rare in corrosive acids, is a frequent symptom, accompanied by severe pain and straining. The motion consists of stringy mucus mixed with blood.

The ammoniacal vapour is very irritating to the respiratory organs. When inhaled it produces congestion and watering of the eyes, running of the nose, and a feeling of suffocation. Death may occur immediately from suffocation due to inflammation of the glottis, or later from pneumonia or broncho-pneumonia.

Fatal Dose.—The average fatal dose of ammonia, and of caustic potash and soda is half an ounce. The smallest fatal dose of liquor ammonii fortis is one fluid dram, and that of caustic potash is forty grains. Half an ounce of carbonate of potash is regarded as a fatal dose. The fatal dose of carbonate of sodium is not certain. It is much less poisonous than potassium carbonate. Recovery has occurred even after a dose of twelve ounces of sodium carbonate.

Fatal Period—Usually within twenty-four hours. Ammonia vapours have caused death in four minutes, and potassium carbonate in three hours. Sometimes death may occur after weeks or months, or even after two or three years from inanition and starvation due to the œsophageal stricture.

Treatment.—Neutralize the poison by acids, chiefly vegetable, viz., acetic (vinegar), citric (lemon juice) and tartaric acids mixed with a large quantity of water. These should be followed by olive oil, white of egg, and acidulated demulcent drinks. Pieces of ice should be given to suck. Cold should be applied to the abdomen. Opium may be given hypodermically to relieve pain, and ether to counteract the effects of collapse.

The œsophageal stricture should be dilated by means of a bougie, or it may be necessary to perform œsophagostomy or gastrostomy.

In poisoning by ammonia vapour give oxygen inhalation, or keep the patient in an atmosphere rendered moist with steam. Anodynes may be given for pain.

Post-Mortem Appearances.—These indicate marks of corrosion, but not so well-marked as in the mineral acids. The mucous membrane of the mouth, throat, gullet, stomach and duodenum is softened, exfoliated and inflamed in patches of chocolate or black colour. The contents of the stomach are turbid, usually blood stained, but frequently coffee coloured. Its perforation is rare, but may occur in ammonia poisoning. The deeper tissues are inflamed and congested.

The mucous membrane of the larynx and trachea shows the same appearances as are found in the mouth, throat, etc. In protracted cases of poisoning stenosis is found more often at the lower end of the œsophagus than at the pyloric.

Chemical Analysis.—The contents of the stomach are alkaline in reaction and soapy to the feel. Ammonia may be separated from organic mixtures by distillation, and other alkalies may be separated by dialysis or by incinerating them in a porcelain capsule to drive off animal and vegetable matter. The residual ash is then dissolved in acidulated

water, and tested for the presence of sodium and potassium as given in the following table :—

Reagents.	Ammonium.	Potassium.	Sodium.
1. Caustic potash and heat.	Ammonia gas is given off known by its odour, by its turning red litmus paper blue and by giving rise to white fumes of ammonium chloride when a glass rod wet with hydrochloric acid is brought into contact with it.	Nil.	Nil.
2. Nessler's reagent.	Brown precipitate.	Nil.	Nil.
3. Tartaric acid (strong) and alcohol.	Nil.	White crystalline precipitate.	Nil.
4. Platinic chloride.	Nil.	Yellow crystalline precipitate.	Nil.
5. Flame test.	Nil.	Violet.	Yellow.

The caustic alkalies give a brown precipitate with silver nitrate ; while their carbonates give a whitish yellow precipitate and effervesce on the addition of an acid.

Ammonia is formed during putrefaction. Hence its detection is of no consequence, unless analysis is undertaken immediately after death, when the body is still fresh.

POTASSIUM PERMANGANATE, $KMNO_4$.

This salt is a powerful oxidizing agent for almost all organic substances, and is destructive to the low organism of infectious deseases. Condy's fluid contains 2 per cent. of permanganate and Darby's fluid also contains it. Poisoning by it is very rare, but a few accidental cases have lately been recorded.

Symptoms.—These are burning pain in the mouth, throat and stomach, spreading over the whole abdomen, intense thirst, difficulty in swallowing, almost continuous vomiting and difficult breathing. The salt corrodes the tongue and pharynx, and stains the parts black or dark brown. Death occurs from paralysis of the heart.

Fatal Dose.—225 or 300 grains have caused death. A "handful" has caused the death of a woman aged 47 years. One and two grains have caused alarming symptoms.

Fatal Period.—Thirty-five minutes in one case, and five hours in the other.

Treatment.—Usually there is not much corrosion of the stomach, and hence it may be lavaged. Treat the symptoms on the general lines.

Post-Mortem Appearances.—Signs of corrosion if a strongly concentrated solution of the salt is taken. The mouth, pharynx and œsophagus are very often corroded and blackened. The parts that escape corrosion are usually congested and inflamed. Œdema of the glottis and inflammation of the larynx and trachea have been observed.

Tests for Manganese.—Ammonium sulphide produces a flesh-coloured precipitate soluble in acids. Ammonia or caustic soda yields a white precipitate, which becomes brown on exposure to air, and dissolves pink in oxalic acid.

CHAPTER XXIV.

IRRITANT POISONS.

Irritant poisons are those which, by their specific action, set up inflammation in the gastro-intestinal canal.

General Symptoms.—Symptoms are delayed from half an hour to an hour or more. These are burning pain, difficulty in swallowing, and feeling of constriction in the throat and œsophagus, severe pain in the stomach, intense thirst, nausea and violent, persistent vomiting. The vomited matter at first contains food, then becomes bilious and lastly contains altered blood. There is purging accompanied by tenesmus and pain, and tenderness over the abdomen ; the stools may contain mucus and blood. There is dysuria. Collapse sets in, when the skin is cold and clammy, and the pulse is quick, feeble and intermittent. Cramps also occur in the legs. Sometimes convulsions may occur before death, which may take place at once from shock, or from exhaustion in one to four days.

If the patient survives for some time, reaction sets in, and consequently the skin becomes hot and dry with a rise of temperature, but death may occur later from stricture of the œsophagus.

Diagnosis.—Irritant poisoning has to be diagonised from certain diseases, such as cholera, acute gastritis, acute gastro-intestinal catarrh, peritonitis, colic, and rupture of the stomach.

A. INORGANIC.

I. NON-METALLIC POISONS.

PHOSPHORUS.

There are two varieties of phosphorus ; viz., *yellow crystalline* and *red amorphous*. The yellow variety is poisonous,

and is used in preparing vermin paste for the destruction of rats and other vermin. This paste contains three to four per cent. of phosphorus mixed with flour, sugar and some pigment probably indigo. It is also used in the manufacture of lucifer matches, and enters into the composition with which these matches are dipped.

Red phosphorus is not poisonous, and is used in the manufacture of "safety" matches; phosphorus is combined with sulphide of antimony and potassium chlorate forming the layer on the box, on which the matches are struck.

Poisoning by phosphorus is very rare in India, but accidental cases among children have occurred from sucking the heads of lucifer matches.

In England phosphorus poisoning is usually suicidal. Pregnant women have very often been accidentally poisoned by phosphorus, as they take it to induce criminal abortion. It has seldom been used for homicidal purposes.

Symptoms.—In acute poisoning the symptoms may appear in a few minutes after swallowing a poisonous dose, but usually they are delayed for two to six hours. In one case the symptoms appeared on the fifth day after taking the poison.

The symptoms complained of by the patient are a garlic-like taste in the mouth, and burning pain in the throat and stomach, followed by intense thirst, nausea and vomiting. The ejected matter has the odour and luminosity of phosphorus and is coloured with bile, but later contains almost pure blood. The breath is also garlicky in odour and may, sometimes, be luminous in the dark. Diarrhœa is not a constant symptom but, when present, the motions are dark, offensive and sometimes phosphorescent just like the vomited matter. In rapidly fatal cases these symptoms become severe, collapse sets in, and the patient passes into a state of delirium or convulsions and coma. Death ensues in eight or ten hours.

In most cases, however, the symptoms abate, and there is a semblance of recovery. After a period of intermission lasting from two or six days, jaundice makes its appearance, and becomes well-marked. The pain in the stomach increases in severity, and the abdomen becomes distended. The liver is greatly enlarged and tender to touch, and so is the spleen. Vomiting is much more distressing. Diarrhœa is more severe. Both the vomited matter and the motions contain blood. There are also hæmorrhages from the nose and other mucous membranes, such as the urethra, vagina and uterus. Abortion occurs in a pregnant woman with alarming flooding. Subcutaneous hæmorrhages or purpuric spots may be present. The urine becomes very scanty, high coloured and strongly acid in reaction, containing albumen, blood and bile-pigments.

Nervous symptoms develop; *viz.*, frontal pains, restlessness, insomnia, singing in the ears, deafness, impaired vision, formication, cramps, tremors and paralysis. There is frequently priapism. The pulse becomes feeble, quick and irregular. Fever sets in, and a condition of stupor or coma supervenes ending in death. Sometimes convulsions or delirium precede death.

Fatal Dose.—One-eighth of a grain has caused death, but one and-a-half grains are an average lethal dose. A child is reported to have died from sucking the heads of two lucifer matches containing about one-fiftieth of a grain of phosphorus. Recovery has followed doses of four and six grains.

Fatal Period.—The shortest recorded fatal period is half an hour. Death usually takes place from two to seven days, but may be delayed for two to three weeks.

Treatment.—Wash the stomach with a solution of potassium permanganate of the strength of about 4 grains to one fluid ounce of water, and leave about a pint in the stomach. The stomach can also be washed with warm water,

until the smell of phosphorus disappears, and then with magnesia suspended in water or with milk of magnesia. Give two to three grain doses of copper sulphate every five minutes until free emesis is produced. It acts as an antidote, as it combines with phosphorus and forms an insoluble harmless salt, phosphide of copper. Oils and fats must never be given, for they dissolve phosphorus, but old unrectified turpentine (French turpentine) is recommended as an antidote. It is given in half-dram doses in mucilage every hour. It owes its action to the presence of oxygen in the form of ozone. If it cannot be obtained, the oxidizing agents, such as hydrogen peroxide and sanitas may be administered. Morphia may be given hypodermically to relieve pain, and to combat shock.

Post-Mortem Appearances.—Petechial hæmorrhages under the skin, which is usually yellow, are commonly found. On opening the cavities of the body a smell of garlic may be observed, but this is not possible in India owing to the rapid occurrence of the putrefactive changes. The mucous membranes of the stomach and intestines are yellowish or greyish white in colour, and are softened, thickened, inflamed and corroded, or completely destroyed in patches exhibiting even perforations. Their contents may be garlicky in odour, and luminous in the dark.

The liver presents the most characteristic appearances. It is very much enlarged, but may be of normal size or contracted. It is doughy in consistence, uniformly yellow, easily friable, and contains many hæmorrhagic spots in its substance. There is fatty degeneration of the liver-cells. In *acute yellow atrophy* the liver is smaller in size, greasy, leathery and of a dirty yellow colour. Its capsule is wrinkled. The liver-cells are mostly necrosed, and contain crystals of leucin and tyrosin.

The heart and kidneys show signs of fatty degeneration.

The blood is fluid and disorganized, the colouring matter of the hæmoglobin being dissolved in the liquor sanguines.

Chronic Poisoning.—This form of poisoning occurs among persons exposed to the white fumes resulting from the oxidation of yellow phosphorus in factories.

The symptoms are a sallow complexion, lassitude, pain in the abdomen, vomiting, diarrhœa and emaciation; but the chief characteristic symptoms are caries of the teeth and necrosis of the jaws, especially the lower jaw. It is supposed that the vapour of phosphorus gains access to the jaw (phossy jaw) through a carious tooth or an interspace caused by a missing tooth. Death occurs from debility, blood poisoning or pyogenic infection.

Pregnant women usually abort.

Treatment.—Advise thorough cleanliness and ventilation by the use of extraction fans in the match factories. The air of the work rooms may be saturated with turpentine. Teeth of the workmen should be occasionally examined, and carious teeth, if found, should be filled in or extracted. They should also be persuaded to use systematically mouth washes of sodium bicarbonate.

Chemical Analysis.—When death has not occurred for several days, phosphorus is not likely to be detected in the contents of the stomach or in the tissues, as it is radiply oxidized. In recent deaths it may be separated by distillation from organic mixtures, and may be detected by its smell and luminosity in the dark. Its phosphorescence is diminished by the presence of alcohol. Hence in cases of suspected phosphorus poisoning a saturated solution of common salt should be used, instead of alcohol as a preservative. It can also be separated by shaking the contents of the stomach, etc., with carbon bisulphide, which dissloves phosphorus.

Tests.—1. *Mitcherlick's Test.*—If the mixture is acidula-

ted with sulphuric acid and distilled, the luminous vapour of phosphorus will be seen in the cool condenser in the dark. This is a very delicate test, and will reveal 1 in 200,000.

2. *Lipowitz's Test.*—If pieces of sulphur are added to the mixture acidulated with sulphuric acid and boiled, they become phosphorescent in the dark.

3. *Scherer's Test.*—If a piece of blotting paper soaked in silver nitrate is suspended in a flask containing the suspected material mixed with lead acetate and ether, the paper will become black from the formation of silver phosphide after keeping it in the dark for some hours.

4. *Phosphine Test.*—If hydrogen is passed through the warmed suspected fluid material, phosphoretted hydrogen is evolved, which will burn with a green flame. If the gas is passed into a solution of silver nitrate, a black precipitate is formed.

CHLORINE.

Chlorine is a greenish yellow gas, having an unpleasant irritating odour even when diluted, and is largely used as a disinfectant and bleaching agent. Poisoning by chlorine is very rare except accidentally in laboratories or in factories, where bleaching powder (calcium hypochlorite) is manufacutred. It was largely used by the Germans during the last German War.

Symptoms.—The chief effects after inhalation of the gas are to induce an intense feeling of tightness in the chest, and a sense of being totally unable to take an inspiration. The cases may be of three degrees, mild, severe or extreme.

Mild.—In these cases cough is frequent and painful. Cough may be dry and harsh, or may be accompanied by greenish, viscid sputum. The other signs are headache, pain in the eyes, and abdominal pain with hurried respiration. These symptoms soon subside.

Severe.—The patient is cyanotic, with frequent panting and painful respirations, headache, a little pyrexia and drowsiness.

Extreme.—Dry, red throat, cracked and furred tongue, intense cyanosis, œdema in the lungs, pulse 80 and respirations 30 per minute, coma and death.

Inhaled in a concentrated form i.e. when not freely diluted with air, it causes death by cardiac paralysis or by asphyxia.

The people exposed to the vapours of chlorine suffer from its chronic effects. They become anæmic, suffer from dyspeptic complaints and acidity, aud lose flesh. Their teeth become soon carious. The lung troubles then set in resulting in chronic bronchitis and emphysema.

Compounds of Chlorine.—The compounds of chlorine, such as bleaching powder and liquor sodæ chlorinatæ (Labarraque's disinfecting fluid) act as irritant poisons, and produce acute gastritis, and suffocative bronchitis.

Fatal Dose.—Uncertain. Three to four drams of a bleaching fluid consisting of a solution of potassium or sodium hypochlorite caused the death of an infant. Recovery has, however, been recorded after a dose of twenty ounces.

Fatal Period.—Forty-eight hours in one recorded case.

Treatment.—Removal of the patient in fresh air, and steam or oxygen inhalation. Atropine hypodermically. It dilates the bronchioles. As a prophylaxis against the gas the soldiers in the late war were provided with respirators (masks) soaked in a solution of sodium bicarbonate and hyposulphite of soda also known as thiosulphate of soda, and goggles for the eyes. When the bleaching powder has been swallowed, evacuate the stomach contents, and treat the symptoms by giving morphia to relieve pain and demulcent drinks.

Post-Mortem-Appearances.—Intense inflammation of the air passages, emphysema and œdema of the lungs, which, on section excude tenacious, frothy and slightly blood-stained secretion. The same kind of secretion fills the trachea and bronchi. Acute catarrhal condition of the stomach and the duodenum. The congestion of the abdominal organs. The odour of chlorine in the ventricles of the brain. The heart is enlarged.

Tests.—The gas can be recognized by its odour and its bleaching action on moist litmus paper. Chlorine water dissolves gold-foil.

BROMINE.

Bromine is a dark, reddish brown liquid, volatilizing at ordinary temperatures in red fumes of an unpleasant odour. In a free state it is found only in laboratories and chemical works. Cases of poisoning by it are rare. Fatal results, however, occur when it is taken internally, or its fumes are inhaled.

Symptoms.—When taken internally in a liquid form, it acts as a corrosive poison, and causes intense burning pain in the mouth, throat,

stomach and abdomen with eructations of the peculiar offensive vapour. The toxic action is so very rapid, and powerful that unconsciousness and collapse soon supervene without even producing the initial symptoms of thirst, vomiting, purging, etc. It produces a severe wound, if it drops on the hand or any other part of the body.

Its fumes, when inhaled, cause symptoms of violent catarrhal inflammation of the air passages, producing cough, constriction of the chest, and hæmoptysis.

The Compounds of Bromine.—Bromides of ammonium, sodium and potassium act as sedatives to the nervous system when taken in medicinal doses ; but produce poisonous symptoms, known as "bromism", when administered in large doses, or when continued for too long a period. The symptoms are skin eruptions in the form of red papules on the face and back, salivation, foul odour from the breath, delirium and death. In some cases the patient loses sexual power, becomes dull and is unable to work. He very often becomes demented or melancholic.

Potassium bromide has been recorded to have caused the fatal results, but not the other compounds.

Fatal Dose.—Uncertain. One ounce of bromine has caused death. 0.203 gramme of free bromine caused the death of a girl aged ten years, who was given a mixture containing potassium bromide and chlorine water in three doses. One ounce and a half of potassium bromide has produced alarming symptoms.

Fatal Period.—Seven hours and a half from bromine vapours. Five days from potassium bromide.

Treatment.—Administer apomorphine hypodermically or other emetics, and give starch or albumen. Give ammonia vapour and steam for inhalation when the bromine fumes are inhaled.

Post-Mortem Appearances.—When liquid bromine is administered, there is inflammation of the œsophagus and stomach with dark brown stains on the mucous membrane, which presents a leathery, parchment-like appearance. Occasionally there is perforation of the stomach, or the stomach wall is destroyed altogether.

When the bromine fumes are inhaled, there is irritation of the air passages with signs of bronchitis or pneumonia.

Chemical Analysis—Free bromine may be separated from organic mixtures by distillation. If combined, the mixture should be saturated with potassium bichromate, and acidulated with sulphuric acid before it is distilled.

Tests.—Bromine can be recognized by its colour and odour, as well

as by its colouring starch paper yellow. It forms an orange or yellow coloured solution in chloroform or carbon bisulphide, and with phenol forms a crystalline white precipitate due to the formation of tribromophenol, insoluble in water. Compounds of bromine give a whitish yellow precipitate of silver nitrate, which is insoluble in ammonium hydrate, but soluble in potassium cyanide.

IODINE.

This is a solid, having blue-black, soft and scaly crystals, with a metallic lustre and an unpleasant taste. At all temperatures it gives off a violet coloured vapour possessing a characteristic odour. Acute poisoning from free iodine is a very rare occurrence. Accidental cases of poisoning by drinking carelessly tincture or liniment of iodine have occurred, and a few suicidal cases have also been reported. The iodine preparations cannot be used for homicidal purposes, as they colour farinaceous foods blue.

Iodine, if swallowed in the solid form, acts as a corrosive, while its vopours are strongly irritant to the respiratory passages. A strong solution of iodine has produced irritant symptoms even when injected into a cyst or a body cavity for treatment.

Symptoms.—In acute poisoning the mucous membrane of the mouth, throat, œsophagus and stomach is swollen and stained dark-brown. There is burning pain in the mouth, œsophagus and stomach, followed by intense thirst, salivation, vomiting and purging. The vomited matter and stools are dark or blue in colour, contain blood, and have an odour of iodine. The urine is suppressed or scanty, dark, red-brown in colour, and has a strong smell of iodine. The pulse is small and compressible, the skin cold and clammy and the patient passes into a state of collapse. Consciousness is retained till death. Severe symptoms from poisoning by potash iodide are more frequently seen in patients suffering from goitre. Some people are particularly susceptible to the poisonous symptoms of potash iodide even from medicinal doses.

Chronic Poisoning.—The symptoms of chronic poisoning very often occur from a continued use of large doses of potassium iodide medicinally, and are known as *iodism.* The symptoms are heavy pain over the forntal sinus, running of the nose, salivation, nausea, vomiting, purging, emaciation, wasting of the breasts, testicles and of other glands and erythematous patches on the skin.

Fatal Dose.—Twenty grains of iodine and one dram of the tincture

have proved fatal, but recovery has followed the dose of one fluid ounce of the tincture.

Fatal Period.—The average fatal period is twenty-four hours but, in cases of poisoning from local application, the death may be delayed for some days.

Treatment.—Evacuate the stomach by emetics, or wash it out with water containing starch and albumen or a solution of sodium thiosulphate. Give arrowroot and barley water and treat the symptoms. Tracheotomy may have to be performed, if death is threatening from œdema of the glottis. In poisoning from potassium iodide stop its administration, and give large doses of bicarbonate of sodium or sulphanilic acid, or lessen the dose or double it.

Post-Mortem Appearances.—The gastro-intestinal mucous membrane is inflamed, excoriated and may be coloured brown. The stomach contents may be coloured blue owing to the presence of starchy food.

Chemical Analysis.—Iodine, if it is present in a free state in organic mixtures, may be extracted by agitating it with chloroform or carbon bisulphide, and then obtained by evaporation and sublimation. If in combination, nitric acid may be added and then iodine may be extracted as above.

Tests.—Free iodine is recognized by its peculiar odour, the violet colour of its vapour, and by its turning starch paper blue.

The iodides produce a flocculent whitish yellow precipitate with a solution of silver nitrate, insoluble in ammonia, but soluble in potassium cyanide. A solution of mercuric chloride produces a scarlet precipitate, soluble in excess of ether. When mixed with chlorine water and starch, a blue coloruation is formed, which disappears on heating, but reappears on cooling.

BORON.

Boracic Acid, H_3BO_3.—This is a crystalline solid, feebly acid and soapy or greasy to the touch. It is soluble in thirty parts of cold water and in three parts of boiling water. It is largely used as an antiseptic in surgical practice, and commercially as a preservative of milk and other articles of food. Its salt, borax or biborate of sodium ($Na_2B_4O_7,10H_2O$) known in the vernacular as *tankankhar*, is also used as a preservative of food. It has been used as an abortifacient.

The adulteration of milk and other food articles with these drugs is regarded as noxious and injurious to health, though there are no ill-effects from swallowing them in small doses.

Accidental cases of poisoning have occurred from the use of boracic acid on raw and abraded surfaces, or from washing out the abscess cavities or the stomach with the acid.

Symptoms.—The chief symptoms are loss of appetite, nausea, vomiting, diarrhœa and suppressed or scanty urine. There are erythmatous eruptions on the skin, and the symptoms of collapse are soon evident. Death occurs from paralysis of the heart. Sometimes delirium and hallucinations appear.

Fatal Dose.—Uncertain. 15 grammes of acid boric caused death in one case.

Fatal Period.—The average period is three to four days.

Treatment.—Wash out the stomach, treat the symptoms and combat the collapse.

Post-Mortem Appearances.—Congestion of the stomach with several spots of erosions on its mucous membrane. The abdominal organs are congested and inflamed. There may be ecchymosis on the inner surface of the pericardium.

Chemical Analysis.—Borax or boracic acid can be separated from organic mixtures by evaporating them with sulphuric acid, extracting them with alcohol, or by drying the material, fusing the residue with sodium carbonate and nitrate, and testing the resultant for borates.

Tests.—1. Barium nitrate solution yields a white precipitate, soluble in dilute hydrochloric acid or nitric acid.

2. Silver nitrate gives a white precipitate in strong solutions, but brown in dilute ones.

3. If alcohol is added to the solution to which concentrated sulphuric acid has been added and ignited, it will burn with a green flame.

4. A solution in dilute hydrochloric acid imparts a rosy colour to a turmeric paper dipped into it. The colour changes to bluish green on addition of caustic potash or ammonia.

CHAPTER XXV.

IRRITANT POISONS, Contd.

II. METALLIC POISONS

ARSENIC.

The metal itself is probably non-poisonous, as it is insoluble in water but, when oxidized by exposure to the air, becomes very poisonous. It is believed that on being administered into the stomach it gets oxidized and then acts as a poison. A preparation, called fly powder, which contains metallic arsenic in a finely divided form mixed with arsenious oxide, is highly, poisonous.

The vapours emanating during smelting of ores are destructive to vegetation and animal life, and cause chronic injurious effects to smelter .

COMPOUNDS OF ARSENIC.

Arsenious Acid (Arsenious Oxide), As_4O_6.—This is commonly known as *white arsenic* or merely as *arsenic.* It is called in the vernacular *Sankhya* or *Somalkhar.* It is sold as a heavy, white, gritty, crystalline powder, in the form of a solid mass or cake. The mass first appears transparent and crystalline but, after some time, becomes white and opaque, having a porcelain-like appearance.

It is odourless and tasteless, but sometimes, it is described as having roughish taste due to the mechanical irritation of the tongue caused by the gritty character of the powder. If heated on charcoal it is reduced to metallic arsenic, which in a vaporous form has an odour of garlic, and a very faint sweet taste.

It is almost insoluble in water, one-half to one grain dissolving in one ounce of cold water, and twelve to sixteen grains in one ounce of water kept boiling for an hour.

In spite of a heavier weight (Sp. gr. 3.699) powdered arsenic has the curious property of floating on water as a white film. If stirred up a good deal, the film disappears, but reappears on standing. It is soluble in spirits and wines in the same proportion as in water, but is much more soluble in acids and alkalies.

White arsenic is largely used in the arts, in calico-printing, in the preparation of wall papers, artificial flowers and taxidermy, and as a mordant in dyeing. It constitutes a principal ingredient of fly papers, and many powders and pastes used for killing rats and vermin, and is an adulterant of "complexion or violet powders."

In India it is used for preserving timber and skins against white ants. It is not unfrequently used by *hakims* and *vaids* in the treatment of certain diseases, such as, fevers, rheumatism, skin diseases, syphilis, and impotency.

Arsenites.—These are formed when arsenious acid combines with alkalies and their carbonates or with other metals. The alkaline arsenites thus formed are soluble salts. The arsenites that are commonly used as poisons are :

1. Potassium Arsenite (K_3AsO_3), **and Sodium Arsenite** (Na_3AsO_3).—These are both poisonous, and are used in manufacturing fly papers and weed killers. Sodium arsenite is also used in preparing "sheep dips."

2. Copper Arsenite (Scheele's Green), $CuHAsO_3$ **and Copper Aceto-arsenite (Paris green, Schweinfurt Green, or Emerald Green,** *Hirwa*), 3 Cu (AsO_2), $Cu(C_2H_3O_2)_2$.—These are used for colouring artificial flowers, wall papers, articles of dress, toys and sweetmeats. These are insoluble in water, but soluble in acid juices of the stomach.

Arsenic Acid, H_3AsO_4.—This is less poisonous than arsenious acid. When deprived of water by heating, it changes into a white amorphous powder, known as arsenic anhydride or arsenic pentoxide. It is used in manufacturing dyes and fly papers.

Sodium or Potassium Arsenate, Na_3 or K_3 AsO_4.—This is formed by the action of arsenic acid on sodium or potassium. It is used as a homicidal and cattle poison.

Arsenic Sulphides.—These are naturally found as ores of arsenic ; the chief being *realgar* or *red arsenic* (*mansil*) As_2S_2, and *orpiment, yellow arsenic* or *king's yellow* (*hartal*) As_2S_3. Both these varieties are used as pigments in arts. Mixed in two parts of quicklime the yellow variety is also very commonly used as a depilatory by Indian women. The poisonous effects produced by them are largely due to the presence of arsenious acid.

Arsenic Chloride, $AsCl_3$.—This is formed by burning arsenic in chlorine or by the action of hydrochloric acid on arsenious acid. It is a highly poisonous, colourless, fuming liquid, and is used in the treatment of cancerous tumours.

Arsenic Triodide, AsI_3.—This is obtained by heating a mixture of iodine and arsenic. It occurs in red flakes, and is used for skin affections.

Arseniuretted Hydrogen (Arsine), AsH_3.—This is a colourless gas possessing a fœtid odour of garlic, and acts as a deadly poison, its discoverer Gehlen having been killed by inhaling a single bubble of the pure gas.

Cacodylic Acid (Dimethyl-arsenic Acid).—$As(CH_3)_2O_2H$.—This is a white crystalline substance, readily soluble in water and alcohol and forms salts, known as cacodylates, when it unites with metals and organic substances. These salts are supposed to be non-toxic, though sodium cacodylate is known to have produced very serious poisonous symptoms.

Atoxyl and Salvarsan (606).—These are organic compounds of arsenic known as sodium amino-phenyl arsonate and dioxydiameno arsenobenzol. They are largely used for the treatment of syphilis, and are known to have produced poisonous symptoms. Atoxyl contains 22. 8 per cent., and salvarsan 34 per cent., of arsenic.

PROPRIETARY ARTICLES CONTAINING ARSENIC.

1. **Rough on Rats.**—A mixture of white arsenic and barium carbonate. Strength, 98.89 per cent. of arsenious oxide.

2. **Fly Papers.**—Strength varying from half a grain to one grain per each paper.

3. **Weed-Killer.**—This consists of a strong solution of caustic soda and arsenite of sodium. Strength, 6 grains of arsenious acid to one ounce.

4. **Fly-Water.**—This consists of one part of arsenite of sodium or potassium, two parts of sugar and twenty parts of water. It is used for killing flies. Paper dipped in this solution is also used.

5. **Fly-Powder.**—This is a mixture of metallic arsenic and arsenious acid.

6. **Sheep-Dip.**—This is used to kill flies on sheep. It is prepared by mixing white arsenic with soft soap and sulphur or tar water.

Symptoms.—In cases of acute poisoning the symptoms usually appear within half an hour, but they may be delayed even up to ten hours. The patient first of all complains of a feeling of faintness, depression and nausea, and then severe burning pain in the throat and stomach, which increases on pressure. Intense thirst and vomiting are severe and constant symptoms. The vomited matter at first contains the ordinary

contents of the stomach but, later on contains mucus and blood in streaks or in spots ; the colour being dark brown, yellow, green or bluish on account of yellow sulphide of arsenic or owing to indigo of arsenic being mixed with bile. Purging is usually accompanied by tensemus, pain and irritation about the anus. The stools are expelled frequently and involuntarily, and are dark coloured, fœtid and bloody, but later become colourless, odourless, and watery, resembling the "rice water stools of cholera". The urine is suppressed or scanty and contains blood. There is pain in micturition. There may be severe cramps in the calf muscles of the legs and other muscles, which usually commence with purging. The patient becomes restless, greatly prostrated and passes into a state of collapse. The surface becomes cold and clammy, and the face is pale and anxious, but later becomes cyanosed. The eyes are sunken. The pulse is feeble, irregular and frequent. The respirations become laboured. Lastly convulsions and coma precede death. The intellect remains clear till last. When a very large dose is taken, death may occur rapidly from shock without producing any symptoms.

Narcotic Form.—In this form the gastro-intestinal symptoms are absent, but the patient complains of giddiness, formication and tenderness of the muscles, and becomes delirious, but soon passes into a state of coma, and dies without regaining consciousness. The pupils are dilated. Sometimes there may be complete paralysis of the extremeties.

Sub-Acute Form.—This is the form which usually occurs, when criminals give the poison in small doses at repeated intervals so as to cause death by gradual prostration. The symptoms are first dyspepsia, cough and tingling in the throat, then vomiting, purging with abdominal pain and tenesmus, foul tongue, dry and congested throat, and a feeling of depression and languor. The motions are bloody.

The symptoms of neuritis are more pronounced. The patient complains of severe cramps in the muscles, which are extremely tender on pressure. He is very restless and cannot sleep. Ultimately collapse sets in, and results in death. In cases which end in recovery, chronic peripheral neuritis may persist, ending in paralysis from degeneration of the nerves extending up to the nerve centres.

Unusual Symptoms.—These are convulsions, delirium of a maniacal character, rise of temperature, salivation, loss of speech, ringing in the ears, and disordered vision with intolerance to light. Death occurs from asphyxia.

Fatal Dose.—Three grains of arsenious oxide are the average fatal dose. Two grains are the smallest amount known to have caused death. Cases of recovery have occurred even after two ounces. Half-a-fluid ounce of Fowler's solution taken in broken doses has proved fatal in 4 days.

Fatal Period.—The average fatal period is twelve to forty-eight hours, though death has very frequently occurred within two to three hours. The shortest period is twenty minutes, when death occurred from shock. In mild cases life may be prolonged from one to three weeks. In such cases there are usually remissions of the symptoms.

Diagnosis.—Arsenic poisoning has to be diagnosed from—

1. **Acute Gastritis, Enteritis, and Gastro-enteritis.**—In these cases the history and presence of some disease or some cause to account for the symptoms will help the diagnosis. Besides, there will be no pain in the throat.

2. **Asiatic Cholera.**—The usual excuse given to account for the symptoms of arsenic poisoning is an attack of Asiatic cholera.

The differentiating points between arsenic poisoning and Asiatic cholera are given below in a tabulated form :—

Symptoms.	Arsenic poisoning.	Cholera.
1. Pain in the throat.	Before vomiting.	Not so.
2. Purging.	Follows vomiting.	Usually precedes vomiting.
3. Stools.	High coloured, bloody, fæculent, fœtid, and discharged with straining and tenesmus. Very rarely "rice-water".	"Rice-water," liquid, whitish, and discharged in an almost continuous and involuntary jet.
4. Voice.	Not affected.	Peculiar, rough and whistling.
5. Post-mortem venous congestion.	Not present.	Usually present.
6. Blood.	Thicker and contains clots.	Liquid.

3. Cholera Morbus.—This occurs in summer and autumn, and is followed by an indiscrete use of some dish, but does not usually attack all or several persons partaking of the same dish, which excites the outbreak. There are no throat symptoms. It is fatal only among very young and very old individuals, death occurring in three or four days from exhaustion.

4. Peritonitis.—The initial pain in the abdomen is not localised in the stomach, but elsewhere. Constipation is a constant symptom. The throat symptoms are absent and tympanites is present obscuring the liver and spleen dulness.

Treatment.—1. It should be remembered that when taken in a finely powdered condition on an empty stomach, it sticks to the mucous membrane of the stomach, excites

violent inflammation, and the formation of a tenacious mucus, which glues it to the surface, and protects it from the action both of emetics and antidotes.

The first step in the treatment is to remove the poison as promptly as possible from the stomach. If the stomach is full, empty it by giving emetics, but do not use tartar emetic, or copper sulphate. If not, wash out the stomach by passing the stomach tube preferably with large draughts of hot milk and water, and then pour into it through the tube a freshly prepared solution of hydrated ferric oxide, which will convert the arsenious acid into ferric arsenite, a harmless and insoluble salt. It is prepared by adding an alkali (ammonia water or a solution of potassium carbonate) to the tincture of ferric chloride. Calcined magnesia may be substituted for ferric chloride, if the latter is not available.

Dialysed iron has been recommended by some as an antidote, but is not so efficacious as the hydrated ferric oxide.

2. Give demulcents, such as *ghee*, albumen water, milk, or barley water.

3. Give pieces of ice to suck to relieve thirst.

4. Give castor oil to clear the bowels.

5. Hypodermic injection of morphia may be given to relieve pain.

6. Use massage to relieve cramps and hot-water bottles to combat collapse.

7. Administer strychnine hypodermically as well as other heart stimulants, if necessary.

Post-Mortem Appearances—External Appearances.—Rigor mortis lasts longer than usual. Putrefaction is delayed probably due to the diminished quantity of fluids in the body. The body presents a shrunken appearance. The eyeballs are sunken, and the skin of the hands and feet chiefly is cyanosed, but not so much as in death from

Asiatic cholera. The skin may be found jaundiced as it happened in a case described by Von Hoffman.

Internal Appearances.—The lining membrane of the mouth, pharynx and œsophagus is inflamed or even ulcerated, but may escape altogether in rapidly fatal cases. The stomach is the chief organ that exhibits characteristic *post-mortem* changes even if the poison has been administered by means other than the mouth. These changes, however, depend on the quantity of the poison taken, and the time that has elapsed since its administration.

On opening, the stomach contains articles of food in a process of digestion mixed with gritty, sandy particles of arsenic, or a dark brown, odourless, turbid and unctuous liquid with crystals of arsenic embedded in large masses of mucus. The inner wall of the stomach, which is swollen, softened and congested, is generally tinged with streaks of blood and white particles of arsenic embedded in the tough mucus or lymph covering it. On scraping this mucus, the mucous membrane is found highly congested and inflamed wholly or in many small patches, its colour varying from brownish-red or bright scarlet to vermilion. The congestion is due to petechial hæmorrhages from the minute vessels most marked along the crests of the rugæ. Inflammation is more marked at the greater curvature, posterior part and the cardiac end of the stomach. Ulceration of its mucous membrane has been noticed if arsenic is given in a very crude form. Gangrene and perforation have also been observed in rare instances.

The small intestine appears flabby and contains large flakes of mucus with very little fæcal matter. On opening the intestine, the mucous membrane is found finely injected and pale violet coloured, and presents the signs of inflammation with submucous hæmorrhages along its whole length but more marked in the duodenum and jejunum. These changes are very much similar to those in the stomach, but less

intense. Very often longitudinal ulcers are also seen. The epithelium is flabby, œdematous and shed in a large amount.

The large intestine contains a small quantity of seromucus, but more often is empty and contracted. The cæcum and rectum are found inflamed, and their mucous membrane is found flabby. The intestinal glands are often enlarged and swollen, but not inflamed. The peritoneum is congested and pink in colour.

The liver, spleen and kidneys are highly congested, enlarged, and may show signs of fatty infiltration and degeneration.

Arsenic has, sometimes, penetrated through the walls of the stomach, and has appeared on the liver, omentum and the walls of the left ventricle of the heart.

The lungs are congested with subpleural ecchymoses.

Both sides of the heart contain loosely coagulated blood, and ecchymoses are present under the endocardium, and in the muscle of the left ventricle.

The membranes of the brain are hyperæmic, and the ventricles are full of serum.

Chronic Poisoning.—Chronic arsenical poisoning occurs among persons engaged in works and factories, where arsenic in one form or the other is used, among persons inhabiting rooms, the walls of which have been painted with arsenical pigments, or papered with coloured papers, or among persons, who have been taking the drug for a prolonged period or in too large a quantity.

Symptoms.—The symptoms of chronic poisoning are exhibited in four stages.

First Stage.—The symptoms in the first stage are those of gastric troubles; viz., malaise, loss of appetite, salivation, colicky pain, constipation, or sometimes diarrhœa and vomiting of glairy mucus tinged with bile. The gums

are red and soft, and the tongue is coated with a thin, white, silvery fur. The temperature is raised to 102° to 103°F. with the frequent pulse.

Second Stage.—This is marked by cutaneous eruptions and catarrh of the larynx and the bronchial tubes. There is a feeling of dryness and itching in the fauces and the larynx. Hence the voice becomes hoarse and husky. The eyes are suffused and the conjunctivæ are greatly congested. There is running from the nose with intense coryza. The patient gets spasmodic cough with expectoration tinged with blood on account of inflammation of the bronchial tubes.

Erythematous, eczematous, urticarial or pustular eruptions manifest themselves on the skin, chiefly on the folds of the armpits and groins, as well as on the scrotum. After a certain time the skin becomes pigmented, and the epidermis comes off in desquamations. The nails become brittle and loose. The hair becomes dry and may fall out.

Third Stage.—In this stage the sensory troubles are more prominent. They resemble those met with in alcoholic poisoning more than in lead poisoning.

The first symptom, which appears from a week to three or four weeks, is headache, followed by numbness, tingling, formication and cutaneous anæsthesia. Perspiration is well-marked. There is extensive tenderness of the muscles of the extremities on pressure and the knee jerk is usually lost. The loss of sexual power is a constant symptom, but the special senses are not deranged.

Fourth Stage.—This is the stage of paralysis. In this stage the muscles become weak and feeble, so that the patient gets easily fatigued while walking or ascending a stair-case. He also adopts an ataxic gait, when he walks. The extensor muscles of the extremities atrophy; hence the patient is unable to use his limbs, and becomes bed-ridden; but the sphincters are rarely affected. Tremors are noticed in the

muscles which become markedly paralysed. The interosseous and intercostal muscles are more often affected. These are followed by general emaciation, dysuria, mental hebetude or delusions, and death occurs from failure of the heart muscle.

Treatment.—Remove the patient from the source of poison, and treat the symptoms as they arise.

Post-Mortem Appearances.—The stomach and intestines present a chronic inflammatory condition but, more often, there may not be any characteristic changes. The liver shows the signs of fatty degeneration and the kidneys show parenchymatous nephritis. The muscles are found greasy and atrophied.

Chemical Tests.—1. Ammonio-nitrate of silver produces a yellow precipitate of arsenite of silver in an arsenious acid solution.

2. Ammonio-sulphate of copper gives a bright green precipitate of arsenite of copper (Scheele's green).

3. *Reinsch's Test.*—This is a very delicate test, and arsenic may be readily detected to the extent of 1 : 1,000,000 and 1 : 7,000,000, if the solution is concentrated. The method of procedure is as follows :—

Drop one or two strips of bright copper foil into the suspected solution previously acidulated with pure hydrochloric acid and boil it for five to ten minutes, when the copper foil is coated steel-grey with a deposit of arsenic, if present. The foil is then removed, washed successively in distilled water, alcohol and ether, dried on filter paper and then heated by placing it in a small test tube. The deposit, if due to arsenic, volatilizes and forms a white deposit further up in the cooler portions of the tube. This deposit, when seen under the microscope, shows octahedral crystals of arsenious acid. If the coating is very thick, it may be scraped off, dissolved in acid and the liquid tests may be applied. Before proceeding with Reinsch's test a control test should

be tried to prove the purity of hydrochloric acid and copper foils.

4. *Marsh's Test.*—This forms such a delicate test for the presence of arsenic that exceedingly small quantities even up to two-hundredths of a milligram may be detected.

The test is based on the formation of arseniuretted hydrogen, when the compounds of arsenic except the metal and its sulphides are brought into contact with nascent hydrogen. It is carried out by means of a Woulffe's bottle (hydrogen generating bottle) to which is connected a long glass tube ending in a jet. Granulated zinc and dilute sulphuric acid are dropped into this bottle, when hydrogen will be evolved, and will burn with a pale blue flame on applying a light to it. On adding the suspected mixture of arsenic into the bottle, the flame begins to burn with a bluish or greenish violet or purple tint due to the formation of AsH_3. If a cold porcelain dish be depressed into the flame, a blackish brown stain of metallic lustre is produced. This stain is readily soluble in a solution of calcium hypochlorite; while the addition of ammonium sulphide does not dissolve, but detaches it from the porcelain, and on heating turns it yellow.

If the deposit be heated with a few drops of strong nitric acid, and if silver nitrate be then added, a brick red (reddish-brown) precipitate of silver arsenate is formed, which is soluble in ammonia.

If the flame be extinguished, and the central part of the tube conveying AsH_3 be heated to redness by means of a spirit lamp for some time, a brilliant arsenical mirror of a darker and less silvery white colour appears immediately beyond the heated spot. If the portion be cut off, and heated in a dry test tube, a white deposit is formed on its inside, which shows octahedral crystals under the microscope.

5. *Fleitmann's Test.*—If the suspected solution is heated with zinc pieces and strong caustic potash, arseniuretted

hydrogen is evolved, which blackens a piece of white filter paper moistened with silver nitrate, if held over the mouth of the tube.

6. *Biological Test.*—This is also a delicate test, and will detect arsenic to an extent of one thousandth of a milligramme. It is based on the fact that certain moulds, such as penicillium brevicaule, have the property of developing volatile products with arsenic, which are known by a garlic-like odour. The test is carried out by putting the suspected substance into a glass flask with some small pieces of bread or biscuit, and by sterilizing for half an hour at 120°C. When cold, the mixture is inoculated with a culture of penicillium brevicaule and kept at a temperature of 37°C. If arsenic is present, a garlic-like odour will emanate owing to the formation of arseniuretted gas or an organic combination of arsenic.

7. *Dry Test.*—If a mixture containing arsenious acid be mixed with sodium carbonate, and heated on a charcoal support in the inner flame of a blow pipe, a characteristic garlicky odour is given off.

A small quantity of the powder, if heated on a platinum foil, volatilizes completely as a white vapour.

Medico-Legal Questions.—1. Arsenic is used homicidally much more frequently in India than in any other country, as it is easily obtained in every town, is easily concealed for want of any particular taste, and a very small quantity is necessary to produce fatal effects. It is not unoften employed to produce abortion, especially in the form of ointment or paste on abortion sticks. It is also used to poison cattle. Wells are known to have been poisoned by arsenic during war, as also during peace times.

Owing to much pain caused by its ingestion suicides resort to this poison much less frequently than to opium.

Accidental cases sometimes do occur from its admixture

with drink, or articles of food, or from its improper medicinal use. White arsenic has been mistaken for baking soda, cream of tartar, sugar, salt and flour. Accidental cases may also occur from drinking water from streams containing arsenical mineral deposits. Accidental deaths occur from an over-dose, when it is given by women to their husbands as a love philter.

Chronic arsenical poisoning with symptoms of peripheral neuritis among beer drinkers broke up in an epidemic form in the county of Lancashire in 1900. Beer was found contaminated with arsenic varying from 0.14 to 0.3 grains per gallon, and derived from impure sulphuric acid used in the manufacture of glucose and cane sugar required for brewing it.

2. Method of Introduction.—In most of the homicidal cases arsenic is administered by the mouth by disguising it with the articles of food, such as sweetmeat, bread, rice, *dal*, cooked vegetables, and drinks, such as tea, coffee, port wine, or with medicine. It has sometimes been given with *prepared pan.* It has occasionally been injected into the rectum after mixing it with a liquid to be used as an enema.

It has also been introduced into the vagina either for the purpose of committing suicide or for procuring abortion.

Cases of poisoning have also occurred from the application of arsenic paste to a cancerous growth, or of its ointment or solution to a blistered or abraded surface, or even to the uninjured skin.

Sometimes fly papers are soaked in water or in tea, and the solution is then administered with the homicidal intent.

Salvarsan.—This is used intramuscularly or intravenously to destroy the microbes of syphilis. It forms an acid solution in water, and is, therefore, neutralized by the cautious administration of caustic soda. To obviate this difficulty neosalvarsan is used, which makes a neutral solution in water convenient for intravenous injections. There is no difference

in toxic or therapeutic effects between the two drugs. Poisonous symptoms ending in death have ensued after the use of either of them. The symptoms are similar to those of arsenic, which is probably excreted into the stomach after the poison is absorbed into the system. The chief symptoms are extensive sloughing abscesses and hæmorrhages, especially at the site of intramuscular injection, abdominal pain, vomiting, profuse diarrhœa with blood in the stools, headache, jaundiced skin, hyperpyrexia, cramps, paralysis and coma. Death occurs from acute encephalitis, or it may occur from the formation of a thrombus and embolism occurring from faulty technique adopted in intravenous injections of muddy solutions. Double optic neuritis common in atoxyl poisoning is rare in salvarsan poisoning.

Fatal Dose.—A dose above 0.6 gramme would be risky, and 10.5 grammes might cause death.

Treatment.—Bowel injections and hypertonic solutions of sodium chloride and sodium bicarbonate to render blood alkaline and to eliminate arsenic from the system. Lemonade water with sodium bicarbonate.

Post-Mortem Appearances.—The mucous membrane of the stomach is injected and ecchymosed, softened and inflamed, accompanied even by perforation, hæmorrhagic and necrotic inflammation of the intestines, fatty degeneration of the liver, inflammation of the kidneys and thickening, reddish discoloration and softening of the pons with hæmorrhagic spots in the brain.

3. Tolerance.—The people who are in the habit of eating arsenic acquire a certain amount of toleration to bear it up to four grains or more in one dose. They use it daily with the idea of improving their looks, and becoming more hardy to carry weights and to climb mountains. This habit is common among the peasants of Syria and Hungary. The people using this drug as a habit

are called *arsenophagists*, and suffer from the symptoms of mild arsenical poisoning, if it is withheld from them.

In India some people are in the habit of taking it daily as an aphrodisiac. Sometimes it is given in small quantities with a view to produce death from slow poisoning, but instead it makes a man plumper and stronger as it happened in the case of the late Fulham of Agra who was being poisoned with arsenic by Clark.

Arsenic is largely given by grooms to improve the coats of horses. If it is withheld, the animals become dull and lose flesh.

4. Solubility of Arsenic.—When administered in a soluble form by the mouth, arsenic gets absorbed into the blood almost in a few minutes but, when taken in solid lumps, it may not be absorbed by the stomach and sometimes passes out with fæces without producing any poisonous symptoms. For instance, in 1872 a Parsee in Bombay had swallowed two masses of arsenious oxide without any serious effects. Within forty-five hours after swallowing the poison he passed per rectum two lumps, one weighing eighty grains and the other weighing twenty-five grains.

Arsenious acid gets converted into yellow sulphide of arsenic in the stomach and intestines, but sulphide of arsenic is not converted into white arsenic.

5. Elimination.—Arsenic when taken for sometime in medicinal doses does not accumulate in the system, so that it may give rise to sudden poisonous symptoms. It is, therefore, not regarded as a *cumulative* poison.

It is eliminated chiefly through the vomit, urine and fæces, and to some extent through perspiration, saliva, bronchial secretion and milk. Its excretion by urine is very rapid, and it is known to have been detected in half an hour after the administration of a medicinal dose of liquor arsenicalis. The excretion is so very rapid and complete that it is hardly

possible to find arsenic in the tissues, if a patient survived more than ten days after acute arsenical poisoning ; however, in a rare exceptional case it has been detected in the tissues, when death took place fifty-nine days after taking the fatal dose.

Arsenic becomes fixed in the cancellous tissue of the bones, chiefly the long ones, owing to the conversion of their phosphates into arsenates. Its elimination being much slower, its presence can be detected in the bones long after every trace has disappeared from other organs, such as the liver, kidneys, etc. Hence it is essential to preserve long bones for chemical analysis in suspected cases of arsenic poisoning, when a body is exhumed, or when it is very much decomposed. Traces of arsenic were found by Dr. Hankin, Chemical Examiner, U. P., in the femurs removed from the body of the late Fulham, which was exhumed in Agra about fourteen months after death.

After death arsenic may also be found in the skin, hair and nails.

6. Deposit of Arsenic.—In acute poisoning arsenic, after it is absorbed, gets deposited more in the liver than in the kidneys and, in chronic poisoning it is found deposited in the brain, the base of the skull, the bones of the vertebræ and pelvis.

7. The Power of Preservation.—Not only does arsenic not disappear by putrefaction, but has the power of retarding decomposition to a certain extent, and so the stomach and other tissues are often well preserved some months after death, though this is not always the case. Thus the body of the late Fulham of Agra had been well preserved, when it was exhumed some fourteen months after death, even though the grave was a *katcha* one, and the lid of the coffin had already given way.

8. Is Arsenic a Normal Constituent of the

Body ?—Arsenic is not physiologically a normal constituent of the body, but it can be taken into the human economy in very minute quantities along with water and some articles of food, as it is very widely distributed in nature.

9. Post-Mortem Imbibition of Arsenic.—In a criminal charge of arsenical poisoning a plea is, sometimes, raised by the defence that the poison was introduced into the stomach after death, and the *post-mortem* imbibition occurred in the tissues. Such a presumption is certainly possible, but the transudation of poison through the organs in such cases seeks an anatomical course ; hence the organs of the left side are affected sometime before those of the right. Besides the fact of *ante* or *post-mortem* imbibition of arsenic can be ascertained by examining the condition of the mucous membranes of the stomach and duodenum. The signs of inflammation and ulceration being the result of vital processes will be absent in *post-mortem* imbibition of the poison.

When arsenic has been found in exhumed bodies, a further question may arise as to whether arsenic found in the body has been absorbed from the earth, which surrounded the coffin or the body. In this connection it must be remembered that arsenic met with in the soil is usually an insoluble salt mixed with lime or iron, and, hence it is highly impossible that an insoluble salt should percolate into the cadaver buried in such soil, especially if the body is laid in a coffin ; however, to avoid the possibility of any doubt, it is safest to preserve the samples of earth from above and below the coffin or the body for chemical analysis, if it has to be disinterred.

ANTIMONY.

The following are the compounds of antimony, out of which antimony tartaratum and the trichloride are important from a medico-legal point of view.

1. Antimony Tartaratum, $KSbOC_4H_4O_6$.—This is also called tartarised antimony, potassio-tartrate of antimony or tartar emetic. It is a pharmacopœial preparation, and occurs as a white crystalline powder. It is soluble in three parts of cold water, the solution having a faintly acid and a nauseating metallic taste. It has been mistaken for tartaric acid, Epsom salts, soda bicarbonate and sometimes for cream of tartar. It constitutes an ingredient of many quack pills, such as, James' pills, etc. It is largely used in veterinary practice for improving the condition of the horses' skin.

2. Antimony Trioxide, Sb_2O_3.—This is a white powder having no taste, nor odour. It is an ingredient of *Pulv antimonialis* (James' powder), and gives rise to the important series of salts. When votalized it condenses into two distinct forms, prismatic and octahedral crystals. It is almost insoluble in water, but soluble in hydrochloric acid and in the gastric juice forming antimony trichloride. It is readily soluble in tartaric acid, and in a boiling solution of hydrogen potassium tartrate (cream of tartar), forming potassium antimony tartrate or tartar emetic.

3. Antimony Trichloride (Butter of Antimony), $SbCl_3$.—This is a colourless, deliquescent, crystalline substance, fusing to a yellow, oily liquid at a temperature of 73·2°C. It dissolves unchanged in a small quantity of water, but a white powder of oxychloride (SbOCl) is formed, if an excess of water is added. When dissolved in hydrochloric acid, it is known as a *bronzing liquid*, and is employed in the arts and in farriery. When taken internally it acts as a corrosive and narcotic poison. It is very often employed as an escharotic by quacks.

4. Antimony Trisulphide (Black Antimony), Sb_2S_3.—This is known as *Surma* in the vernacular. It occurs native as the steel grey ore, and is also formed as an orange red or brick red powder, when sulphuretted hydrogen is passed

through a solution of antimony trichloride or of tartar emetic. The orange variety is an ingredient of Plummer's pill, and antimony sulphuratum. The mineral contains very often arsenic as an impurity.

Antimony Hydride (Antimoniuretted Hydrogen or Stibin), SbH_3.—This is a colourless, offensive, poisonous gas, which closely corresponds to arseniuretted hydrogen ; but it differs from the latter in being less poisonous.

Proprietory Medicines.—Dixon's pills, Johnson's pills and Mitchell's pills contain ·002 to ·003 grains of tartar emetic.

Acute Poisoning—Symptoms.—The symptoms usually appear from a quarter to half an hour after taking a poisonous dose of tartar emetic. The first symptom is a strong metallic taste followed by a burning sensation in the mouth and œsophagus with a feeling of constriction in the throat. Then follow nausea and incessant vomiting with pain in the stomach and abdomen. The ejected matter at first consists of the stomach contents and later becomes fluid, tinged with bile and blood. The patient complains of intense thirst and difficulty of swallowing, as the lips, mouth and throat become swollen and sore. In some cases there is salivation. These symptoms are followed by profuse diarrhœa of bloody stools with suppressed urine. The pulse is small, rapid and imperceptible, and the respirations become laboured and painful. There are cramps in the lower extremities, sometimes, accompanied by tetanic spasms. The skin is cold and clammy. The patient then faints away, is greatly prostrated, becomes unconscious and lastly dies from heart failure. In some cases the patient becomes delirious and comatose before death occurs.

In rare cases vomiting may be absent, or there may not be any purging. Pustular eruptions appear on the skin when it is administered internally.

There are no remissions of the symptoms as in arsenical poisoning.

Fatal Dose.—The average fatal dose is five to ten grains of tratar emetic, though two grains of it have killed an adult, and three-quarters of a grain have killed a child. Recovery has taken place even after half an ounce. The fatal dose of antimony trichloride is two ounces.

Fatal Period.—Death usually occurs within twenty-four hours. In one case it occurred in six hours, and in ten hours in another case. It may be prolonged for several days and weeks.

Treatment.—Use the stomach tube for tartar emetic, but use only emetics in the case of antimony trichloride. Give a dram of tannic acid as an antidote to form an insoluble salt of antimony tannate, or give liquids containing tannin or tannic acid, such as strong and hot tea, coffee, or an infusion of gall-nuts. Demulcent drinks, such as milk, oils, mucilage, albumen water, linseed tea, etc., should then be given. Opium may be given to relieve pain, and ice to control vomiting. Stimulants in the form of coffee, alcohol and ether may be given to combat the heart failure.

Post-Mortem Appearances.—Redness and inflammation of the mucous membrane of the stomach and small intestine. Very often small ulcers and hæmorrhagic extravasations are found in the cæcum. Pustules and aphthous spots are sometimes found on the mucous membrane of the mouth, œsophagus and stomach. The stomach is corrugated and contracted, and its wall may be found pale and yellow. The contents of the stomach are a thick grumous or bloody fluid, slightly acid in reaction, and adhere to its inner wall. The liver, spleen and kidneys are congested. The brain is congested with effusion into the ventricles. The lungs are usually congested, and are darker in colour.

The signs of corrosion and charring are observed, if antimony chloride is taken as a poison.

Chronic poisoning.—This occurs from the administration of the repeated small doses. The symptoms are nausea, persistent vomiting of bile and mucus, and, watery purging sometimes alternating with constipation. The tongue becomes foul ; there is loss of voice, and the pulse is weak and rapid. The skin is cold and clammy. There is great prostration and the patient is very much emaciated. He abhors the sight of food, as he cannot retain it in the stomach. Death results from exhaustion, or from the effects of a larger dose than usually administered at a time. Sometimes cramps occur instead of relaxation of the muscles.

Treatment.—Remove the patient from the source of poisoning, and eliminate the poison from the system by giving potassium iodide.

Post-Mortem Appearances.—The *post-mortem* appearances in chronic poisoning are not so characteristic as in acute poisoning. The body is emaciated. The tongue and the interior of the mouth are covered with fur or marked with aphthous spots. There may be ulcerations in the stomach and intestines. The heart, liver and kidneys show fatty degeneration.

Chemical Tests.—1. The addition of hydrochloric acid to a liquid solution gives a white precipitate, soluble in excess.

2. Sulphuretted hydrogen forms an orange precipitate of sulphide of antimony, soluble in caustic potash or ammonia.

3. If the fluid containing some free hydrocloric acid be put in a platinum capsule, and a fragment of zinc be introduced, a black deposit of metallic antimony is formed on the inside of the capsule ; this will be turned yellow on adding ammonium sulphide.

4. *Reinsch's Test.*—Same as in arsenic, but on heating the sublimate appears amorphous.

5. *Marsh's Test.*—The process is the same as in arsenic, but the flame produced by burning stibine (SbH_3) has a bluish green tint, and the stain formed by the deposit of antimony on the porcelain dish is black and lustreless, insoluble in hypochlorite of lime, but soluble in stannous chloride. On heating the delivery tube the metallic and silvery mirror of antimony is formed on both the sides in the vicinity of the heated part; the mirror does not sublimate, yielding octahedral crystals as in arsenic.

Medico-Legal Questions.—Poisoning from antimony is very rare in India. In Europe a few homicidal and still fewer suicidal cases have occurred. For homicidal purposes tartar emetic is given in small doses for several days, so that the symptoms caused by it may simulate some gastro-intestinal disease.

Accidental cases from tartar emetic have been recorded from an over-dose when given medicinally, or from its administration in mistake for cream of tartar, Epson salt, bicarbonate of sodium, etc.

Tartar emetic is given to confirmed drunkards as a cure for the habit, and accidental poisoning has occurred from an over-dose thus given.

The drug has more deleterious effects on children and on debilitated, infirm and aged persons than on strong and healthy individuals, and hence may cause their death depressing their heart even when given in medicinal doses.

Cases of accidental poisoning occur from chloride of antimony, as it is used in arts as a *bronzing liquid.*

Method of Administration.—Symptoms of poisoning have occurred not only from its administration by the mouth, but from its external application in the form of a powder or ointment to the unbroken skin, from its use as an enema and from its absorption into the system by wearing a cloth, to colour which tartar emetic was used as a mordant.

Elimination of Antimony.—By the vomit and purging it promotes, antimony is largely expelled immediately after swallowing it, and is eliminated rapidly by the kidneys, after it is absorbed into the system. It is also eliminated by the mucous membrane of the stomach even if administered by any other channel than by the mouth. Before it is eliminated it is deposited into the liver, spleen, kidneys and long bones. The drug is completely eliminated from all the organs, if a patient survives for fifteen to thirty days.

Antimony is not a normal constituent of the body, nor is it met with in any of the food articles. Hence its presence in the tissues must be accounted for unless the case happens to be a criminal one.

MERCURY (*PARA*).

Mercury or quicksilver is a liquid metal having a bright silvery lustre. It is easily converted into the form of a dull grey powder when shaken up with oil or triturated with sugar, chalk or lard. This process is known as *deadening*, and is used in preparing mercurial ointment and emplastrum. The metal is not acted upon by hydrochloric acid.

COMPOUNDS OF MERCURY.

1. Mercuric Oxide, HgO.—This is a brick-red crystalline powder but it forms an amorphous yellow powder, when a mercuric salt is acted upon by caustic soda or potash. Both the red and yellow varieties are insoluble in water. They are used in preparing red and yellow ointment.

2. Mercuric Chloride (Perchloride of Mercury, Corrosive Sublimate), $HgCl_2$.—In the vernacular it is known as *Ras kapoor*. It exists in the form of heavy masses of prismatic crystals, or as a white crystalline powder.

It has a styptic, nauseous, metallic taste. It is soluble in 16 parts of cold water and three parts of boiling water. It is readily soluble in alcohol and ether. On account of its antiseptic properties it is largely used in medicine as well as in toxicodermy. It is a violent poison, and is obtained in the *bazar*, very often mixed with impure subchloride.

When ammonia is added to its watery solution, a white precipitate of ammonio-chloride of mercury is formed; it is used in preparing an ointment. It also acts as a poison.

3. Mercuric Iodide (red Iodide, or Biniodide of Mercury), HgI_2.—This is met with as a brilliant red crystalline powder. It is insoluble in water, but readily dissolves in alcohol, nitric acid and in a solution of potassium iodide or mercuric chloride. It forms one of the constituents of Donovan's Solution.

4. Mercuric Cyanide, HgCN.—This is nearly as poisonous as corrosive sublimate, but has no corrosive action. It exists as white prismatic crystals, having a bitter metallic taste but no odour. It is soluble in twelve parts of water and fifteen parts of alcohol.

The sulpho-cyanide of mercury (HgCNS) is used in preparing toys known as *Pharaoh's Serpents.*

5. Mercuric Nitrate, $Hg(NO_3)_2$.—This is crystalline, but deliquescent. It is used for painting on porcelain, and is used by hatters and furriers, as well as in veterinary medicine. It acts as a corrosive poison, and is similar in action to mercuric chloride. Symptoms of chronic poisoning occur among hatters and furriers.

6. Mercuric Sulphide (Cinnabar), HgS.—This is known in the vernacular as *hingul*, *ras sindoor*, or *shingarf*. It occurs as a chief ore of mercury, and is artificially prepared as a red crystalline powder, which is then known as the

pigment vermilion. It is regarded as non-poisonous, but its vapours are poisonous. Cases of acute poisoning have occurred from its use as fumigation. Chronic poisoning has also occurred from its having been used to colour vulcanised rubber meant for artificial teeth.

Mercuric Sulphate, $HgSO_4$.—This is a white crystalline powder, and acts as a corrosive poison. It has been mistaken for sulphocarbolate of sodium, and has caused death.

Mercuric Methide (Mercury Dimethyl), $Hg(CH_3)_2$.—This is a highly poisonous liquid, and has produced death by the inhalation of its vapour. It has also produced insanity.

Mercurous Chloride (Subchloride of Mercury, Calomel), Hg_2Cl_2.—This is a heavy, amorphous, white and tasteless powder, insoluble in water, as well as in alcohol. When heated, it sublimes without fusing. It is converted into mercuric chloride by alkaline chlorides, and by common salt; hence it should never be prescribed with any of these substances. Exposure to sunlight also converts it into mercuric chloride.

Subsulphate of Mercury (Turpeth Mineral), $HgSO_4$, HgO_2.—This is a lemon-yellow powder, and is official in U. S. Pharmacopœia. It is insoluble in water.

Mercuric Nitrate, $Hg_2(NO_3)_2$.—This is colourless and crystalline. It is soluble in water acidulated with nitric acid, and is as poisonous as mercuric nitrate.

Acute Poisoning—Symptoms.—The symptoms are mostly due to corrosive sublimate, and commence immediately after swallowing the poison. They are never delayed half-an-hour. These are an acrid, metallic taste and a feeling of constriction or choking sensation in the throat, hoarse voice and difficult breathing. The mouth, tongue and fauces become corroded, swollen and coated with a greyish white

coating. Salivation, gingivitis and loosening of the teeth are very often the chief symptoms. Hot burning pain is felt in the mouth, extending down to the stomach and abdomen, followed by nausea, retching and vomit, The vomited matter is a greyish slimy mucoid material containing blood and shreds of mucous membrane. This is followed by diarrhœa with bloody stools and accompanied by tenesmus. The urine is suppressed or scanty, containing blood and albumen. The pulse becomes quick, small and irregular, and collapse soon supervenes. In some cases spasms, tremors, convulsions and unconsciousness are observed before the death occurs.

Diagnosis.—This has to be diagnosed from arsenic poisoning. The symptoms of mercurial poisoning commence sooner, the acridity and the constriction of the throat are more marked. The vomited matter and the stools more often contain blood. The irritation of the kidneys is also more pronounced.

Fatal Dose.—The average fatal dose of mercuric chloride is three to five grains. Its smallest recorded dose is two grains which killed a child. Recovery has resulted after the administration of ninety or a hundred grains, or even larger doses under prompt treatment by milk, eggs, and emetics. The average fatal dose of mercuric cyanide is ten to twenty grains. That of mercuric nitrate is one dram, of turpeth mineral is 40 to 60 grains, though three to six grains have caused death from 3 to 15 hours, when administered to young children.

Fatal Period.—The usual fatal period is 3 to 5 days. The shortest recorded period is half an hour, but death may be delayed for 8 to 16 days.

Treatment.—Give emetics, if vomiting has not already commenced. The syphon tube should be used cautiously. Albumen in the form of milk, white of egg, or *ghee*, or

carbonate of magnesium should then be given. Later on treat the symptoms as they arise. Sodium chloride should always be avoided, as it favours the absorption of mercury.

Post-Mortem Appearances.—The appearances of corrosive poisoning will be present, if the poison is taken in a concentrated form. Otherwise the signs of irritant poisoning will be observed.

The mucous membrane of the lips, mouth and pharynx present a diffuse greyish-white escharotic appearance. The same appearance is noticeable in the œsophagus; its mucous membrane appears also corrugated and eroded. The stomach contents are masses of coagulated albumen mixed with mucus and liquid blood. Its mucous membrane is corroded, inflamed and covered with a greyish deposit of mercury, or a black deposit of its sulphide.

During *post-mortem* examination great care should be taken to remove the stomach from the abdominal cavity, lest it might not be ruptured owing to the great softening of its walls. Perforation of the stomach is very rare.

The intestines, chiefly the cæcum and rectum are found inflamed. The liver, spleen and kidneys are congested.

Chronic Poisoning.—This form of poisoning occurs among those who are exposed to the vapours of mercury in factories, where mercury and its salts are largely used. It also occurs among those who have taken internally for a prolonged period excessive doses of mercury compounds, or used the mercurial ointment in the form of an external application.

Symptoms.—These are nausea, digestive disturbances, colicky pain and vomiting. Ptyalism or salivation is a constant symptom, which is accompanied by foul breath, and inflamed and ulcerated gums, which usually present a blue line at their junction with the teeth. Later the teeth become loose and carious; necrosis of the jaws occurs, and general wasting and anæmia result.

The skin eruptions of erythematous, eczematous and pustular character may be noticed. The nervous symptoms known as *mercurial tremors* supervene. These first of all affect the muscles of the tongue producing stammering and hesitation of speech, and then affect the muscles of the face; these later extend to the muscles in the arms and legs. They are excited by voluntary movements, and are absent during sleep. The tremors are followed by paralysis of the limbs. The patient complains of cough with bloody expectoration, and dies from exhaustion. Sometimes he is affected by mental disturbances and hallucinations, which may result in insanity.

The lung and kidney affections, as well as nervous affections are likely to be aggravated by the toxic effects of mercury.

Treatment.—The patient should be removed from the surroundings where he was exposed to the poison. He should be directed to gargle his mouth with potassium chlorate or borax, to keep his bowels open, and to take warm baths to promote the action of the skin. It is advisable to give potassium iodide in small doses, so that the poison may be converted into mercuric iodide, which is soluble in excess of the potassium salt. Massage and electricity should be advised for paralysis.

Chemical Tests for Mercuric Salts.—1. Hydrochloric acid gives a yellow precipitate, which changes to orange, brown and lastly black, insoluble in alkalies or dilute acids.

2. Caustic potash gives a yellow precipitate.

3. Potassium iodide gives a scarlet precipitate, soluble in excess.

4. Stannous chloride gives a white precipitate changing to black.

5. If a piece of a bright wire of iron be introduced into the solution, a silver coating of mercury will be formed on the wire.

Chemical Tests for Mercurous Salts.—1. Hydrochloric acid gives a white precipitate blackened by ammonia.

2. Potassium iodide gives a greenish precipitate, which becomes black, if the reagent is added in excess.

3. Caustic Potash yields a black precipitate, insoluble in excess.

4. Potassium bichromate gives a brick-red precipitate.

5. Stannous chloride gives a white precipitate changing to grey.

Reinsch's Test.—This is used to detect mercury in organic mixtures. A grey coating of mercury forms on the copper foil. If the copper foil is dried and heated in a dry test tube, mercury will volatilize and deposit as round globules of the metal on the cooler part of the tube, which can be seen under the microscope.

Medico-Legal Questions.—1. Cases of poisoning occur chiefly from the use of corrosive sublimate and mercurial nitrate.

Corrosive sublimate is extensively used as a disinfectant and as an antiseptic. Hence accidental cases of poisoning from this salt are likely to occur. It is also largely used in medicine and, therefore, an accidental case may occur from an over-dose, or from the use of too strong a solution used in washing abscess cavities, etc.

Sometimes corrosive sublimate is selected for suicidal poisoning, but it is seldom used for homicidal purposes.

2. The metal itself has no poisonous effect, but its fumes when inhaled, cause poisonous symptoms.

3. Fatal poisoning occurs, when mercury ointment is rubbed into the skin, or applied to ulcers or injected into the vagina.

4. After it is absorbed into the system, mercury is eliminated in the saliva, urine and fæces, and in the milk and perspiration, if the quantity is large. In some cases elimina-

tion is so very rapid, that mercury may not be detected in the solid organs, even though death has occurred from its poisoning. Taylor says that it is thus completely eliminated in 15 days from the system without leaving any trace in the organs; while according to Witthaus elimination is rapid and complete in from one to four days, if a single dose is given, but it is slow, if the poison is given in repeated small doses, and may be detected into the tissues even after thirteen years.

5. Mercury is very often used as medicine, and, hence the detection of a small quantity in the viscera does not contra-indicate death from some other cause.

6. It is not a constituent of the human body, and, therefore, its detection in the tissues proves that it must have been intoduced into the system from outside.

7. Mercuric salts are more poisonous than mercurous salts. Children bear mercury well. Some persons have idiosyncrasy for mercury salts.

COPPER (*TAMBA*).

The salts of copper which are important from a toxicological point of view are—

1. Copper Sulphate (Blue Vitriol, Blue Stone), $CuSO_4$.—The vernacular name of this salt is *Nila tutia.* It occurs in large, blue, slightly efflorescent crystals, freely soluble in water and having a styptic taste. It is converted into a bluish white salt, $CuSO_4$, H_2O, when heated to 100°C. It becomes anhydrous at 220° to 240°C. The anhydrous salt is white and extremely hygroscopic.

Copper Carbonate.—The normal carbonate has not been obtained, but the basic carbonate, $CuCO_3$, $Cu(HO)_2$ occurs native as malachite, and is obtained when carbonate of sodium is added to a solution of copper sulphate. Natural verdigris, the green deposit, which appears on copper when

exposed to the atmospheric moisture and carbon dioxide, is the same compound.

3. Copper Subacetate (Artificial Verdigris, Aerugo), $Cu_2C_2H_3O_2$, CuO.—This is known in the vernacular as *zangal.* It occurs in powder, or in bluish green masses of very minute crystals. It is frequently employed in the arts.

Acute poisoning—Symptoms.—These commence from a quarter to half-an-hour after swallowing the poison, with a metallic taste in the mouth, burning pain the stomach, thirst, nausea, eructations and repeated vomiting. The vomited matter is blue or green in colour, and can be distinguished from bile by its turning deep blue on the addition of ammonium hydroxide. The colour does not change in the case of bile. There is diarrhœa with much straining, the motions being liquid and brown, but not bloody. The urine is suppressed or diminished in quantity, and may contain blood. The skin becomes jaundiced, and cramps of the legs or spasms and convulsions occur. There is frontal headache, and the symptoms of collapse set in, if the dose is large.

In some cases there is complete paralysis of the limbs, followed by insensibility and coma ending in death.

Fatal Dose.—Uncertain. Half-an-ounce of verdigris, and one ounce of copper sulphate have proved fatal.

Fatal Period.—The shortest period is four hours. The usual period is one or two days, but death may be delayed for days.

Treatment.—There is no need to use emetics, as vomiting occurs in five or ten minutes after taking the poison. Wash out the stomach with water containing potassium ferrocyanide, which forms an insoluble cupric ferrocyanide. Administer the white of egg or milk as an antidote. The albumen contained in them will form an insoluble salt, an albuminate of copper. Give demulcent drinks. Relieve pain

by opium, and use diuretics, if the urine is suppressed. Support the patient by giving nutrient enemata, and by using stimulants hypodermically.

Post-Mortem Appearances.—The skin may be yellow due to jaundice. The mucous membrane of the alimentary canal may be found congested, swollen, inflamed and excoriated. The contents of the stomach are greenish, and so is the colour of its mucous membrane. The rectum is usually perforated. The liver may be soft and fatty. The kidneys show the signs of parenchymatous inflammation.

Chronic Poisoning.—This may occur among the workers in copper and its salts or its alloys. It may also occur from food being contaminated with verdigris obtained from dirty copper vessels.

Symptoms.—These are a green or a purple line on the gums, constant coppery taste in the mouth, giddiness, headache, dyspepsia, vomiting, diarrhœa with colicky pain, anæmia, and paralysis ; but paralysis is not so common as in lead poisoning. The skin becomes jaundiced ; the hair, urine and perspiration become green.

Treatment.—Remove the cause, and use massage and warm baths. Keep the patient in fresh air, and attend to his diet and dyspepsia. Copper vessels used for cooking purposes should be tinned, and kept scrupulously clean.

Post-Mortem Appearances.—The chief *post-mortem* appearances are fatty degeneration of the liver and degeneration of the epithelial cells of the kidneys.

Chemical Tests.—1. Hydrochloric acid and hydrogen sulphide give a brownish black precipitate, insoluble in ammonium sulphide, but soluble in potassium cyanide.

2. Ammonia gives a greenish-blue precipitate, soluble in excess forming a blue solution.

3. Potassium ferrocyanide gives a reddish-brown precipitate of copper ferrocyanide.

4. An iron wire or a piece of zinc, if introduced into a solution of copper salt, becomes soon covered with a red coating of metallic copper. This test may be used in the case of an organic mixture containing copper.

Medico-Legal Questions.—1. Copper as a metal is not poisonous. Copper coins, when swallowed, may remain in the stomach or in the intestines for days without producing any poisonous symptoms. All the copper salts are poisonous.

2. The strong metallic taste of its salts prevents their use for homicidal purposes though, in India, copper sulphate is known to have been used homicidally either mixed with glass or sweetmeat, or some other article of food.

Suicidal cases are occasionally met with. Sometimes copper sulphate is taken internally with a view to procure abortion.

Accidental cases occur from contamination of food due to the formation of verdigris resulting from the action of vegetable acids on copper cooking vessels, which are dirty and have not been properly tinned.

The author has seen an accidental case of poisoning in a child, who playfully swallowed a big crystal of copper sulphate.

3. Poisonous symptoms may occur from the application of the salt to an abraded or raw surface.

4. Copper sulphate is added to impart a rich green colouration to preserved and tinned peas, other vegetable substances and pickles, but the quantity is so small (probably one grain to one pound), that the toxic effects are not usually produced ; besides, the salt, when taken into the stomach, is very likely converted into a harmless albuminate of copper.

5. Copper is a normal constituent of the body, and is found in the liver. It is also taken into the system along with food, as it exists in minute traces in almost all the varieties of food, such as cereals, potaotes, beans, spinach, different

varieties of fruits, and even in mineral water. Hence the detection of copper in the viscera is of no value, unless the quantity found is excessive ; however on account of free vomiting provoked by its salt, a very little quantity may be left in the tissues. It is, therefore, essential to examine chemically the vomited matter, whenever available.

6. Copper is eliminated from the system more by the bowels than by the kidneys. It is possible that a portion may accumulate very slowly in the body.

LEAD (*SHISHA.*)

The following are the preparations of lead, which are used in medicine or the arts :—

1. Lead Acetate, $Pb(C_2H_3O_2)_2$, $3\ H_2O$.—This is commonly called sugar of lead or salt of Saturn. It occurs in white masses of acicular crystals, slightly efflorescent and having a sweetish taste. It dissolves in water, forming an acid solution. It looks very much like loaf sugar.

2. Lead Subacetate, $Pb_2O\ (C_2H_3O_2)_2$.—This is a chief constituent of Goulard's extract, which is a colourless liquid with a sweetish astringent taste, and alkaline in reaction.

3. Lead Carbonate, $PbCO_3$.—This is a white crystalline powder, almost insoluble in water, but soluble in dilute acids. In the form of a basic carbonate or white lead (*Safeda*), $(PbCO_3)_2$, PbH_2O_2, it is extensively used as a pigment in oil painting. It is also used as an ointment. Chronic cases of poisoning occur from the use of this salt.

4. Lead Nitrate, $Pb(NO_3)_2$.—This is a crystalline, poisonous salt, soluble in water, and is used in calico printing.

5. Lead Sulphate, $PbSO_4$.—This is a heavy white powder, insoluble in water and is, therefore, supposed to be non-poisonous but cases of poisoning have occurred from sucking yarn coloured white with this salt.

6. Lead Chromate, $PbCrO_4$.—This is a bright yellow, insoluble powder, known as chrome yellow, and is used as a pigment. Poisoning from this salt has occurred, as it is used in colouring sweetmeats.

7. Lead Chloride, $PbCl_2$.—This occurs as white needle shaped crystals, sparingly soluble in cold water, but more so in boiling water. When heated in contact with air, it is converted into an oxychloride, which is employed as a white pigment, known as Pattinson's white lead. The yellow oxychloride obtained by heating lead oxide and ammonium chloride is known as Cassel yellow, and is used as a pigment.

8. Lead Iodide, PbI_2.—This is a tasteless, odourless and bright yellow powder, slightly soluble in cold water, but readily soluble in boiling water. It is used in preparing emplastrum and unguentum plumbi iodidi, the pharmacopœial preparations.

9. Lead Sulphide (Galena) PbS.—This is naturally found in the form of cubic crystals, but is sold in the *bazar* in a powder form as *Surma* in place of sulphide of antimony, which is used as a collyrium for the eyes.

10. Lead Monoxide (Litharge, Massicot), PbO.—This is called *Murdasang* in the vernacular. It is a yellowish powder, very slightly soluble in water, but readily soluble in nitric and acetic acids. It is a constituent of the emplastrum plumbi. Quacks use monoxide as a remedy for syphilis. It is also commonly used by painters and glaziers, and is a constituent of certain hair dyes.

11. Lead Tetroxide (Red lead, Minium), Pb_3O_4.—This is a scarlet crystalline powder, though varies in colour according to its mode of preparation. It is insoluble in water, but partially dissolved by nitric acid. It is called *Sindur* in the vernacular, and is employed as a pigment. It is also used to adulterate snuff just to improve its colour.

Acute poisoning.—This occurs mostly from lead acetate.

Symptoms.—Sweet metallic taste, dryness of the throat and intense thirst immediately after swallowing the poison. Vomit occurs within half-an-hour, the vomited matter being white or tinged with blood. Colicky pain comes in paroxysms, but is relieved on pressure. The abdominal walls are tender and contracted. Constipation is a constant feature, though purging has occurred in some exceptional cases, when stools are offensive and dark or black from the formation of lead sulphide. The urine is scanty. The tongue is coated and the breath is very foul and offensive. Great prostration occurs with the cold and clammy skin and the quick and feeble pulse. Nervous symptoms develop; viz., drowsiness, insomnia, headache, vertigo, muscular cramps, convulsions, numbness and paralysis of the lower limbs. Wasting follows, and death occurs generally from exhaustion.

Sub-Acute Form.—The sub-acute form of poisoning results from the administration of repeated small doses of a soluble salt, such as lead acetate. A black line is marked on the gums, and the gastro-abdominal symptoms are usually present. The face is livid and sunken and the look is anxious. Secretions are mostly arrested. The urine is scanty and deep red. The nervous symptoms are more prominent; such as numbness, vertigo, dragging pain in the loins, cramps and paralysis of the lower limbs. Death, though rare, may occur from convulsions and coma within three days.

After apparent recovery the symptoms, sometimes, return more probably in an aggravated form, and the illness lasts for a long time.

Fatal Dose.—Uncertain. Lead is not an active poison, though alarming symptoms have been produced even from the medicinal doses of acetate of lead. Recovery has followed one ounce of sugar of lead, or of lead carbonate. 1½ ounces of carbonate of lead have proved fatal, and a "knife-pointful"

of litharge taken with a view to procure abortion has caused death.

Fatal Period.—Uncertain, Two children who swallowed Goulard's extract died in 36 hours. An adult who took 1½ ounces of white lead died on the 3rd day.

Treatment.—Administer sodium and magnesium sulphate to form an insoluble lead sulphate, and then wash out the stomach. Dilute sulphuric acid may be given. If vomiting does not occur, it should be excited by giving simple emetics. Give mlik, white of egg and barley. Opium may be given to relieve pain. Potassium iodide should be given to eliminate the lead, after it is absorbed. Liquid and non-irritant diet should be given.

Post-Mortem Appearances.—The signs of acute gastro-enteritis are present. The mucous membrane of the stomach may be thickened and softened with eroded patches, and may be covered with a whitish grey deposit. The same appearances may be observed in the duodenum.

Chronic Poisoning (Plumbism, Saturnine Poisoning.—This occurs among persons employed in factories and industries, in which lead and its salts are used ; thus it occurs among painters, plumbers, pewters, enamel workers, glass blowers, electric light workers, glaziers, lace workers, lead smelters, card players, etc. It may also result from tinned foods contaminated with lead, from drinking water or cider stored in leaden cisterns and from constant use of hair dyes and cosmetics containing lead.

Persons of all ages are attacked. Women are more prone to it than men. Children are less susceptible.

Symptoms.—A metallic taste in the mouth ; a black line on the gums, especially of the upper jaw, but it is absent if there are no teeth or if they are kept clean. This is due to the decomposed food in the mouth forming hydrogen sulphide, which forms black sulphide of lead. The pulse is

slow and of high tension. The patient complains of dyspepsia, becomes emaciated and anæmic, and has a shallow complexion.

The chief prominent symptoms are colic and constipation, arthralgia, encephalopathy and paralysis.

1. Colic and Constipation,—(Dry belly-Ache).—The colicky pain felt round the umbilicus is very intense, but is relieved on pressure. The abdominal muscles are retracted, though hard and tense. There is obstinate constipation. Tenesmus is usually present, but diarrhœa is very rare.

2. Arthralgia.—The patient complains of rheumatic pain of a shooting nature in the bones and joints, such as knees, elbows and shoulders, but the small joints are not affected. Contractions and twitchings of the muscles may be present.

3. Encephalopathy.—This involves cerebral and psychical affections; such as, intense headache, dizziness, insomnia, anæsthesia, optic neuritis, amaurosis, convulsions, hallucinations, delirium, insanity, eclampsia and coma. Besides these, there are other symptoms, viz., vaginismus, abortion in pregnant women and loss of sexual power in men.

4. Paralysis.—Paralysis first effects the extensor muscles of the fore-arm and fingers except the supinator longus and causes "wrist drop" and "claw shaped hand". It then spreads to the extensors of the foot, resulting in "dropped foot". The tibialis anticus is generally not affected. The muscles begin to waste, and the condition resembles that of acute anterior poliomyelitis.

Tremors, which are increased by movements, are observed in the muscles before paralysis sets in.

Treatment.—Remove the patient from the source of poison. It has been suggested that potassium iodide elimi-

nates lead from the system, but this is not reliable. Give magnesium sulphate to remove lead from the bowels. Hot baths, sulphur, galvanism, massage, fresh air and nutritious diet are the usual forms of treatment adopted in chronic poisoning. As a prophylactic use thorough cleanliness, wet grinding, exhaust fans, dilute sulphuric acid and lemonade.

Post-Mortem Appearances.—Not constant. A black line along the margin of the gums. The paralysed muscles are flaccid, and show fatty degeneration. The intestines are contracted and thickened. The liver and kidneys are found hard and contracted, the seat of granular degeneration.

Chemical Tests.—1. Hydrochloric acid produces a white precipitate soluble in boiling water, but insoluble in ammonia.

2. Hydrogen sulphide produces a black precipitate insoluble in dilute acids, and caustic potash or ammonia.

3. Potassium iodide gives a yellow precipitate soluble in boiling water, but reappears on cooling.

Potassium chromate or dichromate gives a yellow amorphous precipitate soluble in potassium hydroxide and strong hydrochloric acid, but insoluble in acetic acid. A yellow precipitate produced by potassium chromate with a copper salt is soluble in acetic acid.

4. Sulphuric acid gives a white crystalline or granular precipitate insoluble in nitric acid, but soluble in hydrochloric acid and ammonium acetate.

Medico-Legal Questions.—Lead in the metallic form is not poisonous, but it is very likely acted upon by the secretion of the intestines, and hence acts as a poison after it is absorbed into the system as a salt. Its compounds are powerful poisons.

In the absence of air pure water has no action upon lead, but in the presence of air a slightly soluble lead hydroxide is formed. Again, the solvent action of water

upon lead is greatly influenced by the presence of chlorides, nitrates, nitrites, and carbon dioxide dissolved under pressure. Water containing carbonates, sulphates and phosphates has no action on lead.

2. Acute lead poisoning is very rare, and usually terminates in recovery. Hence it has very little toxico-logical importance, but chronic poisoning is more common, and is very interesting from a hygeinic point of view, as it is regarded as an industrial disease.

The chief compounds of lead which produce poisonous symptoms are acetate, carbonate, oxide, red lead, and lead chromate. The chloride and nitrate do not figure so much in medico-legal work, as they are not easily obtainable by the public.

Criminal poisoning by lead salts is a very rare occurrence.

The paste used for anointing "abortion sticks" very often contains red lead as a chief ingredient. Mixed with arsenious acid it is used as a cattle poison. Diachylon has been recently used largely as an abortifacient.

Most of the accidental cases have occurred from administering a large dose of lead acetate in mistake.

Accidental chronic poisoning has occurred from the use of lead oxide (*Murdasang*) as a remedy for syphilis by quacks.

3. Lead enters the system through the skin and lungs, but chiefly through the digestive organs.

4. It is eliminated from the system largely in the fæces, and to a small extent in the urine. It is said that it is excreted by the skin, but there is no proof for this. However, it being a cumulative poison tends to accumulate in the system.

5. Idiosyncrasy plays a great part in the effects of the poison. Some people, even though exposed to the action of lead salts, may not be affected. Persons addicted to

alcohol are more prone to the attack of chronic poisoning. Gouty persons are soon affected, while it should be remembered that chronic poisoning develops gout and granular kidneys.

Not only does abortion occur from chronic lead poisoning between the 3rd and 6th months of pregnancy, but a healthy woman, if impregnated by a man suffering from chronic lead poisoning, is likely to abort.

ZINC (*JASAT.*)

The salts of zinc, which are important from a toxicological point of view are :—

1. Zinc Chloride, $ZnCl_2$.—This is a white, deliquescent solid, very soluble in alcohol, its solution being used as a caustic in medicine. It is contained in the proportion of 350 grains to the ounce of water in Burnett's fluid, which is used as a disinfectant. It is also used to load textile fibres. Clothes made with these fibres, when worn, produce ulcers and sloughs of the skin, with which they come in to contract.

2. Zinc Sulphate (White Vitriol, White Copperas, *safed tutia*), $ZnSO_4$.—This is a white crystalline solid, closely resembling magnesium sulphate and oxalic acid, but having a metallic taste. It is extremely soluble in water, but slightly soluble in alcohol.

Zinc Oxide (*Jasat bhashm*), ZnO.—This is a soft, white tasteless odourless powder, commercially known as *Zinc White*; it becomes yellow on heating. The oxide is insoluble in water, but dissolves in acids, forming different salts. It is largely used as a pigment in place of "white lead", which becomes blackened by hydrogen sulphide present in the atmosphere.

Mixed with zinc chloride in the form of a paste, it is used for filling or stopping carious teeth. It is also used as an ointment.

Zinc oxide is not poisonous, but its fumes are highly poisonous.

Acute Poisoning—Symptoms.—Metallic styptic taste, salivation, vomiting, pain in the stomach and abdomen, severe purging, collapse, convulsions and death.

If zinc chloride has been taken, corrosive symptoms are more prominent and aggravated. These are burning pain in the mouth, throat, gullet and stomach immediately after swallowing the poison; persistent vomiting, tinged with blood and traces of mucous membrane, profuse diarrhœa with tenesmus; great prostration, collapse and death.

Fatal Dose.—The smallest fatal dose of zinc sulphate is half-an-ounce, though recovery has followed one-and-a-half ounce. The smallest fatal dose of the solid zinc chloride, that has been recorded, is 6 grains; but recovery has been brought about after a dose of 200 grains. Two drams of Burnett's fluid have caused death.

Fatal Period.—Death from zinc sulphate poisoning, though rare, has occured within 2 and 4 hours after taking 3 ounces of zinc sulphate, as well as in 5 days.

Death occurs within a few hours from primary shock and collapse caused by the cloride. Two hours are the shortest recorded fatal period. In some cases the primary effects may be recovered from and the patient may die weeks or months afterwards from inanition or perforation.

Treatment.—Emetics need not be given, as zinc sulphate produces vomiting; but it should be promoted by giving warm water or warm milk and by tickling the fauces. Wash out the stomach with water containing sodium carbonate except when zinc chloride has been taken. The antidotes are eggs, milk and the vegetable astringents containing tannin, such as strong decoctions of green tea. Treat the

symptoms as they arise. For instance, give opium to relieve pain, and warmth and stimulants to combat collapse.

Post-Mortem Appearances.—The usual consequences of irritant poisoning, *viz.*, congestion in the mouth, gullet, stomach and intestines are to be seen, if zinc sulphate has been taken; but their mucous membrane will be whitened, detached and corroded, if zinc chloride has been used, There may be ulceration and even perforation of the stomach.

Chronic Poisoning.—This occurs among zinc smelters. It has also resulted from taking milk, soup, oil, water and alcoholic liquids stored in the zinc vessels, zinc being soluble in the weak acids of food.

Symptoms.—Digestive disturbances; dyspepsia; colic with constipation, but more often diarrhœa; anæmia; peripheral neuritis leading to paralysis.

Chemical Tests.—1. Ammonium sulphide in an alkaline solution gives a white precipitate, insoluble in caustic potash or ammonia, but soluble in mineral acids.

2. Potassium ferrocyanide gives a white gelatinous precipitate, insoluble in hydrochloric acid. Magnesium sulphate and oxalic acid which resemble zinc sulphate are not pricipitated by potassium ferrocyanide.

3. Potassium ferri-cyanide gives a brownish orange yellow or fawn coloured pecipitate.

Medico-Legal Points.—1. Poisoning by zinc is very rare indeed. Poisoning has occurred from zinc sulphate having been taken in mistake for magensium sulphate. It has once been used to procure abortion. Zinc chloride has been used suicidally, but rarely for homicidal purposes. Poisoning from this salt has occurred from its application to a wound or to a raw cancerous surface, as also from injection into the rectum in mistake for glycerol. Burnett's fluid has caused poisonous symptoms owing to it having been mistaken for fluid magnesia.

2. The salts of zinc are eliminated from the system chiefly by the bowels and to a slight extent by the kidneys. Zinc may be found in a small amount in the body after death owing to its absorption by food kept in galvanized iron vessels.

BISMUTH.

The salts of bismuth, which are used in medicine, are the oxide, carbonate, salicylate and subnitrate. They are all insoluble in water.

These salts are ordinarily non-poisonous. They are, therefore, given in large quantities mixed with gruel or bread and milk as bismuth meal for the X-ray examination of the stomach and intestines. They are, however, more readily absorbed by abraded surfaces, and poisonous cases have, therefore, resulted from the use of bismuth paste for the treatment of sinuses, abscess cavities and burns.

Bismuth subnitrate is the only salt which has so far produced poisonous symptoms. It is a heavy white, tasteless, odourless powder insoluble in water and alcohol, but soluble in dilute nitric acid. It is known as *majestery of bismuth*, and is sometimes used as a cosmetic under the name of *pearl white.*

The subnitrate, as well as the other salts contain as an impurity arsenic, antimony, lead or tellurium to which they possibly owe their toxic effects.

The proprietary medicines, dermatol and airol, are the subgallate and the oxyiodogallate of bismuth.

Symptoms.—Metallic taste ; salivation ; pain in the throat and abdomen ; sore mouth ; vomiting, purging, the stools being greyish black ; a violet black line is formed on the gums which may be inflamed, ulcerated or even gangrenous ; the garlic-like odour (bismuth breath) probably due to the presence of tellurium as an impurity ; the weak and feeble pulse ; pain over the prœcordial region ; suppressed or scanty urine which is dark and contains albumen and casts ; collapse and lastly death.

Fatal Dose.—A dose of two drams of bismuth subnitrate has caused death. A dose three times as large has been recovered from.

Fatal Period—Nine days in one case.

Treatment.—Use the stomach tube or emetics. Administer demulcents. Give ice to relieve vomiting, and opium to relieve pain.

Post-Mortem Appearances.—Those of acute gastritis.

Tests.—1. Hydrogen sulphide in a weak acid solution gives a black precipitate insoluble in ammonia, but soluble in strong nitric acid.

2. Potassium chromate or bichromate yields a yellow precipitate, soluble in nitric acid, but insoluble in potassium hydrate.

3 *Water Test.* - Hydrochloric acid gives a white precipitate, soluble in excess. To the solution thus obtained if a large quantity of water is added, a white precipitate insoluble in tartaric acid is obtained. The same test is applicable in the case of antimony, but the white precipitate is soluble in tartaric acid.

Medico-Legal Points.— 1. The subnitrate of bismuth is more soluble in the stomach of a dyspeptic patient owing to the presence of butyric and lactic acids. It should, therefore, be prescribed with caution in such cases, lest toxic effects might not be produced.

2. It is eliminated from the system in the fæces, urine and saliva. Like lead, a greater portion of it passes out either unaltered from the bowels, or becomes converted into bismuth sulphide imparting a black or dark brown colour to the fæces.

SILVER *(CHANDI).*

The only salt that has any toxicological value is *silver nitrate* ($AgNO_3$), also known as *lunar caustic* or *lapis infernalis.* It occurs as large colourless rhombic crystals. Mixed with potassium nitrate it is moulded into white or greyish white rods or cones, and is known as *mitigated caustic.* It is freely soluble in distilled water. Its solution has an acid reaction, and a styptic, metallic taste.

Silver nitrate is much used externally for destroying exuberant granulations and warts, and also as a styptic. It is also used in photography, and constitutes a chief ingredient of indelible ink and hair-dyes.

Acute poisoning.—Cases of acute poisoning have occurred from the accidental slipping of the lunar caustic while applying it to the throat. When thus swallowed it acts as a corrosive poison.

Symptoms.—Severe pain in the stomach and vomiting. The vomited matter becomes black on exposure to light, and may contain blood. These are followed by frequent motions, the stools sometimes containing blood. Cramps, convulsions and collapse precede death.

Fatal Dose.—Uncertain. 30 grains have caused death of an adult.

Fatal Period.—The shortest recorded period is 6 hours. Death occurred in 3 days, when 50 grains were given in divided doses in a mixture of 4 ounces.

Treatment.—Give sodium chloride as an antidote to form an insoluble silver chloride. Produce vomiting by administering ipecacuanha powder,

or the hypodermic injection of apomorphinæ hydrochloride. Give demulcent drinks, eggs and milk. Give opium and stimulants.

Post-Mortem Appearances.—The local action of the caustic will be evident by stains, at first white, but becoming black on exposure to light. These stains are noticed on the lips, in the mouth but on the mucous membrane of the alimentary canal touched by the poison as also on the white clothing. Signs of gastro-intestinal inflammation are present.

Chronic Poisoning.—This results from the long continued use of the salt as a medicine or from its long application to the granulations of wounds and ulcers. It also affects those who constantly come in to contact with the salt owing to their occupation.

Symptoms.—These are a black line on the gums and a general discoloration of the skin (*argyria*) due to the deposition of minute silver particles in the cutaneous tissues. This discolouration is permanent, greyish blue or dark grey in colour and first affects the lips, inside of the cheeks, gums, nostrils, eyelids and lastly the chin. It also affects the viscera, chiefly along the walls of the smaller blood vessels. Albuminuria and paralysis of the extensor muscles common in lead poisoning are also met with.

Treatment.—No treatment of any kind is available to remove this discolouration.

Post-Mortem Appearances.—Pigmentation in the corium, liver and kidneys. Dark colouration of serous and mucous membranes.

Chemical Tests.—1. Hydrochloric acid gives a white, curdy precipitate, insoluble in nitric acid, but readily soluble in ammonia and potassium cyanide.

2. Potassium iodide gives a yellow precipitate insoluble in ammonia.

3. Potassium bichromate gives a brick-red precipitate soluble in ammonia.

4. Hydrogen sulphide or ammonium sulphide gives a dark brown precipitate of silver sulphide.

Medico-Legal Points.—1. Cases of silver poisoning are all accidental. One case of suicide has been reported, in which a man took one ounce of silver nitrate, but recovered.

2. Silver is partly eliminated in the urine and fæces, but a great deal is retained in the system, and deposited in the tissues.

IRON (*LOHA*).

The pharmacopœial preparations of iron salts, which are largely used in medicine are mostly prepared from the sulphate and perchloride of iron,

These two salts produce poisonous symptoms, when administered in large doses.

Iron Sulphate (Ferrous Sulphate), $FeSO_4$, $7H_2O$.—This is commercially known as green vitriol or copperas, and is called *Kasis* in Hindustani and *Hirakashi* in Guzerati. It forms green monosymmetic crystals efflorescing on exposure to the atmosphere. It is freely soluble in water. It is used in making blue black ink and dyes.

Perchloride of iron (Ferric chloride), Fe_2Cl_6, $12H_2O$.—This is an extremely deliquescent salt, rapidly soluble in water. When its watery solution is slowly evaporated, yellow crystals are formed. When dissolved in alcohol, it forms a pharmacopœial preparation, called tincture of ferri perchloride. The watery solution is known as liquor ferri perchloride.

Symptoms.—Inky metallic taste in the mouth; violent pain in the stomach and abdomen; vomiting; purging with black motions; suppression of urine; collapse and death. Sometimes there may be convulsions and paralysis of the extremities.

Fatal Dose.—The fatal dose of the sulphate is not known, one ounce and-a-half of the ferric chloride tincture has proved fatal, though recovery has followed a dose of 3 ounces.

Fatal Period.—Uncertain. 5 weeks when one ounce and-a-half of tincture ferric chloride was taken.

Treatment.—Wash out the stomach with the syphon tube, or administer emetics. Give sodium carbonate dissolved in a large amount of water or milk, demulcent drinks, opium and stimulants if necessary.

Post-Mortem Appearances.—Appearances as those of acute gastro-enteritis. The mucous membrane of the stomach is inflamed, and thickened towards its pyloric end.

Chemical Tests.—1. Alkaline solutions of ferrous and ferric salts yield on the addition of the ammonium sulphide, a black precipitate soluble in hydrochloric and nitric acids.

The reactions which distinguish the ferrous from ferric salts are given below in a tabulated form :—

Reagents.	Ferrous Salts.	Ferric Salts.
1. Hydrogen sulphide.	No precipitate.	White precipitate and reduces to ferrous.
2. Potassium ferricyanide.	Prussian-blue precipitate.	Reddish solution but no precipitate.

Reagents.	Ferous Salts.	Ferric Salt.
3. Potassium ferrocyanide.	White precipitate turning blue on exposure.	Prussian-blue precipitate.
4. Potassium sulphocyanide.	No precipitate.	Intense blood-red colour.
5. Acid Tannic.	No change.	Greenish black, inky precipitate.

Medico-Legal Points.—1. Ferrous sulphate has been administered with criminal intent in coffee. It has been used as a cattle poison, especially to kill sheep.

Perchloride of iron has been given for homicidal purposes to persons in an intoxicated condition. Poisonous irritant symptoms have followed the use of iron chloride as an injection into the uterus. Both the sulphate and the chloride have been used in poisonous doses to procure abortion.

2 Iron is eliminated in the fæces and urine.

TIN *(KALAI).*

The only salts that are of any toxicological interest are stannous and stannic chloride. They occur as whitish yellow crystals, but, being deliquescent, are met with in acid watery solutions. A mixtue of these two chlorides in solution is known as *dyers' spirit*, and is used as a mordant in calico-printing.

Symptoms.—Metallic taste in the mouth; nausea accompanied by vomiting; pain in the abdomen; purging; feeble, irregular pulse; cyanosis; headache; great depression; collapse; unconsciousness or drowsiness.

Fatal Dose.—Not known. Half a dram of the tin chloride solution has caused death. Four to ten grains of mallate of tin have proved fatal in children.

Fatal Period.—Not known.

Treatment.—Emetics and the stomach tube should be used. Eggs, bland demulcent drinks, stimulants and anodynes should be next administered.

Post-Mortem Appearances.—Not known, probably those of gastro-enteritis.

Chemical Tests.—1. Sulphuretted hydrogen yields with stannous solutions a dark brown precipitate, and with stannic solutions a yellow precipitate. Both precipitates are soluble in ammonium sulphide.

2. Hydrochloric acid, potassium ferricyanide, and ferric chloride give a blue precipitate to stannous solutions and no precipitate to stannic solutions.

3. Mercuric chloride gives a white precipitate to a stannic salt, which turns grey and lastly black.

4. Gold chloride produces a purple precipitate with a stannous salt, but none with a stannic salt.

Medico-Legal Questions.—1. Poisoning from tin salts is very rare indeed. Accidental cases occur from the use of tinned fruits owing to the mallic acid of fruits acting on tin and forming mallate of tin.

Poisonous symptoms may arise from wearing silk articles of clothing, such as silk stockings, which are sometimes impregnated with tin chloride.

A fatal dose of poisoning has occurred from the accidental use of "putty powder" a higher oxide of tin, which is used for polishing silver vessels.

2. Tin is eliminated in the urine and fæces.

CHROMIUM.

The following preparations of chromium are important from a toxicological point of view :—

Chromic Acid (Chromic Anhydride, Chromic Trioxide), CrO_3.—This occurs as crimson, needle shaped crystals. It is deliquescent and readily soluble in water and alcohol. It is a powerful oxidizing agent, and is used in preparing *liquor acidi chromici.* It is prepared by the action of strong sulphuric acid on a cold saturated solution of potassium bichromate, and therefore exists in "battery fluids" used in bichromate cells. It is a powerful corrosive, and is used as a caustic in medicine.

Potassium Chromate, K_2Cro_4.—This is a yellow crystalline salt, with a disagreeable bitter taste, and readily soluble in water, the solution being alkaline in reaction. It is chiefly used in manufacturing chrome yellow (lead chromate), a very poisonous salt.

Potassium Dichromate (Red Chromate), $K_2Cr_2O_7$.—This is also known as potassium bichromate. It is an orange-red crystalline salt, having a bitter and metallic taste. It is soluble in ten parts of water, forming an acid solution, which is highly poisonous having a special action on the

nervous system. It is insoluble in alcohol. It is used by dyers, furniture stainers and photographers.

Acute Poisoning.—The toxic effects appear within a few minutes, say, 5 minutes or less, after swallowing the poison, usually potassium dichromate or chromic acid. The symptoms are a bitter metallic taste, intense pain in the stomach, vomiting and diarrhœa. The vomited matter is yellow, and sometimes tinged with bile and blood. The stools are yellow owing to the reduction of the salt, and may contain blood. The pupils are dilated, and do not react to light. The respirations are very slow and gasping. The pulse is feeble and almost imperceptible. These are followed by muscular cramps, collapse, unconsciousness and death. Convulsions or unconsciousness may occur in some cases.

Fatal Dose.—Two drams of dichromate have proved fatal in one case. 10 grains have also killed a boy of twenty months. Recovery has followed a dose of 273 grains taken in a solution in mistake for tea, and a dose of half-an-ounce in the case of two individuals who attempted to commit suicide. Death has occurred after swallowing a teaspoonful of chromate of potassium in place of Glauber's salt, as also from a tablespoonful of a fifty per cent. solution of chromic acid.

Fatal Period.—The shortest fatal period is 40 minutes. The average is $8\frac{1}{4}$ hours. Death has been delayed ten days.

Treatment.—Empty the stomach by emetics, or wash it out with warm water. The stomach may then be washed with a weak solution of silver nitrate. Give solutions of magnesium or calcium carbonate in water or in milk, and demulcents, as well as stimulants.

Post-Mortem Appearances.—The mucous membrane of the stomach is inflamed and corroded in patches, and coloured olive-green, or purple due to the conversion of the salt into an oxide. The duodenum also shows the same appearances. Blood is chocolate coloured and shows the spectrum of methæmoglobin. Fatty degeneration of the liver and heart, and acute inflammation of the kidneys.

Chronic Poisoning.—This is apt to occur among those who are employed in the manufacture of dichromate of potassium, and are thus constantly handling the salt, or are exposed to its dust.

Symptoms.—Irritation and inflammation of the mucous membrane of the nose causing sneezing, salivation and conjuctivitis. The nasal membrane then becomes ulcerated, and a perforation occurs in the lower part of the septum.

Deep ulcerated sores known as *chrome holes* occur on the hands, face and other parts of the body, resembling hard chancres in appearance.

At the same time eczematous and psoriatic rashes may appear on the skin, and the periosteum may be inflamed and painful.

Chemical Tests.—An alkaline solution of a chromium salt yields a green precipitate soluble in excess, on the addition of an ammonium sulphide. A solution of chromic acid gives a yellow precipitate with barium nitrate or chloride, soluble in hydrochloric and nitric acid. With silver nitrate it gives a brick-red precipitate soluble in ammonia. When boiled with dilute sulphuric acid and alcohol it acquires a green colouration.

Medico-Legal Points.—Poisoning from chromates is extremely rare, though they are very poisonous. Chromic acid has produced fatal symptoms from an external application as well as from accidentally swallowing it, while applying it to the throat with a throat brush.

Accidental and suicidal cases, though rare, have occurred from swallowing a dichromate as well as a chromate solution. Dichromate has also been given in two or three instances for homicidal purposes, as also for procuring abortion.

The chromate salts are eliminated mainly by the kidneys, but to some extent by the liver and bowels.

POTASSIUM.

The following salts of potassium have caused poisonous symptoms :—

Potassium Nitrate (Salt Petre, Nitre, Sal Prunelle), KNO_3.—In the Vernacular, the salt is called *Sorakhar* or *Kalmi Sora.* It exists as odourless, rhombic crystals. It has a cool saline taste, and is soluble in water. Its solubility increases with the rise of temperature. It is chiefly used in the manufacture of gunpowder and pyrotechnic.

Acute Poisoning.—Accidental cases of poisoning, though rare, have occurred from its use in mistake for magnesium sulphate (Epsom salt) or sodium sulphate (Glauber's Salt). It has been once used to cause abortion. Used as an enema it has caused death.

Symptoms.—Nausea, pain in the stomach and epigastrium, vomiting and purging. The vomited matter and the stools may contain blood. The urine may also contain blood. Dyspnœa, weak irregular pulse, collapse, convulsions and death. Coma may precede death. Recovery from large doses is slow, and the gastric disturbance, parasthesia, cramps and muscular twitchings or paralysis may persist for two or three months.

Fatal Dose.—The smallest is 2 drams. The usual fatal dose is an

ounce, though recovery has occurred even after 4 ounces, taken by mistake for magnesium sulphate.

Fatal Period.—The shortest recorded period is 45 minutes in one case, and 2 hours in the other; the average fatal period is somewhat longer.

Treatment.—Wash out the stomach with the syphon tube. Give stimulants by hypodermic injection; apply mustard plaster on the epigastrium and warmth to the body. Also treat the prominent symptoms.

Post-Mortem Appearances.—The mucous membrane of the stomach is stained bright red or brownish red, inflamed and detached in various parts. Perforation of the stomach has been observed in one case. The small intestine is acutely inflamed. The blood is liquid.

Potassium Chlorate, $KClO_3$.—This is a colourless, crystalline salt with a cool saline taste, soluble in 16 parts of cold water and 2 of boiling water, but insoluble in alcohol. It is largely used in the manufacture of matches, and pyrotechnic, and in calico-printing and dyeing.

Accidental cases of poisoning occur chiefly from an over-dose or from having been swallowed in mistake when prescribed as a gargle.

Symptoms.—When swallowed in large doses it causes pain in the stomach and abdomen, severe vomiting and diarrhœa. When absorbed it breaks up the red blood corpuscles, converting the hæmoglobin into methæmoglobin and setting up secondary symptoms, such as pain in the loin, hæmoglobinuria, suppression of urine, bloody tube-casts, cyanosis of the skin, jaundice, drowsiness, delirium, coma and death.

Fatal Dose.—According to Witthaus the smallest fatal dose is 3 drams for an adult, 75 grains for a child and 15 grains for an infant. According to others 1½ ounce is a fatal dose for an adult, and 45 grains for a child.

Fatal Period.—The shortest recorded fatal Period is 2½ hours in the case of an adult. The longest period is 12 days.

Treatment.—Administer emetics, or wash out the stomach, and use oxygen inhalation, stimulants, transfusion of defibrinated blood, or infusion of normal saline.

Post-Mortem Appearances.—Submucous hæmorrhages in the mucous membrane of the stomach and duodenum, which is swollen, reddened and easily detached. The liver and spleen are enlarged and dark brown in colour. The kidneys are enlarged and inflamed. The lungs are marked with subpleural ecchymoses. The heart is dilated. The brain and its membranes are congested. Blood is chocolate coloured with degenerated red blood corpuscles.

Elimination.—After administration by the mouth potassium chlorate appears in the saliva in five minutes, but is chiefly eliminated in the urine.

Chemical Tests.—If the solution be heated after adding sulphuric acid and indigo solution, the colour disappears.

Potassium Sulphate (Sal Polychrest, Sal de Duobus), K_2SO_4.—This forms colourless, rhombic crystals, having a bitter, salty taste. It is soluble in ten parts of water. It is extensively used for agricultural purposes. Accidental cases of poisoning occur from its use. It has also been employed in France for procuring abortion.

Symptoms.—Pain in the abdomen, vomiting, diarrhœa, exhaustion and collapse ending in death.

Fatal Dose.—The smallest is 2 drams. The usual fatal dose is 2 ounces.

Fatal Period.—2 hours in one case.

Treatment.—Empty the stomach by the emetics or the stomach tube, and treat the symptoms of irritation and depression, as they arise.

Post-Mortem Appearances.—The mucous membrane of the stomach is congested and inflamed.

Potassium Sulphide (Liver of Sulphur), K_2S.—This occurs in dull green solid masses, and is used as potassa sulphurata in the ointment of skin diseases.

Symptoms.—It acts as an irritant poison, but at the same time, exhibits narcotic symptoms owing to its rapid decomposition into sulphuretted hydrogen, death occurring in 15 minutes.

Treatment.—Give dilute solutions of chloride of soda or lime and then treat the symptoms.

Post-Mortem Appearances.—The body surface is livid. Redness of the stomach and duodenum with deposit of sulphur. The lungs are gorged with dark blood.

Chemical Tests.—1. A solution of silver nitrate gives a black precipitate to sulphides. 2. If the solution be heated after adding an acid, hydrogen sulphide will be evolved, known from its turning white paper black, when moistened with a lead acetate solution.

ALUMINIUM.

Alum (*Phitkari*).—This is a double salt of sulphate of aluminium and potassium (potash alum), $Al_2(SO_4)_3\ K_2SO_4,\ 24H_2O$, or sulphate of aluminium and ammonium (ammonia alum), $Al_2(SO_4)_3\ (NH_4)_2\ (SO_4)_3$,

$24H_2O$. It occurs as transparent, colourless, and octahedral crystals, having a sweetish astringent taste. It is soluble in water, but insoluble in alcohol. It is largely used as a mordant for dyeing, as a constituent of certain baking powders to whiten bread, and for purifying water before filtering it.

Symptoms.—Burning pain in the mouth, throat and stomach ; vomiting mixed with blood ; dyspnœa ; frequent pulse ; subnormal temperature ; loss of co-ordination ; convulsions of a clonic nature ; death. In a solid form it acts as a corrosive in the mouth and throat.

Fatal Dose.—Half-an-ounce to an ounce. One dram killed a child.

Fatal Period.—24 hours.

Treatment.—Emetics ; lime water.

Post-Mortem Appearances.—The tongue, mouth and œsophagus are œdematous and corroded. The mucous membrane of the stomach is corrugated, loosened or hardened, and stained red or velvety. The intestines are inflamed.

Chemical Tests.—1. An alkaline solution with ammonia and ammonium sulphide gives a gelatinous white precipitate soluble in caustic potash.

2. Caustic potash gives a white precipitate soluble in excess, which reappears on adding ammonium chloride, but not on adding hydrogen sulphide.

3. Ammonium carbonate gives a white flocculent precipitate.

4. A blue incrustation is formed on charcoal, when heated with a solution of cobalt nitrate.

MAGNESIUM.

Magnesium Sulphate (Epsom Salt), $MgSO_4$, $7H_2O$.—This forms colourless, rhombic prisms, and dissolves readily in water. Its solution has a cool bitter taste, and acts as a purgative. When taken in excess, it acts as an irritant poison. It closely resembles oxalic acid and zinc sulphate and, hence the latter salts have, very often, been mistaken for magnesium sulphate.

Symptoms.—These commence in less than half-an-hour after swallowing the poisonous dose. Burning pain in the stomach and intestines, but no vomiting or purging ; dilated pupils ; paralysis of the lower limbs ; tetanic spasms ; stupor ; coma ; death.

Sometimes, after swallowing a large dose, the patient becomes pale, feels giddy, falls down and dies from syncope.

Injection of magnesium sulphate produces very rapid death.

Fatal Dose.—One ounce has caused death, though the same quantity may be given as a purgative. Two ounces have caused the death of a boy ten years old.

Fatal Period.—An hour after a fatal dose of 2 ounces. 80 minutes after swallowing 4 ounces.

Treatment.—Empty the stomach; give stimulants and treat the symptoms.

Post-Mortem Appearances.—Not characteristic.

Chemical Tests.—1. Caustic potash gives a white precipitate.

2. Rosy pink incrustation on charcoal, if heated with cobalt nitrate.

BARIUM.

Barium Chloride, $BaCl_2$.—This forms colourless, rhombic crystals, having an acrid taste, and soluble in water. It is chiefly used as a chemical reagent. It is highly poisonous, and has been taken by mistake for Carlsbad salt and Glauber's salt.

Barium Nitrate, $Ba(NO_3)_2$. – This crystallizes in large colourless octahedra. It is soluble in water. It is used in pyrotechnic to make green fire.

Barium Carbonate, $Ba(NO_3)_2$.—This occurs as a mineral witherite. It is a fine white powder, insoluble in water, but soluble with effervescence in dilute acids, and is readily decomposed by the free acids of the stomach. It is largely used as a rat poison.

Symptoms.—The symptoms appear within half-an-hour after swallowing the poison. These are severe pain, nausea, vomiting, intense thirst and purging; dilatation of the pupils; dimness of vision; singing in the ears; violent cramps in the legs; convulsions; paralysis; collapse or coma; death.

Fatal Dose.—A dram of the chloride and a dram of the carbonate have caused death. $\frac{1}{4}$ grain of chloride given in $\frac{1}{12}$ grain doses three times a day has produced toxic symptoms. 4 drams of the nitrate have proved fatal. Recovery has followed a dose of 370 grains of the chloride and 540 grains of the carbonate.

Fatal Period.—In recorded fatal cases the shortest period is 1 hour, the longest is 28 hours and the average is 11 hours. Death may be delayed till 7 days.

Treatment.—Give one ounce doses of sodium or magnesium sulphate as an antidote and then give emetics or wash out the stomach with milk

and water. Use morphia to relieve pain and stimulants to combat collapse.

Post-Mortem Appearances.—Reddening and congestion of the mucous membrane of the stomach and duodenum; sometimes erosions of the mucous membrane. Perforation at the cardiac end of the stomach has been observed in one case. The heart is large and flabby. The lungs and brain are congested.

Chemical Tests.—1. Dilute sulphuric acid gives a white precipitate insoluble in hydrochloric or nitric acid.

2. Potassium bichromate yields a bright yellow precipitate.

3. *Flame Test.*—The flame assumes a green colouration, when barium salt is held in it by a loop of platinum wire moistened with hydrochloric acid.

Medico-Legal Questions.—The soluble salts of barium are highly poisonous. They have locally an irritant action and remotely have a depressant action on the heart.

Most of the poison cases are accidental. A few are suicidal. Barium carbonate has been once used as an abortifacient.

Barium is eliminated chiefly in the fæces, though slightly in the urine.

SODIUM.

Sodium Chloride (Common Salt or Table Salt), NaCl.—This is called *Namak* in the Vernacular. It occurs as colourless, cubical crystals, and is largely used in the alkali industry. It is a necessary article of food for man and other animals. It is soluble in water.

Symptoms.—In large doses it causes irritant symptoms, followed by paralysis.

Fatal Dose.—Half a pound.

Treatment.—Emetics or stomach tube.

Post-Mortem Appearances.—Not characteristic.

CADMIUM.

Cadmium Chloride, $CdCl_2$, $2H_2O$.—This is an efflorescent salt having white, silky crystals. When heated, it gives up its water of crystallization, and becomes anhydrous.

Cadmium sulphide is used as a pigment in oil and water colour.

Symptoms.—Those of irritant poison.

Fatal Dose.—From experiments 617 grains of the chloride have been regarded as fatal for an adult. 250 grains caused death in one case.

Fatal Period.—One-and-a-half hour in the above recorded case.

Treatment. - Evacuate the stomach contents by emetics, or wash out the stomach with the syphon tube. Treat the symptoms.

Post-Mortem Appearances.—Not characteristic. Congestion of the stomach, lungs and brain may be found.

Chemical Tests.—1. Hydrogen sulphide gives a yellow precipitate in caustic potash.

2. Cadmium salt forms a brownish incrustation, if heated in the reducing flame of a blow-pipe on a piece of charcoal.

Medico-Legal Questions.—A fatal case of poisoning has occurred from the use of the cadmium chloride, taken probably in mistake for magnesium sulphate.

GOLD (*SONA*).

Gold Chloride (Auric Chloride), $AuCl_3$.—This occurs as soluble deliquescent brown crystals, and is used in photography.

Symptoms.—These are due to its local corrosive action. The lips, tongue, teeth, and the inside of the cheeks are purple coloured, followed by tenderness of the epigastrium, persistent vomiting ; diarrhœa and collapse.

Treatment.—This consists in the administration of eggs and other albuminous substances.

Chemical Tests.—1. Hydrogen sulphide produces a black precipitate, soluble in ammonium sulphide.

2. Ammonia yields a reddish yellow precipitate.

3. Stannous chloride gives a purple red precipitate.

Medico-Legal Questions.—Poisonous symptoms occurred in a boy of six, who playfully swallowed a solution of 12 grains of gold chloride buried in a dust heap.

Six grains of gold fulminate produced death in one case, the prominent symptoms being salivation, vomiting and convulsions.

PLATINUM.

The salts of platinum act as irritant poisons. A double chloride salt of platinum and potassium is used in photography. Hence it is liable to cause poisonous symptoms from its accidental internal use ; but so far no case of poisoning has been recorded. In an experiment on a dog, it was killed by 12 grains of the platinic chloride.

Chemical Tests.—Hydrogen sulphide gives a dark brown precipitate insoluble in hydrocloric acid. Caustic potash or ammonia gives a yellow crystalline precipitate.

NICKEL AND COBALT.

Poisoning from the salts of these metals is exceedingly rare. The chief salts that are likely to produce poisonous symptoms are carbonyl of nickel and cobalt. Nickel carbonyl, $(Ni(CO)_4$, which is a colourless, mobile, highly refracting liquid, has produced fatal symptoms among workmen employed in nickel work. The toxic symptoms are also produced by the inhalation of air charged with the vapours of nickel carbonyl, which is converted into a gaseous condition at 104°F.

Symptoms.—Headache, giddiness, fever, dyspnœa, convulsions, coma and death.

Post-Mortem Appearances.—The brain is congested. The lungs are congested and œdematous. The heart is flabby and dilated.

Chemical Tests.—1. Ammonium sulphide, ammonium chloride and ammonium hydrate yield a black precipitate with nickel and cobalt salts.

2. Potassium ferricyanide gives a yellow precipitate to a nickel salt, and a reddish brown precipitate to a cobalt salt.

3. Ammonium hydroxide gives a green precipitate to a nickel salt, and a blue precipitate to a cobalt salt, soluble in excess.

OSMIUM.

Osmium Tetroxide (Osmic Acid), OsO_4.—This is a crystalline salt, melting at 40°C., and boiling at 100°C. It has a caustic burning taste and a penetrating odour. Its vapours are most irritating and poisonous, the chief injurious effects being the inflammation of the eyes and lungs, and the painful eruptions on the skin.

CHAPTER XXVI.

IRRITANT POISONS, (*Continued*).

B. ORGANIC POISONS.

I. VEGETABLE POISONS.

The vegetable purgatives, when given in large doses act as irritant poisons, and their action is due to an alkaloid, or an acrid oil, or resin residing in them. When applied externally to the skin, they produce inflammation, pustular eruptions, or vesications, and unhealthy calous sores or ulcers. When taken internally the symptoms of grastro-intestinal irritation are more marked, while nervous and cerebral symptoms are mostly absent.

The *post-mortem* appearances show the signs of inflammation of the alimentary canal.

RICINUS COMMUNIS (CASTOR OIL SEEDS, *ARANDI*).

The castor oil plant belongs to N. O. *Euphorbiaceæ*. Its seeds possess severe toxic properties, which are due to *ricin*, a toxalbumin, present in them. The fixed oil expressed from the seeds is largely used in medicine as a purgative.

Symptoms.—Pain in the throat; vomiting; colicky pain in the abdomen; purging may or may not be present; cold skin; prostration; collapse and death.

Fatal Dose.—3 seeds have proved fatal. Recovery has occurred after 17 and 20 seeds.

Fatal Period.—Uncertain. 46 hours to 5 or 6 days.

Treatment.—Evacuate by washing out the stomach, administer hypodermic injection of morphia and stimulants, and apply warmth externally.

Post-Mortem Appearances.—Ecchymoses all over the body. Congestion, softening and inflammation of the mucous membrane of the alimentary canal, with occasional erosions. Blood in the serous cavities.

Detection of Seeds.—There are two varieties of the seeds, *viz.*, a large red seed with brown blotches yielding 40 per cent. of oil, which is largely used for lubricating and illumination, and a small grey seed having bright polished, brown spots and yielding 37 per cent. of oil, the better quality of which is used for medicinal purposes.

Medico-Legal Points.—Accidental cases of poisoning occur among the children from eating the seeds in mistake. The seeds have been administered in food. Ricin acts much more powerfully when injected into the blood, than when taken by the mouth, as it is destroyed in the stomach by the gastric ferments.

CROTON TIGLIUM (CROTON, *JAMALGOTA OR NÆPALA*).

This plant belongs to N. O. *Euphorbiaceæ*. Its seeds are very poisonous, and contain *crotin*, a toxalbumin, which resembles ricin. The fixed oil extracted from the seeds produces vesication, when dropped on the skin, and gastro-intestinal irritation, when swallowed. These effects are due to the crotonoleic acid, which is easily set free from the oil. It is a pharmacopœial preparation.

Symptoms.—Hot burning pain in the mouth and throat extending to the abdomen ; vomiting ; purging with severe griping pain and bloody stools ; great prostration ; collapse and death.

Fatal Dose.—4 seeds have caused death. 3 drops of the oil proved fatal in the case of a child about one year old. 20 and 30 drops have proved fatal in adults, while recovery has followed after half-an ounce of the oil.

Fatal Period.—A few hours ; usually 4 to 5 hours.

Treatment.—Wash out the stomach ; administer opium and stimulants.

Post-Mortem Appearances.—Those of irritation in the alimentary canal.

Detection of Seeds.—The croton seeds are ½ inch long, ⅓ inch broad, oval or oval oblong, odourless and about the size of a grain of coffee. They are covered with a brown or brownish grey shell, which, on scraping becomes black. The kernel is white and oily. One seed weighs about 4 grains. The seeds resemble very much the smaller variety of castor oil seeds, but the latter are bright, polished and mottled.

Medico-Legal Points.—Poisonous symptoms have been produced by inhalation of the dust of the seeds. Accidental symptoms of poisoning have been very often produced on account of croton oil having been frequently administered as a purgative by quacks. It has been used, though rarely, with homicidal intent.

When applied to the skin, croton oil may produce watery and bloody stools owing to the excretion of the crotonoleic acid into the intestines.

COLOCYNTH (BITTER APPLE, *INDRAYAN*).

This is the dried pulp of the plant *Citrulus Colocynthis* (*N. O. Cucurbitaciæ*). The pulp freed from its seeds is an official drug in B. P., and its preparations, extract and pill, are largely used as purgatives. The root and the fruit of the plant contain an active principle, *colocynthin*, which acts as a powerful irritant, when taken in large doses. It has been used to procure abortion.

Symptoms.—Vomiting, severe diarrhœa, collapse and death.

Fatal Dose.—1½ to 2 drams of colocynth powder.

Fatal Period.—40 hours in one case.

Treatment.—Empty the stomach, and give demulcents and stimulants.

Post-Mortem Appearances.—Redness and inflammation of the abdominal organs.

ERGOT.

This is the product of a fungus *Claviceps purpurea*, attacking the grain of several plants, such as rye, oats, wheat, barley and *bajra*, in wet seasons and in ill-drained soils. The ear of the plant is occupied wholly, or in part, by the diseased grains, each of which is of a deep purple colour, tapering at both ends, curved and ½ to 1½ inches long. These diseased grains collected, dried and powdered form the ergot of the shops.

Ergot is lighter than water, has a disagreeable odour and a mawkish, rancid taste. It contains chiefly sphacelinic acid, cornutine and ergotinic acid as its active principles.

Acute Poisoning—Symptoms.—Nausea, vomiting, pain in the stomach, thirst, slight diarrhœa, giddiness, dilatation of the pupils, depressed action of the heart, suppression of urine, cramps, stupor, convulsions, abortion in pregnant women, delirium, coma and death. Death usually occurs from asphyxia.

Chronic Poisoning (Ergotism).—This occurs among those who take it as medicine over a long, continued period or among people who eat bread made of rye flour infested with the ergot fungus.

Symptoms.—The first symptoms are those of gastro-intestinal catarrh, which are followed by convulsive or gangrenous form. In the convulsive form the patient complains of itching, tingling and numbness of the hands and feet, which soon spreads over the whole body. He then gets tonic contractions of various muscles, especially those of the extre-

mities. Dimness of vision, loss of hearing, epileptiform convulsions and dementia are the next symptoms from which the patient suffers. Death occurs from asphyxia due to spasm and weakness of the respiratory muscles.

In the gangrenous form the fingers and toes become painful, swollen, and become dark owing to dry gangrene setting in. Gangrene may extend up to the elbow or knee.

Fatal Dose and Period.—Not known. Two "handfuls" have caused death.

Treatment.—Give emetics or wash out the stomach with warm water. Keep up the body heat; use stimulants and amyl nitrite for inhalation. In chronic poisoning the treatment should be directed to remove the cause.

Post-Mortem Appearances.—Jaundice of the skin and ecchymoses of the blood in the abdominal organs.

Chemical Analysis.—Ergot can be separated from an organic mixture, or suspected bread, or flour by treating it with alcohol acidulated with sulphuric acid. The extract thus obtained is red in colour, and shows two bands-one in the green and the other in the blue—in the spectroscope. If heated after adding caustic potash, ergot assumes a lake-red tint, and emits a fishy odour, which is due to the evolution of trimethylamine.

Medico-Legal Points.—Ergot is largely used as an abortifacient. Its action is more effective on the uterus, which is already contracting. It fails in the early pregnancies. Fatal cases do not seem to occur from a single large dose, but from medicinal doses administered for a long time.

CAPSICUM ANNUUM AND CAPSICUM FRUTESCENS (CHILLIES, RED PEPPER, CAYENNE PEPPER, *LALMIRCH*).

These plants belong to N. O. *Solanaceæ*. The caspicum fruits are powdered, and are then universally employed in

India as a principal condiment in preparing various *chutneys* and *curries*. They owe their pungency and acridity to an oleoresin, called capsicin.

Chillies are used in India for the purpose of torture, when money or confession of some guilt has to be extorted. They are either introduced into the vagina, rectum, or urethra, or rubbed on the breasts of the females. The "Pindaris" used to torture their victims by covering their head with a nose-bag containing chillies. The fumes arising from burning chillies are very irritating, and are used by superstitious people to scare away devils and ghosts.

The seeds, which are contained in a capsule, resemble *Datura* seeds.

ABRUS PRECATORIUS (JEQUIRITY, INDIAN LIQUORICE, *GUMCHI OR RATI*).

This is a beautiful climbing plant belonging to N. O. *Leguminosæ* and found all over India. Its seeds are egg shaped and scarlet in colour, with a black spot at one end, and are each about $\frac{1}{3}$rd inch long and $\frac{1}{4}$ inch broad, having an average weight of $1\frac{3}{4}$ grains. They are used by Indian goldsmiths for weighing silver and gold.

The seeds contain an active principle, *abrin*, a tox-albumin, similar in action to ricin extracted from the castor oil seeds. It loses its activity when boiled, and therefore, the seeds, when cooked, may be used without any harmful effects. The seeds are powdered, boiled with milk, and are then used as a nervine tonic in 1 to 3 grain doses. If administered uncooked they produce vomiting and diarrhœa. The seeds are usually used criminally for poisoning cattle, but sometimes, for homicidal purposes.

The seeds alone or mixed with *datura*, opium and onion are worked with a small quantity of spirits into a paste, which is made into spikes or *suis*, and then dried and hardened

in the sun. These spikes are then placed in a wooden handle, and thrust into the skin of an animal intended to be killed. Sometimes the spike is kept between the two fingers, and is used to slap a person. In his annual report of 1908, the Chemical Examiner, U. P., mentions a case of human "Sui Poisoning." It is possible for the occurrence of such cases in districts in the Bareilly Division and the adjoining districts.

Symptoms.—In a few hours after being pricked with one of these spikes a swelling appears, and slowly extends over a portion of the body. But until the animal drops and cannot move, which is three or four days from the time the swelling appears, there are no symptoms other than this swelling, abstinence from food, and disinclination to sit down. The animal then gets tetanic convulsions or becomes cold, drowsy and comatose, and dies in twenty-four hours.

The symptoms are very much like snake-poisoning. Hence the peasants think that the snake killed the cattle.

In human poisoning a swelling occurs near the puncture, which becomes painful. The swelling rapidly increases and erysipelas supervenes. Death occurs from 3 to 5 days.

Fatal Dose.—1½ to 2 grains.

Fatal Period.—The average fatal period is 3 to 5 days. The shortest is 24 hours.

Treatment.—An anti-abrin can be produced by repeated, small and gradually increasing doses which can be used curatively in abrus poisoning.

Post-Mortem Appearances.—Fragments of "sui" containing ground up seeds of abrus precatorius are usually found in the wound, which is so small that it is not easily seen. Patches of ecchymoses like purpura under the skin, pluera, pericardium, and peritonium. The mucous membrane of the stomach and intestines is highly congested with numerous hæmorrhagic patches on its surface as well as

in the interior of the organs, such as the lungs, liver and spleen.

Test—Physiological.—A watery infusion of abrin or decoction of the seeds, if dropped into the eye, causes purulent ophthalmia.

SEMECARPUS ANACARDIUM (MARKING NUT TREE).

This tree belongs to N. O. *Anacardiaceæ*. Its fruit called marking nut (*Bhilawa*) weighs 25 to 55 grains, and has a hard, black rind within which is a thick pericarp. The pericarp or fleshy pulp of the fruit or seed abounds in a brownish, oily, acrid juice, which turns black on exposure to the air, and is used as "marking ink" for linen and cotton clothes. A dark brown oil is extracted by boiling the bruised seeds in water, and is closely allied to the vesicating oil of the cashew-nut (*Kaju*). The active principles of the oil are anacardic acid and cardol.

The juice is used internally in 1 to 2 minim doses as a remedy for nervous and scrofulous affections and syphilis. When applied externally it produces irritation and a blister containing an acrid serum, which produces eczematous eruptions of the neighbouring skin, with which it comes into contact. 100 grains of the dried juice are fatal.

Criminally the juice is introduced into the vagina as a punishment for infidelity, or is applied to the skin to produce a bruise to support a false charge. It is also instilled into the eyes by malingerers to produce ophthalmia.

Detection.—To find out whether the vesication is produced by the marking nut, remove the epidermis of the blister and extract with alcohol, or apply lint soaked in alcohol under gutta percha tissue over the vesicle. The alcoholic extract with liquor potash assumes a bright greenish colour turning to reddish brown.

CALOTROPIS GIGANTEA AND PROCERA (*MADAR, AKDO*).

These plants belong to N. O. *Asclepiadeæ*, and grow wild on waste ground. The flowers, leaves and the bark of the root are used in medicine. The powdered bark in 5 to 10 grain doses is used as a substitute for ipecacuanha, and its tincture is used in dysentery.

The leaves and the stalks, when fresh, yield an acrid milky juice, which irritates the eyes, and is used as a vesicant, depilatory and as a remedy for chronic skin affections. For criminal purposes it is used as an abortifacient, infanticide, and smeared on a rag it is used as a cattle poison. It has been rarely used suicidally. One dram of the root bark has caused death.

The poisonous properties appear to reside in a yellow bitter resin present in the juice, and in *madar-alban* and *madar-fluavil* contained in the root bark.

PLUMBAGO ROSEA (*LAL CHITRA*), AND PLUMBAGO ZEYLANICA (*CHITRA*).

The roots of these plants, which belong to N. O. *plumbagineæ*, contain as an active principle a glucoside *plumbagin*. When applied externally they produce painful irritation and blisters, while administered internally they act as a narcotic-irritant poison.

The crushed roots are largely used for procuring abortion. They are either taken internally, or in the form of paste are applied to the os, or painted on the "abortion sticks." Deaths have ensued from this use. They are rarely used with homicidal intent.

The root of plumbago rosea is also applied to the skin to simulate a bruise.

Tests.—The root is from $\frac{1}{4}''$ to $\frac{1}{2}''$ thick, dark externally and reddish internally. Plumbagin can be extracted with alcohol. It gives a red colour with caustic alkalies and also with lead acetate.

VERATRUM.

There are three species of veratrum belonging to N. O. *Melanthaceæ*. These are Veratrum album (white hellebore) Veratrum viride (green hellebore) and Veratrum officinale (sabadilla). Several alkaloids have been obtained from these plants, the chief of which are veratrine, jervine, pseudojervine and cevadine. From among these, veratrine is an official preparation having a dose of $\frac{1}{70}$ to $\frac{1}{15}$ grain to be given in pill form.

Veratrine.—Veratrine is a white, amorphous, inodorous powder, having an acrid, bitter taste, feebly soluble in water, but readily soluble in acids, alcohol and ether. Pure veratrine is crystalline in character. It is a powerful cardiac depressant.

Symptoms.—Burning pain in the throat, œsophagus and stomach; nausea; thirst and vomiting; diarrhœa accompanied by tenesmus; tingling and itching of the skin which becomes reddened; salivation; sneezing, and running of the eyes and nose; giddiness; feeble pulse; slow and gasping respirations; dilated pupils; cold and clammy skin; death occurs from heart failure or from exhaustion due to incessant vomiting and prostration. Occasionally the tongue may be swollen, the throat may become sore, and spasms of the muscles and convulsions may occur.

Fatal Dose.—Uncertain. 3 grains of veratrine have produced poisonous symptoms. 18 grains of veratrum powder have caused death. 70 minims of the fluid extract (U. S. P.) have proved fatal.

Fatal Period.—Uncertain. Death has occurred within 2 and 4 hours, but it may be delayed for several weeks.

Treatment.—Wash out the stomach thoroughly by the stomach tube or employ emetics. Tannic acid or vegetable astringents will precipitate the alkaloid. Give spirit ammonia aromatic and other stimulants. Keep up the body heat by warmth and friction. Keep the patient flat on the back, and start artificial respiration, if necessary. Opium may be given to check pain and diarrhœa.

Post-Mortem Appearances.—Marks of acute inflammation in the alimentary canal.

Tests.—Strong sulphuric acid gives a play of colours ; viz., yellow, orange and lastly red. On heating, the colour becomes red at once ; or the red colour is developed on adding bromine water.

Concentrated hydrochloric acid has no action in the cold, but on boiling the solution for a minute or two, it acquires a permanent bright red colour.

Weppen's Reaction.—One part of veratrine rubbed with six parts of cane sugar is moistened with a few drops of concentrated sulphuric acid. The colour developed is first yellow, dark green, then blue and lastly dirty violet.

Medico-Legal Points.—All the parts of the veratrum plants are poisonous, but the chief source of poison is their root. It has been taken with a view to cause abortion. Powdered white hellebore has been mistaken for cream of tartar.

Poisonous symptoms have been produced by the subcutaneous injection of veratrine, as also by the application of veratrine ointment.

COLCHICUM AUTUMNALE (COLCHICUM, MEADOW SAFFRON).

This plant belongs to the N. O. *Liliaceae.* Its poisonous properties are due to an active alkaloid, *colchicine*, which with a trace of veratrine is found residing in the root and the seed. These are both official in the B. P.

Colchicin is usually amorphous, but may be obtained in a yellow crystalline form. It is soluble in water and alcohol, but is changed by most acids into colchiceine which is almost inert.

Symptoms.—The symptoms supervene from three-quarters of an hour to two or three hours after swallowing the poisonous dose. These are burning pain in the mouth, throat, œsophagus and stomach. The mouth and the throat are also dry and consequently swallowing is difficult. Intense thirst, nausea, vomiting and diarrhœa. The motions resemble very much choleraic stools except that they contain blood and shreds of mucous membrane, and that they are accompanied by tenesmus. A sensation of oppression is felt in the prœcordial region with a feeling of vertigo. The patient is greatly prostrated and collapsed. The skin is cold, the face is pale or cyanosed. The pulse is small, irregular and imperceptible, and the respirations are slow and laboured. Towards death the pupils are dilated, the twitchings of the muscles, spasms or convulsions occur, and the urine becomes

scanty. The mind remains clear till last. In rare cases stupor may supervene before death.

Fatal Dose.—Uncertain ; 6 grains of colchicin taken internally and 20 grains of colchicin administered hypodermically have caused death. $3\frac{1}{2}$ drams of vinum colchici have proved fatal, though recovery has followed one ounce or more.

Fatal Period.—Average thirty hours. The smallest period is 7 hours. Death may be delayed for days or weeks.

Treatment.—Wash out the stomach with water containing tannic acid or tannin, which is a chemical antidote. Give mucilaginous drinks, opium, and hypodermic injections of stimulants. Apply warmth and friction to the body ; artificial respiration, if necessary.

Post-Mortem Appearances.—Not characteristic. The blood may be found of a dark cherry-red colour, with the consistency of treacle. Inflammation of the mucous membrane of the stomach and intestines is usually found.

Chemical Analysis.—1. Strong sulphuric acid forms with colchicin a bright yellow solution which, on adding nitric acid, changes to green, blue, violet and lastly to pale yellow. A brick red colour is produced, if now a strong solution of caustic potash be added.

2. Ferric chloride solution gives a dark green colour.

3. Tannic acid gives a white precipitate, readily soluble in acetic acid, alcohol and alkaline carbonates.

4. Chlorine water gives a yellow precipitate, which dissolves into an orange-coloured solution, if ammonia is added to it.

Medico-Legal Points.—Colchicum and its preparations are used as a remedy for gout. Hence accidental cases of poisoning, sometimes, occur from an over-dose of their preparations. Similarly poisonous cases have been produced by the administration of Blair's gout pills and other patent remedies containing colchicum.

Accidental cases of poisoning have also occurred from taking the milk of a goat fed on the leaves of the colchicum plant.

Colchicine has been detected in the bodies of animals exhumed four and-a-half to five and-a-half months after death.

DELPHINIUM STAPHISAGRIA (STAVE SACRE).

This is a plant belonging to N. O. *Ranunculaceæ*. Its seeds are official, and are used in the form of an ointment for destroying pediculi. They contain alkaloids, the chief of which are delphine and staphisagrine,

and also a fixed oil. They act both as an irritant and depressant. Poisoning from the seeds is very rare.

The symptoms are a distended, painful abdomen, dilated pupils, slow feeble pulse, difficult and laborious breathing and severe collapse.

HELLEBORUS NIGER (BLACK HELLEBORE, *(KALI-KATUKI)*.

This plant belongs to N. O. *Ranunculaceæ*. All its parts are poisonous. The root is employed as a hydragogue cathartic, emmenagogue and anthelmintic. It is given in five to ten grain doses, but in large doses acts as an irritant-narcotic poison.

The symptoms are vomiting, pain in the abdomen, diarrhœa, profuse perspiration, convulsions, insensibility and death.

CYSTISUS LABURNUM (*LABURNUM*).

This belongs to N. O. *Leguminaceæ*. It grows wild in gardens, shrubberies and woods in England. All parts of the plant, viz., the bark, wood, seeds and flowers, produce toxic effects, when taken internally. The plant has a most nauseous and disagreeable odour and taste. The active principle is an alkaloid, cystisine, which is a chief ingredient contained in Australian or Persian insect powder.

Symptoms.—Pain in the stomach, thirst, nausea, vomiting, purging, giddiness, collapse, drowsiness and coma. Occasionally convulsions and delirium have preceded death. The pupils are usually dilated, but may be found contracted. Death results from asphyxia.

Fatal Dose.—Not known. 3 or 4 seeds are enough to produce toxic symptoms.

Fatal Period.—Death has occurred from one to thirty hours, and has been delayed the seventh day.

Treatment.—Emetics, or wash out the stomach with warm water; stimulants, and artificial respiration, if necessary.

Post-Mortem Appearances.—Not characteristic. The brain and its membranes may be found congested. The stomach and intestines may be inflamed.

Tests.—1. Strong sulphuric acid dissolves cystisine without effecting any change of colour, but, on heating, the solution acquires a yellow colour.

2. A mixture of sulphuric and nitric acids produces a yellow colour.

3. A ferric chloride solution gives a red colour, which disappears on adding hydrogen peroxide. On further heating, it assumes a blue colour.

Medico-Legal Points.—Accidental cases of poisoning have occurred among children on account of having eaten the bark in mistake for liquorice, as well as the seeds which are sweet in taste.

Cystisine is eliminated largely in the urine, and to some extent in the fæces, as well as in the saliva.

TAXUS BACCATA (*YEW*).

This plant belongs to the N. O. *Coniferæ*. The poisonous symptoms are due to an alkaloid, *taxine*, contained in the leaves and seeds of its berries. Taxine is hardly soluble in water, but dissolves in alcohol, ether and chloroform. Yew leaves are sold as *birmi* and *taliopatra* in Indian towns.

Symptoms.—Giddiness, dilated pupils, vomiting, purging, pain in the abdomen, small irregular pulse, slow laboured breathing, collapse, convulsions, insensibility, delirium or coma.

Fatal Dose.—Unknown. One tea-spoonful of the leaves, and 4 berries have caused death.

Fatal Period.—4 hours in one case, but may be delayed for some days.

Treatment.—Empty the stomach, keep the body warm, and use stimulants and artificial respiration, if necessary.

Post-Mortem Appearances.—Inflammation of the mucous membrane of the stomach which may contain the seeds or the leaves of the plant.

Medico-Legal Points.—Cases of poisoning occur accidentally among children on account of their eating in mistake the leaves and fruits of the plant, and among women, as they very often use the infusion of the leaves as an abortifacient owing to its emmenagoguic properties.

JUNIPERUS SABINUS (*SAVIN*).

This shrub belongs to N. O. *Coniferæ*, and yields a round purple fruit about the size of a currant. It has a peculiar strong odour, and an acrid taste. Its leaves and tops contain, as an active principle, an essential oil, oil of savin, which acts as a vesicant, when applied externally and acts as an irritant, when administered by the mouth. The oil and the infusion of the leaves have been very often used as abortifacients, but they have no direct ecbolic action on the uterus. They cause abortion by

producing congestion of the pelvic organs due to their irritating action, and consequently the death of the woman.

Symptoms.—Violent pain in the throat, and abdomen ; vomiting ; purging though rarely ; hæmaturia ; strangury ; laboured and stertorous respiration ; unconsciousness rapidly ending in death. Salivation occurs occasionally.

Treatment.—Eliminate the stomach contents ; give heart stimulants, and chloral hydrate and morphia.

Post-Mortem Appearances.—Acute inflammation of the œsophagus, stomach, intestines and kidneys.

Detection.—Perchloride of iron imparts a deep green colour to watery solutions of savin.

GAMBOGE (*REVENCHINO SHERO*).

This is the gum obtained from Garcinia morella belonging to N. O. *Guttiferæ*. It is used as a purgative, the dose being $\frac{1}{2}$ to 2 grains. It is largely used by quacks, and forms one of the chief ingredients of several quack vegetable pills, which very often produce poisonous symptoms of an irritant poison. One dram has proved fatal.

JALAP.

This is a powder prepared from the dried tubercles of Ipomea purga or Exogonium purga belonging to N. O. *Convolvulaceæ*, and is used as a hydragogue purgative from 5 to 20 grain doses. The purgative properties are due to a resin contained in its root. The resin is also an official preparation having a dose of 2 to 5 grains. In larger doses it acts as an irritant.

SCAMMONY.

This is a gum resin obtained from the root of Convolvulus scammonia belonging to N. O. *Convolvulaceæ*. It is easily pulverized, and forms into an emulsion when mixed with emulsin. The resin is used as a drastic purgative in 3 to 8 grain doses. It contains an active principle *jalapin*. In large doses it acts as a strong gastro-intestinal irritant, and may cause death, if administered to weak, debilitated persons.

KALADANA SEEDS.

These are the seeds of Ipomea hedercea cultivated in several places of India, and belonging to N. O. *Convolvulaceæ*. Their active principle is a

pale yellowish resin, *pharbitisin*, corresponding in chemical action to jalapin, to which its irritant properties are chiefly due.

The seeds are official in the Pharmacopœia of India, having a dose of 30 to 50 grains. Its resin has also been made official, the dose being 2 to 8 grains. In large doses they act as an irritant poison.

IPOMŒA TURPETHUM (*NISHOTAR, PITHORI*).

This plant belongs to N. O. *Convolvulaceæ*, and is called an Indian jalap or *white turpeth*. Both the root and the bark are used as a cathartic and laxative. The ordinary dose is ½ to 1½ drams. Large doses produce irritant symptoms. Another variety known as *black turpeth*, is more drastic in its action and is, therefore, not used in medicine.

CUSCUTA REFLEXA (*AKASBEL*).

This is a parasitic climbing plant growing wild on certain hedges, and belonging to N. O. *Convolvulaceæ*. Its decoction is used as an abortifacient by "Dais", chiefly in the Punjab. It is said that a decoction of 180 grains of the plant produces abortion, though at the same time it causes nausea, vomiting and depression.

EUPHORBIUM.

This is an acrid milky juice exuded from the stems of various euphorbious plants belonging to N. O. *Euphorbiaceæ*; the chief of these are Euphorbia antoquorum (*tidhara, sehund*), Euphorbia nerifolia (*thohar*) and Euphorbia tirucalli (milk hedge or Indian tree-sponge).

The juice produces vesication when applied to the skin, and conjuctivitis when applied to the eyes. Internally it acts as an irritant, causing vomiting, diarrhœa, convulsions and coma. A teaspoonful has caused death of an adult in 3 days. It is used to procure abortion.

JATROPHA CURCAS (PHYSIC NUT, *JANGLI ARANDI*).

This evergreen plant belongs to N. O. *Euphorbiaceæ*. Its seeds contain a pale yellow acrid oil, which has almost the same action as croton oil. Applied externally, it causes irritation, and has a purgative action, when administered internally. 12 to 15 drops of the oil produce alarming symptoms.

The active principle of the oil is jatrophic acid, but the seeds owe their toxic properties to a tox-albumen, called *curcin* and analogous to ricin.

Symptoms.—Nausea, vomiting, diarrhœa, pain in the abdomen, general depression, twitchings of the muscles, derangements of the special senses and loss of memory.

JATROPHA URENS.

This plant also belongs to N. O. *Euphorbiaceæ*. Its leaves are covered with hairs, which, if rubbed against the skin, produce irritation inflammation and severe prostration.

ALOES (*ELWA* OR *ELIO*).

This is the inspissated juice derived from the leaves of Aloe Vulgaris and other species belonging to N. O. *Liliaceæ*. Its active principle is aloin. Aloes and aloin are both used as purgatives, but in large doses act as irritants, 2 drams of aloes having proved fatal in 12 hours. The *post-mortem* appearances are inflammation of the stomach and small intestine to some extent.

Aloes increases the menstrual flow reflexly by stimulating the uterus. It is, therefore, used as an abortifacient. Aloes is a leading ingredient in most quack aperient pills, and is one of the chief ingredients of Morison's pills, the other ingredient being colocynth. *Heira picra* (holy bitter), a compound of 4 parts of aloes and one part of canela bark is, sometimes, employed to procure abortion.

URGINEA SCILLA.

This plant belongs to N. O. *Liliaceæ*. Its bulbous root cut into slices and dried is an official preparation known as squill, and is given internally as a diuretic and expectorant in 1 to 3 grain-doses. In large doses it acts as a powerful gastro-intestinal irritant, and produces vomiting, purging, strangury, bloody urine and cardiac depression. 24 grains of the root have proved fatal. It owes its toxic properties to *scillitoxin* or *scillin*, a glucoside, the most active principle.

An Indian variety called urginea Indica (*Jangli piyaz*) is used as a substitute for squills.

GLORIOSA SUPERBA (*CARIHARI, KHADIYANAG*).

This belongs to N. O. *Leguminosæ*. It is an elegant climbing hedge plant growing in Bengal and in low jungles throughout India, and flowers about the end of the rains. Its root contains an active bitter principle *superbine*, a glucoside. It is used as a tonic, stomachic and antiperiodic in 5 to 10 grain-doses. Up to 12 grains it is not poisonous, but beyond that it has possibly the same poisonous action as squill. It is said to be used in India as an adulterant of aconite.

Symptoms.—Nausea, violent vomiting, purging, spasms, convulsions, profuse sweating and collapse with heart-failure. Death occurred in 4 hours in the case of a female 18 years old.

Post-Mortem Appearances.—Inflammation of the gastric mucous membrane. Congestion of the liver, kidneys, lungs and brain.

ARUM MACULATUM (LORDS AND LADIES, CUCKOO-PINT, WAKE-ROBIN, THE PARSON IN THE PULPIT).

This plant belongs to N. O. *Araceæ*. Its root, if eaten raw, produces irritant symptoms in addition to the swelling of the tongue, salivation and dilatation of the pupils, but it loses its poisonous properties by soaking it in water, and then baking it. It is thus used as an article of food.

Cases of accidental poisoning have occurred among children on account of their having eaten the leaves.

The other arum varieties are Amorphophallus Campannalatus (*Suran*) and Arum Colocasia (*Kachu*).

CRINIUM DEFLEXUM OR ASIATICUM (*SUKHADARSHAN, NAGDOWN*).

This is a large plant belonging to N. O. *Amaryllideæ*, and much cultivated in Indian gardens. Its leaves and root are used as a substitute for ipecacuanha, and act as vesicants if applied externally. They produce irritant symptoms if administered internally in large doses.

ARGEMONE MEXICANA (*PILA DHATURA, DARUDI*).

This is an American herbacious annual belonging to N. O. *Papaveraceæ*, but now growing wild in the cold season all over India. The oil expressed from its seeds acts as an irritant, if given in doses of more than 30 minims.

COCCULUS SUBEROSUS (*KAKMARI, KAKPHAL*).

This belongs to N. O. *Menispermaceæ*, and is also known as Anamirta Cocculus. It grows in Southern and Eastern parts of India and in Burma. The poisonous berries are dark brown, and constitute the cocculus indicus or Levant nut of commerce. These berries are used as fish poison by the pearlers, especially in the Persian Gulf. For this purpose the berry is mixed with flour and a little tobacco, made into a dough, and small pellets are thrown into water. The decoction of the berries is also sometimes used to facilitate theft or rape, and to adulterate country liquor to increase its intoxicating effect.

The poisonous properties are due to an active principle, *picrotoxin*, which exists in colourless shining prismatic crystals, and has an intensely bitter taste. The pericarp is not poisonous, and the entire berry might pass through the body without causing poisonous symptoms. As an ointment it is employed to destroy pediculi, but care must be taken in its application; as it is absorbed through the abraded skin.

MORINGA PTERYGOSPERMA (*SHAJNA, SHARAGAVA*).

This tree belongs to N. O. *Moringeæ*, and grows wild in the Sub-Himalayan range. The fresh root of this tree closely resembles the common horse-radish in taste, smell and general appearances. The pods are used as a vegetable, and are considered preventive against intestinal worms. The root acts as a vesicant, if applied externally. The powdered bark is largely used as an abortifacient in Bengal, and has produced fatal results.

RUTA GRAVEOLENS (*SATAP*).

This plant belongs to N. O. *Rutaceæ*, and is commonly cultivated in Indian gardens. It yields, on distillation, a volatile oil, which is acrid bitter in taste, and is a valuable diuretic and emmenagogue. In large doses it acts as an abortifacient, and produces irritant symptoms.

SAPINDAS TRIFOLIATUS (*RHITHA*).

This tree belongs to N. O. *Sapindaceæ*, is common in Southern India and is cultivated in Bengal. The fruits are known as soap-nuts, and are largely used for washing silk, etc. They contain an active principle *saponin*, a white amorphous powder, which dissolves in water, forming a froth like soap. When taken internally or used hypodermically, it acts as an irritant poison with nervous symptoms.

CHAPTER XXVII.

IRRITANT POISONS—*Continued.*

II. ANIMAL POISONS.

CANTHARIDES.

The Cantharis Vesicatoria or Spanish fly is $\frac{5}{4}$ to 1 inch long and $\frac{1}{4}$ inch broad, and is distinguished by the shining metallic green colour of the head, legs and wing-sheaths. Under these sheaths there are two thin, brownish, transparent membranous wings. The powder of its dried body is greyish-brown, and contains shining green particles. The active principle is *cantharidin*, a crystalline body, insoluble in water, but soluble in alcohol, ether, chloroform and oils. It is a powerful vesicant.

Symptoms.—Soon after swallowing the poison there is an intense burning pain in the mouth and throat, quickly extending to the stomach and the whole of the abdomen, and is accompanied by difficulty in swallowing, intense thirst, salivation due to the inflammation of the salivary glands, nausea, vomiting containing blood and shreds of mucus mixed with shining green particles, and diarrhœa of bloody stools with tenesmus. These are followed by pain in the loins, distressing strangury, passage of scanty urine containing blood and albumen, painful priapism in the male with swelling and inflammation of the genital organs and frequent seminal emissions, and abortion in pregnant women. The patient becomes extremely restless, with laborious respirations and hard, quick pulse. In severe cases, headache, delirium, convulsions and coma occur followed by death.

Occasionally blisters occur in the mouth and other parts

of the digestive tract with which it comes into contact. There is also redness of the eyes and lacrimation.

Fatal Dose.—Twenty-four grains of the powder, and one ounce of the tincture of cantharides have caused death, though recovery has occurred after larger doses. 11½ grains of cantharidin have also caused death.

Fatal Period.—The usual period is twenty-four to thirty-six hours. A man 70 years old died in 12 to 24 hours from a dose of 11½ grains of cantharidin. Death has also occurred in 4, as well as 14 days.

Treatment.—Eliminate the poison by washing out the stomach. Give demulcent drinks and opium. Do not give oils or fats, as they dissolve cantharidin.

Post-Mortem Appearances.—The shining particles of powdered cantharides may be found adherent to the mucous membrane of the stomach, which is softened, inflamed and ulcerated, showing patches of vesication or even gangrene. The same is the condition of the lining membrane of the intestines. The spleen is hyperæmic and congested. The kidneys are congested and inflamed. The bladder is injected and ecchymosed.

Chemical Analysis.—Cantharidin should be extracted by Dragendorff's method, and should be tested by its blistering action on the skin.

When combined with a solution of caustic potash or soda, cantharidin gives a green precipitate with copper sulphate, and a red precipitate with cobalt sulphate.

Medico-Legal Points.—Cantharides has produced poisonous symptoms on account of it having been used as an aphrodisiac, or as a criminal abortifacient. It is very rarely used for homicidal purpose. Accidental poisoning has occurred from its external application as a vesicant, or from the use of a blistering paper.

According to the law of England it is a criminal offence to

administer a drug with the intention of exciting sexual passion, but not so according to the Penal Code of India.

Cantharidin is eliminated in the urine and fæces. Cantharides does not affect fowls, but poisonous symptoms occur in a man, who eats a fowl, that has been fed with cantharides.

SNAKES (OPHIDIA)

In India there are two chief varieties of snakes, poisonous and non-poisonous.

Poisonous Snakes.—These are again classified as Colubrine and Viperine.

The Colubrine snakes are the land (terrestrial) snakes (elapinæ), and the sea snakes (hydrophinæ.

The land snakes are the cobra (Naia tripudians), the king cobra (Naia bungarus), the common Krait (Bungarus cæruleus), and the branded Krait (Bungarus fasciatus). These land snakes have a round tail. The first two varieties are hooded, and the second two are non-hooded and have a dorsal line of hexagonal scales.

Among the sea snakes the commonest is Enhydrina Valakadien. The sea snakes have a flattened tail, and the snout and crown are covered with large plate-like shields.

The viperine snakes are Daboia or Russell's viper (Daboia or Vipera Russellii), and the Phoorsa (Echis Carinata). These snakes have a peculiar broad lozenge-shaped head, small scales and a round tail.

These poisonous snakes possess two grooved or tubular fangs or poison teeth, communicating by means of a duct with the racemose glands secreting the venom. These glands are the homologues of the parotid glands and situated behind the eyes, one on each side. The whole mechanism is so arranged, that all the venom secreted by the glands is discharged without any leakage at the moment the fangs pene-

trate the skin. The colubrines have very short fangs, and hence they cannot bite through the clothes ; while the vipers have long fangs, so that they can easily bite through the clothes.

Characteristics of the Snake Venom.—The snake venom is not a simple solution of one poisonous substance, but is a mixture of one or more of the following :—

1. *A powerful fibrin ferment.*—This is separated at 75°C, because it is destroyed causing coagulation of the blood.

2. *An anti-fibrin ferment.*—This is not important. It causes permanent fluidity of the blood *post-mortem.*

3. *A proteolytic ferment.*

4. *Cytolysins.*—These are present in a greater proportion in the viperine poison. They are capable of acting upon the red blood cells, leucocytes, endothelial cells of the vessels, nerve cells, and the cells of various other tissues. Hence in bites by viperines there is much hæmorrhage and sloughing.

5. *Aglutinin.*—This is for red blood cells.

6. *Neurotoxins.*—These attach themselves to all the nerve cells and especially the cells of the respiratory centre. These are the chief constituents of colubrine venoms. Hence paralysis, especially of respiration is a marked symptom. These substances vary greatly in different specimens.

7. *A substance* which acts directly on the heart muscle, stimulating it and increasing its tone. This is also more marked in the colubrine venoms.

Non-Poisonous Snakes.—There are several species of non-poisonous snakes inhabiting India. Their tails are not markedly compressed, and in most of the varieties their belly is covered with transverse plates, which, however, do not extend completely across it. They possess several small teeth attached to a short maxillary bone, and have no long and grooved fangs like the poisonous variety.

Symptoms of Snake Poisoning (Ophitoxæmia).—

These vary according to the variety of the snake. If bitten by the cobra or the krait, the symptoms are considerable burning or stinging pain, irritation, redness and swelling at the site of the bite. In about an hour the patient begins to feel giddy, lethargic, and weak in the muscles and feels as if intoxicated. Salivation, nausea and vomiting are, sometimes, the early symptoms. Weakness of the muscles increases, and develops into paralysis, so that the patient is unable to stand. The tongue and the larynx are also affected. Respiration becomes slower until it stops altogether; the heart continuing to beat for sometime. Sometimes convulsions may precede death.

In the case of viperine or daboia poisoning there is a good deal of swelling and ecchymosis beyond the site of the bite and bleeding from the apertures caused by the bite. Within a few seconds to fifteen minutes after the bite, nausea, vomiting and the signs of collapse supervene with the cold, clammy skin, a small thready, imperceptible pulse, and dilated pupils which are insensible to light. These are followed by complete unconsciousness. In a case reported by Captain Coffin R. A. M. C., 36 hours elapsed before the symptoms appeared. If the patient recovers from these effects, hæmorrhages occur from the mucous membranes of the rectum and other orifices of the body. Extensive local suppuration and sloughing, and malignant œdema or tetanus may supervene, or death may occur from septicæmia. In some cases of snake bite death occurs from shock due to fright before the poisonous symptoms commence.

The snake poison, whether colubrine or viperine, has the hæmolytic action on blood, and reduces the power of its coagulability with the result that a thin bloody serum continues to ooze out from the wound for many hours.

Fatal Dose.—15 to 20 milligrammes of the dried cobra

venom. The amount of the dried venom yielded by a cobra in one bite is 200 to 370 milligrammes, and 150 to 250 milligrammes by a large daboia.

Fatal Period.—Death occurs within a few hours or after 1 or 2 days.

Treatment.—1. Ligature with a thick India rubber band above the site of the bite.

2. Cut out from the part a big piece one to two pounds in weight or amputate, if the finger is bitten; then wash the wound with a strong solution of potassium permanganate, because it destroys the venom, but the crystals are not effective.

3. Inject hypodermically, preferably intravenously polyvalent antivenomous serum of Calmette. This is useful against poisoning by the cobra and krait and not the viper. 1. c. c. of the serum can neutralize 1 milligramme of the dried venom. At least 100 c. c. of the serum should be injected.

4. Inject intravenously Bayliss's fluid; viz., gum arabic 7 parts, sodium chloride, 0.90 parts and water 92.10 parts.

5. Inject hypodermically adrenalin chloride and intramuscularly one 0.90 grain of calcium chloride in 20 minims of water.

6. Use ammonia and strychnia, but avoid alcohol if antivenene has been used.

7. Promote the warmth of the body by hot water bottles, and by friction with ginger or mustard.

8. Adopt artificial respiration.

Post-mortem Appearances.—The wounds resulting from snake bite are, as a rule, two lacerated punctures about $\frac{1}{2}''$ deep in the case of colubrines and about $1''$ deep in the case of vipers. They may be so minute as may not be visible to the naked eye, but may be seen with a lens. There is a good deal of swelling and cellulitis about the bitten part and hæmorrage from the wound, as well as

from the mucous membranes of the body orifices. The areolar tissue round about the wounds is purple and infiltrated. The blood is extremely fluid and purple in colour. In viperine poisoning solid clots may occur in the veins due to the fibrin ferment.

Chemical Analysis.—This can be determined by testing its physiological action on animals and controlling the experiment by mixing the suspected substance with double the quantity of antivenene.

Medico-Legal Points.—Snake poisoning has not much medico-legal value except that very often, in cases of suicidal or homicidal deaths of poisoning, the alleged cause of death given by the relatives is due to snake-bite.

Cattle have been criminally poisoned by introducing into the rectum, rags impregnated with cobra poison. Dr. Hankin describes the process as follows :—A cobra is shut up in an earthen vessel with a banana and irritated. It bites the fruit, thus injecting its venom into the pulp, which is smeared on a rag. This rag is thrust, by the aid of a split bamboo, into the animal's rectum. Such rags are usually found *post-mortem* ; they should be dried, but never preserved in spirit, for this destroys the poison, which looks like a greasy substance of a dirty white colour like putty. It is also asserted that sometimes the snake is made to directly strike the victim.

The bodies of animals killed by snake poison may be eaten without any ill-effects, but their blood is poisonous, and destroys life, if injected into the human body.

The snake venom does not remain in the skin after the bite, but infiltrates into the areolar tissue and at some distance from the punctures owing to the free movement of the skin.

The snake poison is secreted by the milk. Hence an infant died by sucking its mother who was bitten by a snake.

The venom, if properly dried, retains its toxic properties for an indefinite period. It dissolves rapidly in water. Cobra venom loses its poisonous property to a slight extent only, if heated to 73°C. for half-an-hour, but daboia poison loses it altogether, if treated accordingly.

POISONOUS INSECTS.

Ants.—These produce pain, irritation and swelling at the seat of the bite owing to the action of formic acid secreted by certain glands situated in the tail.

Wasps, Bees and Hornets.—These secrete a poisonous fluid containing formic acid, when they bite. Single bites produce local irritation, burning pain and swelling; but multiple bites, sometimes, produce symptoms very much resembling heat apoplexy. These are unconsciousness, lividity of the face, jerky breathing, cold and clammy skin, and involuntary passage of the urine and fæces. Death may occur from shock as well.

Scorpions.—These possess a hollow sting in the last joint of their tail, communicating by means of a duct with the poisonous glands, which secrete poison on stinging. Symptoms produced by the sting are severe local irritation and burning pain. Sometimes, there may be giddiness, faintness, muscular weakness, vomiting, diarrhœa and convulsions. Very rarely death may occur, especially in the young and feeble.

Treatment.—Remove the sting by a forceps or pressure. Apply salt, sulphur matches, potash permanganate, ammonia, washing soda, indigo or ipecacuanha.

POISONOUS ANIMAL FOOD.

Poisoning from animal food may occur in the following ways :—

1. The animal may have been infected by a micro-organismal disease, previously to its slaughter. Even if the

micro-organism is killed by cooking, the spores as well as the toxins generated by the germ will not be affected thereby.

2. The animal may have been fed on poisonous plants or drugs, and consequently the flesh of such an animal, if eaten, will produce toxic symptoms.

3. The animal may have been infected with parasites or ova; such as cysticerci, or trichina. These will develop in the body of the individual partaking the flesh of such an infected animal. He will consequently be infected by tœnia or trichiniasis.

4. The food may have developed toxins or toxalbumins during the process of decomposition.

5. The food may have been infected by pathogenic or saprophytic bacteria gaining access to it.

6. Preserved and tinned foods may have undergone decomposition, or may have been contaminated with poisonous metals used in soldering tins or manufacturing the tins themselves.

7. The food itself may be quite healthy but, owing to indiosyncrasy an individual partaking it may get poisonous symptoms.

Food poisoning is commonly known as *ptomaine* poisoning though the symptoms may be due to the generation of the ptomaines or due to the Bacillus enteridis or Bacillus of Gärtner.

Symptoms.—These usually come on soon after taking food, if infected by chemical ptomaines, but are delayed from twelve to twenty-one hours, if contaminated with a bacterial organism. The chief symptoms are headache, giddiness, intense thirst, acute vomiting, diarrhœa with colicky pain in the abdomen, dilatation of the pupils, ptosis, cold, clammy skin, rise of temperature to 101° and 103° or 104°F. with rigors, muscular weakness, cramps and paraly-

sis of the lower limbs. The pulse becomes slow, weak and finally imperceptible. Death occurs from the failure of the heart.

Treatment.—Wash out the stomach, and give brisk saline purgatives to empty the bowels. Give saline infusions to promote elimination of the toxins from the system. Use stimulants, if necessary.

Post-Mortem Appearances.—Acute congestion of the alimentary canal. The lungs are usually found congested.

BOTULISM OR ALLANTIASIS.

This is also called sausage poisoning, because it results from eating sausages infected with an anaærobic organism, bacillus botulinus. It also infects ham and fish. These cases occur very largely in Germany.

Symptoms.—These are dryness of the mouth, difficulty of swallowing, retching, vomiting, colic, diarrhœa followed by constipation. After a few days nervous symptoms appear, viz., dilatation of the pupils, ptosis, diplopia and a sense of suffocation. Marked muscular weakness and nervous prostration are the prominent symptoms. The pulse becomes weak, and the face becomes cyanosed. The temperature rises to 103°F., but falls below normal towards death, which is preceded by delirium and coma.

Post-Mortem Appearances.—Hyperæmia of the alimentary tract. The other organs are found congested.

Treatment.—Give large draughts of warm water and salt, and mild laxatives to be followed by high irrigation of the intestines with enemata. Administer morphine hypodermically to relieve vomiting and purging. It may be helpful to use stimulants, and intracellular injections of normal salt solution.

FISH POISONING.

Certain kinds of fish belonging to the species tetrodon found in China and Japan are very poisonous, and cause death within an hour.

Fish in sprawn is likely to produce poisonous symptoms. Of all the varieties of shell-fish mussel is the chief, that gives rise to poisonous symptoms on account of a ptomaine, *mytilotoxine*, which develops chiefly into its liver. The characteristic symptoms are urticaria and a difficulty of breathing. Death may occur from collapse within two hours.

Symptoms of gastro-enteritis may occur from eating stale or decomposed oysters.

POISONING BY MILK AND ITS PRODUCTS.

Milk and cheese, especially in hot weather, have given rise to the symptoms of acute gastro-intestinal irritation from the presence of an alkaloid, tyrotoxin.

PTOMAINES.

These are the alkaloidal bodies produced by the action of saprophytic micro-organisms upon nitrogenous materials, probably during the process of decomposition. They are called *cadaveric alkaloids*, as they are generated in dead tissues ; while alkaloids secreted by the living cells during the metabolic processes are called *leucomaines*.

Ptomaines exist as methylamine in the gaseous form, as ethylamine in the liquid form and as neurine in the solid form. They are unstable alkaline bases, forming salts when acted upon by acids.

These ptomaines very closely resemble vegetable alkaloids, such as veratrine, morphine, codein, etc., inasmuch as they respond almost to the same chemical group reagents and to the physiological tests. At present there is no special test by which a cadaveric alkaloid can be distinguished from a vegetable alkaloid ; however, no cadaveric alkaloid will yield the same chemical reactions and will have the same physiological results, if injected into the body of a healthy animal, as any of the vegetable alkaloids.

In suspected poisoning, when one of the rare vegetable alkaloids, which does not ordinarily respond to chemical tests, has been detected in the body, the defence pleader may set up a plea that the alkaloid was not a vegetable poison, but a ptomaine developed in the body after death. In this connection it should be remembered that most of the ptomaines that have been discovered are non-poisonous except *neurin* and *mydalein*, which are actively poisonous, while a few more are poisonous in a much larger quantity than the lethal dose of the corresponding vegetable alkaloid. Again neurin is not generated till the fifth or sixth day has elapsed since death, and mydalein not until the seventh day and that too in traces only. It is not produced in quantity sufficient for analytical purposes until the second or third week after death. Choline, which is a very weak poison, is the only alkaloid met with at the time, when medico-legal *post-mortems* are ordinarily held.

The symptoms produced in animals by neurin are marked increase in salivation, lachrymation and nasal secretion ; diarrhœa ; contraction of the pupils ; slowing of the heart and respiration ; convulsions ; paralysis of the limbs and death. These symptoms are analogous to those of muscarine, the active principle of the fly fungus. Atropine acts as an antidote and, if previously injected, will render the animal immune against its action.

Mydalein produces increased lachrymal and nasal secretions, vomiting, diarrhœa, dilatation of the pupils and a slight rise of temperature to 99° or 100°F. Later clonic spasms occur with paralysis and stupor ending in death. The pulse and respirations are first quickened and then become slow. The fatal dose is fifty milligrammes.

CHAPTER XXVIII.

IRRITANT POISONS—(*Continued.*)

C. MECHANICAL (VULNERANT) POISONS.

Mechanical irritants are actually not poisons, inasmuch as they do not produce any toxic symptoms by being absorbed in the blood, but they are conscious substances as they act mechanically only, and thus irritate the stomach and the bowels with their angular edges or sharp points, when they are swallowed. The examples are powdered glass, diamond dust, pins, needles, nails, chopped animal and vegetable hair.

POWDERED GLASS.

The symptoms are those of gastro-enteritis. At Agra a young Mahomedan about 20 years old was invited for a breakfast at his father-in-law's house, where he was given pounded glass in the food. About 8 hours after breakfast he complained of intense burning pain in the pit of the stomach, and brought up mouthfuls of blood without any nausea or pain in the throat. The vomiting of blood was so very persistent that he became pale and had almost collapsed with a thready and imperceptible pulse, when ergot injection and saline infusion had to be tried. The symptoms abated after 3 days.

Fatal Dose.—Not known.

Fatal Period.—48 hours in one recorded case.

Treatment.—Give bulky food, such as a lot of rice, and then give emetics, as well as purgatives. Give ice and morphia to relieve thirst and pain. Adopt such remedies as will combat collapse.

Post-Mortem Appearances.—The fragments of glass

may be found adherent to or penetrating into the mucous membrane of the stomach. The mucous membrane of the stomach and intestines is red, congested and shows small hæmorrhagic points.

Chemical Detection.—By straining the stomach contents and fæces through a muslin cloth, glass fragments may be detected with the naked eye, or they may be seen as transparent and amorphous pieces under the microscope.

Medico-Legal Points.—The popular belief is that glass is highly poisonous, so that it is very frequently administered in a powdered form mixed with some article of food, such as rice, wheat, flour, sweets, etc. Usually a woman pounds her own glass bangle or a glass bottle, and gives it to her husband with a homicidal intent. Sometimes, it is mixed with arsenic before administration. Rarely it has been selected for suicidal purposes.

It does not produce the desired effect, if it gets entangled in the mucus or food in the stomach, so as to be rendered harmless. Similarly it will not have any bad effects, if it is so well pounded as not to have any sharp points, or if it is so well chewed as to get well pounded before it is swallowed. This is the reason why professional exhibitors (*human ostriches*) do not come by any harm by swallowing glass Some years ago I saw in Bombay a gentleman and his wife both eating chimney glass without any ill-effects.

DIAMOND DUST.

The proverbial method of committing suicide by sucking a diamond ring is nothing but a myth, as a diamond has no other action but mechanical on account of its prominent sharp angles.

In the famous Baroda case white arsenic and a very fine powder of diamond was mixed in a *sherbet* drink.

NEEDLES.

These have been swallowed for suicidal purposes, and are known to have caused death.

CHOPPED ANIMAL HAIR.

This is supposed to be poisonous, and has been given to cattle with the idea of destroying them, but it should not be forgotten that, sometimes, round boluses of hair are found in the stomach and intestines of animals dead from natural causes.

VEGETABLE HAIRS.

Hairs of some vegetables, such as nettle (*Kavach*) and *mucuna pruriens*, the cow-itch or cowhage and also known as "Russian fleas," produce local redness, scratching and even blisters when applied to the skin, and are liable to set up the symptoms of irritation, when swallowed by the mouth. The Chemical Examiner of the United Provinces of Oudh and Agra mentions in his annual report for 1916, that an anonymous letter containing some of the hairs of mucuna pruriens was sent. It leaked in the post office, and produced irritating symptoms on the hands of post office officials.

CHAPTER XXIX.

NEUROTIC POISONS.

POISONS AFFECTING THE BRAIN (CEREBRAL, NARCOTIC).

A. SOMNIFEROUS POISONS.

OPIUM *(AFIYUN)*.

This is the inspissated juice obtained by making incisions into the unripe capsules of Papaver Somniferum, the white poppy (N.O. *Papaveraceæ*).

The poppy capsules *(Post ka Dodá)*, when they are ripe and dry, contain a trace of opium and are, therefore, narcotic in action. Their warm decoction is used locally as a sedative fomentation and poultice.

The poppy seeds *(khas-khas)* are innocuous and used as food. They are sprinkled over some Indian sweets. They are regarded as demulcent and nutritive. They yield a bland oil, known as poppy oil *(khas-khas ka tel)*, which is largely used for culinary and lighting purposes.

Opium occurs in dark-brown masses, having a heavy poppy-like smell and a mawkish bitter taste. It contains a large number of alkaloids united with meconic acid; of these morphine, codeine, narcotine and thebaine are important from a toxicological point of view. The remaining alkaloids are inert and occur in minute traces.

Opium yields from 6 to 15 per cent. of morphine to which its poisonous properties are chiefly due. It yields 0.25 to 0.5 per cent. of codeine, 4 to 8 per cent. of narcotine and 0.15 to 1 per cent. of thebaine, which acts as a convulsant like strychnia, but less powerfully.

Of the several varieties of opium met with in India, the

chief are Patna opium and Malwa opium. Patna opium yields 7 to 8 or even 10 per cent. of morphine, and is chiefly prepared for medicinal purposes. It occurs in square packages of from two to four pounds in weight, usually covered with layers of talc. It is solid, brittle in the cold season, and has a brown colour and fine odour. Malwa opium occurs in many varieties ; of these the superior quality yields from 6 to 8 per cent. of morphine, and occurs in balls or cakes weighing about 10 ounces and covered with a coarse dust consisting of broken poppy petals. The inferior quality yields only from 3 to 5 per cent. of morphine and occurs in flat circular cakes weighing about 1½ pounds without any external covering. These are dull, opaque, blackish brown externally, and somewhat dark and soft internally.

Dionin, heroin and peronine are non-official preparations used in medicine to allay cough of phthisis and asthma. They are alkaloids artificially prepared from morphine. 2½ grains of dionin have produced toxic symptoms.

Proprietary Medicines.—The following are the proprietory medicines containing opium and morphine, and are sold largely by every chemist :—

1. *Atkinson's Infant Preserver.*—Strength, 3 minims of laudanum to 1 oz.

2. *Battley's Liquor Opii Sedativus.*—Strength, 2 grains in 12 minims, i. e., double the strength of laudanum.

3. *Black Drop.*—Strength, 4 times as strong as laudanum.

4. *Barhave's Odontalgic Essence.*—Strength, about 3 per cent. of opium.

5. *Chlorodyne.*—Strength, about 4 grains of morphine hydrochloride to an ounce. In addition to morphine it contains chloral, chloroform, hydrocyanic acid and tincture of cannabis Indica.

6. *Dalby's Carminative.*—Strength, 2½ minims of laudanum to 1 fluid ounce.

7. *Godfrey's Cordial.*—Strength, ½ to 1½ grain of opium to 1 ounce.

8. *Grimrod's Remedy for Spasms.*—Strength, 1 grain of morphine hydrochloride in 5 ounces.

9. *Le Maurier's Odontalgic Essence.* – Strength, 1 grain of morphine acetatis to 1 ounce.

10. *Locock's Pulmonic Wafers or Lozenges.*

11. *Mrs. Winslow's Soothing Syrup.*—Strength, 1 grain of morphine in 1 ounce.

12. *Nepenthe.* – Strength, same as laudanum.

13. *Powell's Balsam Aniseed.*—Strength, $\frac{1}{10}$ grain of morphine in 1 ounce.

Symptoms.—These commence usually within half-an hour after swallowing the poison. They may appear much sooner, if opium is taken in a liquid form, or may be delayed for several hours, say, up to twelve to eighteen hours. The symptoms manifest themselves in three stages ; *viz.*, 1. stage of excitement ; 2. stage of sopor ; 3. stage of narcosis.

1. *Stage of Excitement.*—During this stage the symptoms are increased mental activity, loquacity, restlessness, or even hallucinations, flushing of the face and increased action of the heart. This stage is of a short duration, and may be absent if a large dose is taken. In children convulsions are a marked feature in the first stage.

2. *Stage of Sopor.*—Nerve centres are depressed during this stage which, sometimes, comes on quite suddenly. The symptoms are headache, giddiness, lethargic condition, drowsiness, and an uncontrollable desire to sleep, from which the patient may be roused by external stimuli. The pupils are contracted, the face and lips are cyanosed and an itching sensation is felt all over the skin. The pulse and respirations are still normal.

3. *Stage of Narcosis.*—The patient now passes into deep coma, from which he cannot be roused. During this stage

the muscles are relaxed, and the reflexes are lost. All the secretions are almost completely suspended, except that of the skin, which feels cold and clammy. The face is pale, the lips livid, and the lower jaw drops. The pupils are contracted to pin points and are insensible to light. The conjunctivæ are injected. The pulse is slow, small and compressible. The respirations are slow, laboured and stertorous.

At this stage recovery may take place by prompt and proper treatment; otherwise in the case of fatal termination the lividity of the surface increases. The pulse becomes slower, more irregular and imperceptible. The respirations are slower, more feeble, and assume the character of Cheyne-Stokes, death occurring from asphyxia. The heart may continue to beat for a short time after respiration has stopped. Convulsive twitchings in groups of the muscles are observed and the pupils become widely dilated towards the end. Sometimes death occurs from the failure of the heart. The odour of opium may be present in the breath throughout the illness. This is, sometimes, masked by the injudicious administration of alcohol by relatives.

Unusual Symptoms.—These are vomiting, diarrhœa and tetanic spasms. The pupils are found dilated in poisoning from chlorodyne probably due to hydrocyanic acid contained in it. In the case of a student in the Agra College, who died from opium poisoning, the prominent symptoms were convulsions and a rise of temperature, which misled a medical attendant very much in the correct diagnosis. Convulsions are also very common in children.

After an apparent remission of symptoms, sometimes it so happens that they return with more severity to end in death. This is explained by the fact that absorption is practically in abeyance during the stage of depression, and the poison is re-absorbed from the alimentary canal, when circulation has improved.

Diagnosis.—Opium poisoning has to be diagnosed from apoplexy, uræmic coma, acute alcoholic poisoning, carbolic acid poisoning, and compression of the brain.

Apoplexy.—In apoplexy the patient affected is usually fat and old The onset is sudden and abrupt. The chief symptoms are a slow, full pulse and paralysis, usually hemiplegia. The pupils are dilated except when the lesion is in the pons Varolii, when they are contracted but not symmetrical, and the temperature is raised to 103° or 104°F.

Uræmic Coma.—In uræmic coma there is always a previous history of a kidney disease with the presence of albumen and casts in the urine and anasarca. Epileptiform convulsions generally precede coma.

Acute Alcoholic Poisoning.—In acute alcoholic poisoning the chief symptoms are the congested face, injected eyes, dilated pupils, odour of alcohol in the breath and snoring respirations. The patient may be roused by loud shouts or vigorous shaking, and there is no paralysis.

Carbolic Acid Poisoning.—The most characteristic signs are the localised action on the lips and mouth, and green coloured urine.

Compression of the Brain.—History of the accident, probably fracture of skull bones. The pupils are unequal or dilated with subconjunctival hæmorrhages.

Fatal Dose.—4 grains of opium have proved fatal to an adult, and $\frac{1}{5}$th grain to young children. One grain of morphine hydrochloride has caused death, and so have two drams of the tincture of opium. $\frac{1}{30}$ grain of opium or two minims of the tincture killed an infant. 1 grain of Dover's powder has also killed an infant.

Fatal Period.—The shortest recorded period is 45 minutes. The usual period is 8 to 12 hours. Recovery is probable, if the patient survives 24 hours.

Treatment.—Wash out the stomach first with warm

water and then with a solution of potassium permanganate of the strength of 8 to 10 grains to a pint, as it oxidizes and neutralizes the alkaloids of opium, 1 grain of the salt oxidizing 1 grain of morphine or 10 grains of opium. The neutralizing action is increased by the addition of dilute sulphuric acid. To continue this action it is advisable to allow about half-a-pint of the solution to remain in the stomach. The practical test to stop the lavage of the stomach is to find the return water of a pink colour. If this salt is not procurable, the stomach may be washed out with infusions of tea or tannic acid or a mixture of powdered animal charcoal and water. Mustard or zinc sulphate may be given as emetics. A prompt emetic is the hypodermic injection of apomorphine.

One to 6 drams of a solution of permanganate of potash of the strength of 1 grain in 2 fluid ounces may be injected subcutaneously at two or three points. It mixes with the blood serum, and forms an albumin manganic oxide, which decomposes morphine.

If the patient is seen in the earlier stage before coma has supervened, an attempt should be made to keep him awake by flicking a wet towel on the face, by cold effusions on the head and by making him walk after he is well supported by two men, one on each side, but it is no use dragging him if he cannot use his muscles.

Injection of atropine sulphate in $\frac{1}{30}$ to $\frac{1}{20}$ grain doses hypodermically has been recommended as a physiological antidote, to be repeated until the pupils begin to dilate; but it should be remembered that this drug paralyses the medulla oblongata, and so may aid in bringing about the fatal termination.

The heart should be stimulated by hot applications to the præcordium and by hypodermic injections of caffein, strychnine and sulphuric ether. Hot coffee and hot tea may be administered either by the mouth or by the rectum.

Inhalations of amyl nitrite and oxygen must be tried, for they have been reported successful in the treatment of opium poisoning.

Galvanism with Faradaic current and artificial respiration should be resorted to, if respiration becomes shallow or falls to less than eight per minute.

Post-Mortem Appearances.—Small, soft, brownish lumps of opium may be found in the contents of the stomach, which may also look brown and viscid, and may give the smell of opium on being opened. Very often the smell is noticed, as soon as the chest cavity is opened, but the smell disappears on account of putrefaction.

The signs of asphyxia are prominent. Froth is seen at the nostrils. The trachea is rosy coloured, congested and covered with froth, if seen soon after death. The lungs are congested and exude frothy blood on being cut. The right side of the heart is full of blood, and the left is empty. Sometimes both the chambers are full, with venous engorgement. The brain is congested. Similarly the abdominal organs are largely congested, and exude dark fluid blood on section.

Chemical Analysis.—To ascertain whether the suspected article contains opium or not, it is necessary to detect the presence of meconic acid and morphine, if possible.

Tests for Meconic Acid.—1. A solution of ferric chloride gives a blood-red colour, which is not affected by dilute hydrochloric acid (distinction from acetates) or by mercuric chloride (distinction from sulphocyanides). If meconic acid is present in a minute trace the colour becomes orange. 2. Lead acetate gives a white precipitate, soluble in nitric acid.

Tests for Morphine.—1. Strong nitric acid gives an orange colour unchanged by sodium thiosulphate.

2. Ferric chloride gives a greenish-blue colouration,

3. Sulphuric acid and dichromate of potash give a green colouration.

4. Sulpho-molybdic acid gives a reddish purple colouration, which changes to blue.

5. Iodic acid turns yellow, when morphine is added, but assumes a blue colouration on the addition of starch owing to the liberation of iodine by morphine.

6. *Housemann's Test.*—Sulphuric acid is added to a mixture containing morphine, and allowed to stand for sixteen to eighteen hours. Nitric acid is then added to the mixture, when a blue violet colour appears, which changes to blood-red.

7. *Porphyroxin Test.*—Sulphuric ether is added and shaken up with the alkaline fluid which is separated from the suspected organic mixture by filtration, after it is digested with alcohol and boiled with sub-acetate of lead. A portion is allowed to evaporate spontaneously in a small porcelain dish. To the dry residue a few drops of hydrochloric acid are added, and the dish heated over a flame, when a rose pink colour shows the presence of porphyroxin, a neutral constituent of opium, first described by Merck.

Medico-Legal Points.—Opium is about the commonest drug selected by suicides. Young men, who have lost money in speculation or in gambling or who have been scolded by their parents for some offence, frequently resort to its use. Similarly women who have quarrelled with their husbands or relatives, or who have been disappointed in love, take opium either to terrify their relatives or to end their imaginary worries and miseries.

Suicides usually mix opium with mustard oil or asafœtida n the belief that these substances increase its absorptive power, but there is no foundation about this belief. However, it is true that the mustard oil makes it difficult to be eliminated even by washing the stomach.

It is also believed that alcohol hastens the action of opium, but it does not do so in all cases. I saw an Anglo-Indian in Agra, who took a bottle of beer and opium, but he developed no other symptoms except dryness of the throat and drowsiness.

On account of its bitter taste opium is very rarely used for homicidal purposes, but it is often resorted to for infanticide.

Cases of poisoning occur among infants and children by their accidentally swallowing crude opium or opium pills meant for their parents or grand parents, who are in the habit of using the drug. They are also, sometimes, poisoned by an accidental over-dose, as opium is usually administered to soothe them. Children are extraordinarily susceptible to the influence of opium. Hence great precaution should be used in prescribing the drug to them.

Mode of Administration—Fatal cases of poisoning have occurred from the administration of opium by the mouth, from the hypodermic injection of morphine, from the application of morphine to a wound, from the injection of the enema containing opium into the rectum, from the introduction of opium into the vagina, from the application of a liniment of opium to an abraded skin, and from the application of a poultice to the abdomen containing about one ounce of the tincture of opium.

Even in poisoning by the hypodermic injection of morphine the stomach should always be washed as, after absorption in the blood, morphine is secreted into the stomach from which it is again liable to be reabsorbed.

Elimination.—Opium is chiefly eliminated in the fæces and urine. It is, sometimes, detected in the saliva and bile. That it is eliminated by the milk is proved by the occurrence of fatal poisoning in infants sucking their mothers, who have been poisoned by opium. Elimination being very slow, a portion accumulates in the system. Opium withstands putre-

faction, and has been detected in the viscera two months after the death in one case, and fourteen months in another case.

Opium Habit (Opium Eating).—The habit of taking opium is very prevalent in India, particularly among the people of Rajputana. Ordinarily crude opium is used but, on special festive occasions, *Kasoomba*, its decoction, is offered to the guests. Opium is also smoked in the form of *Chandul*, the watery extract.

Opium is believed to increase the duration of the sexual act. Hence it is very often taken by young men, who get accustomed to the drug by constant use. It is also used to steady the nerves for doing some bold deed requiring special courage. For instance, in ancient times Rajputs used to take the drug before they took part in battles.

The morphine habit is acquired by people, who are advised to take the drug either by the mouth or subcutaneously as a remedy for some excruciating pain, as of sciatica. Once the habit is formed, it is difficult to give it up. In fact the victim has to take the drug in a larger dose to combat the feelings of lethargy and mental depression, as the symptoms of the first dose wear off. It is very difficult to estimate the fatal dose in the case of habitual opium eaters. The quantity which under ordinary circumstances, proves fatal, can be very easily tolerated by such people.

Unlike alcohol, it does not seem to produce injurious effects on the system or to shorten life, if used in moderation; but its abuse, for a prolonged period, leads to the derangement of appetite and digestion, disturbance of sleep, vomiting, sluggishness of the bowels, impotence, neurasthenic condition, mental weakness, perversion of morality, premature old age and to mania. These symptoms are more evident among morphine eaters than in opium eaters, and are known as *morphinism* or *morphinomania.*

The best treatment for such a condition is the total

deprivation of the drug from the patient, but this cannot be achieved without great moral control over one's mind which is not possible in such persons. Again the sudden deprivation of the drug produces cerebral excitement, restlessness, relaxation of the bowels, pain in the stomach and a burning sensation in the back due to formation of oxydimorphine, an acrid irritating substance in the tissues. Hence the gradual deprivation is better for practical purposes.

CHAPTER XXX.

CEREBRAL POISONS—(*Continued*).

B. INEBRIANT POISONS.

ALCOHOL (ETHYL ALCOHOL), C_2H_5OH.

This exists in alcoholic beverages in varying proportions. Absolute alcohol contains 99 per cent. by weight of alcohol, and is used to prepare chloroform and liquor sodii ethylatis. Rectified spirit contains 90 per cent. by volume of alcohol, and methylated spirit or denatured alcohol is a mixture consisting of rectified spirit and 10 per cent. of wood spirit. Proof spirit contains 49.2 per cent. by weight and every half per cent. above this corresponds to 1 degree over proof.

The following is the percentage of alcohol contained in different alcoholic beverages :—

Whisky,	51 to 59 per cent.
Rum, Gin and Strong Liqueurs.	51 to 59 per cent.
Brandy.	43 to 57 per cent.
Port.	20 to 30 per cent.
Sherry and Madeira.	16 to 22 per cent.
Claret.	10 to 18 per cent.
Champagne.	10 to 13 per cent.
Cider.	5 to 9 per cent.
Ales and Stout.	4 to 6 per cent.
Lager Beer.	2 to 3 per cent.

Acute Poisoning.—This may result from inhaling the alcoholic vapours, or from swallowing the alcoholic liquid.

Symptoms.—These are confusion of ideas, muscular

inco-ordination, giddiness, staggering gait, flushed face, indistinct and foolish speech, and stupor. After a time recovery may occur, accompanied by nausea and vomiting, which are regarded as hopeful signs. These may be followed by sleep and headache.

If recovery does not occur, the patient passes into coma with slow stertorous breathing and full pulse. The breath smells of alcohol. The patient may be roused temporarily by a loud noise or by a violent shake. The pupils are generally dilated, but may be contracted in exceptional cases. Their reaction to light is a hopeful sign. The temperature becomes subnormal. Death occurs from shock due to paralysis of the abdominal nerve centre, if a very large dose is taken ; otherwise it occurs from asphyxia. Sometimes convulsions precede death. In some cases the patient regains sensibility on account of partial recovery, but a relapse occurs and the patient dies suddenly in a state of coma.

Diagnosis.—Acute alcoholic poisoning has to be diagnosed from opium poisoning, apoplexy, cerebral compression, uræmic coma, diabetic coma and epilepsy.

Fatal Dose.—This is modified according to the habit and age of the patient, and the nature and strength of the liquor taken. Death occurs usually from a large quantity taken in a short space of time. 5 fluid ounces of absolute alcohol are considered fatal for an adult. The equivalent of 2 ounces of absolute alcohol is probably fatal to a child under 12 ; though very large doses may be tolerated by habit.

Fatal Period.—The usual fatal period is 12 to 24 hours.

Treatment.—Eliminate the poison by emetics or the stomach tube. Cold affusion to the head, or pour a *mashaq* of water over the head. Use hypodermic injections of strychnine and digitalin. Give coffee per rectum. Resort to galvanism and to artificial respiration.

Post-Mortem Appearances.—Smell of alcohol in the

stomach, lungs and brain. The mucous membrane of the stomach may be red, intensely congested and inflamed, or it may be only pale. The liver, lungs and brain are usually congested.

The necessary viscera should be preserved in a saturated salt solution for chemical analysis.

Chronic Poisoning.—Habitual drunkards, who have been taking alcohol in one form or the other for a long and continued time, suffer from many organic diseases.

The appetite is lost. The patient suffers from vomiting, purging, cirrhosis of the liver, and granular degeneration of the kidneys, with dropsy or general anasarca. The patient gets tremors in the muscles, chiefly of the hands and the tongue. He complains of loss of memory, and impaired power of judgment. Symptoms of peripheral neuritis and dementia supervene in the last stage.

Delirium Tremens.—The chief important condition from a toxicological point of view is delirium tremens, which results from the long-continued action of the poison on the brain. A temporary excess in the case of habitual drunkards is liable to bring on an attack. It sometimes develops in consequence of the sudden withdrawal of the alcohol.

In this condition there is a peculiar kind of delirium of horrors owing to hallucinations of sight and hearing. The patient imagines that the rats, mice and snakes are crawling on his bed. The patient gets a good deal of muscular tremors, suffers from insomnia and has a tendency to commit suicide or even homicide. Hence he has to be watched closely and carefully day and night.

Delirium tremens is considered unsoundness of mind, and not intoxication.

Chemical Analysis.—Alcohol can be extracted by distillation from organic mixture. If the organic mixture is highly acid, sodium carbonate should be added to neutralize it.

Tests.—1. Dilute sulphuric acid and dichromate of potash give a green colour, and emit the odour of aldehyde.

2. On heating with caustic potash and iodine a yellow precipitate of idoform is formed, which is known from its smell and from the hexagonal crystals seen under the microscope.

3. It dissolves camphor.

Medico-Legal Points.—In European countries cases of alcoholic poisoning are very common. In India they are more frequent in big cities than in towns and villages; but fatal cases are very rare. I have seen only two cases of death occurring from acute alcohol poisoning among passengers who were picked up dead from railway trains at Agra Station. Whisky bottles were found in the belongings of both. Probably their deaths were hastened owing to the excessive heat of the summer.

In order to ascertain whether a particular individual is drunk or not the medical officer should bear the following points in mind :—

1. The quantity taken is no guide.

2. The unsteady gait, vacant look, dry and sticky lips, congested eyes, sluggish pupils, unsteady and thick voice, and talks at random, are the usual signs of drunkenness.

3. Drunkenness does not come within the cognizance of the police, unless the man is dangerous to himself or to his property or that he is annoying or dangerous to others.

METHYL ALCOHOL (WOOD SPIRIT, PYROXYLIC SPIRIT OR WOOD NAPHTHA), CH_3OH.

This is formed by the distillation of wood. Owing to its peculiar nauseous odour it is used to render rectified spirit unpalatable for trade purposes. This mixture is known as methylated spirit, and is used in arts and manufactures under the name of denatured alcohol. It is much more poisonous than ordinary alcohol.

Symptoms.—The exhilarating effect is rapidly followed by vertigo, nausea, vomiting, headache, dilated pupils, delirium, coma and death. If recovery ensues, there is a danger of blindness due to optic atrophy.

Fatal Dose.—½ a pint. Five tea-spoonfuls have caused blindness.

Fatal Period.—Death may occur in a few hours or may be delayed for two days.

Treatment.—The stomach should be washed out with warm water. Hypodermic injection of strychnine, cold affusions to the head and artificial respiration.

AMYL ALCOHOL (FUSEL OIL), $C_5H_{11}HO$.

This is formed in the manufacture of ethyl alcohol from grain, potatoes and grapes. It is an oily liquid, very slightly miscible with water, and has an unpleasant odour and an acrid taste. Its vapours are more poisonous than the liquid.

AMYL NITRITE, $C_5H_{11}NO_2$.

This is produced by the interaction of nitrous acid and amyl alcohol that has been distilled between 262° and 270°F. It is a yellowish, volatile liquid, possessing a peculiar fruity and suffocative odour and is insoluble in water.

By swallowing large doses of amyl nitrite the stomach becomes eroded. The patient complains of burning pain in the stomach, nausea and vomiting. Later his pulse becomes thready, and he gets convulsions, passes into a state of coma and dies. When inhaled, it causes dilatation of the arteries, flushing of the face, and a sense of fulness about the head.

Treatment.—Inject strychnine and digitalis hypodermically.

Test.—Heated with caustic potash it forms amyl alcohol and potassium nitrite.

ÆTHER (SULPHURIC ETHER), $C_2H_5O_2$.

This is prepared from ethyl alcohol by interaction with sulphuric acid. It is a colourless volatile, mobile liquid having a characteristic sweetish smell. Exposed to the air it forms an explosive mixture, which renders it dangerous to administer near an open flame.

It is sometimes taken internally as a substitute for alcoholic drinks.

The symptoms are a burning pain in the stomach and bowels, and a great degree of intoxication. One fluid ounce is regarded as a fatal dose, but larger quantities can be borne by those who are accustomed to its use.

Its vapours act as a general anæsthetic just like chloroform. It is considered to be a safer anæsthetic than chloroform as it paralyses the heart with much greater difficulty. Two and a half ounces of ether when inhaled have caused death.

Treatment.—Fresh air, respiratory stimulants, such as ammonia, artificial respiration, inhalation of oxygen combined with carbon dioxide, and strychnine hypodermically.

CHLOROFORM, $CHCl_3$.

This is a colourless, heavy liquid, possessing a sweetish taste and a peculiar ethereal odour. It is volatile at an ordinary temperature. It is very slightly soluble in water, but freely soluble in alcohol, ether, olive oil, or turpentine.

Chloroform produces poisonous symptoms, when it is inhaled as a vapour, and also when it is swallowed as a liquid.

Symptoms when inhaled as a Vapour.—These are divided into the following three stages :—

1. Stage of excitement.
2. Stage of depression (anæthesia).
3. Stage of paralysis.

1. *Stage of Excitement.*—As soon as a few whiffs of the vapour are inhaled, the patient experiences a sense of irritation in the throat and fauces, and a burning sensation in the eyes. The face becomes flushed, and a sense of warmth is felt over the whole body, with a creeping sensation in the eyes. All other senses but those of sight and hearing are dulled, and the mind becomes confused. At this stage the patient gets delirious, begins to sing, laugh, cry, or speak an abusive and profane language. Sometimes he struggles so violently that he requires to be held down by the assistants. The pupils are first dilated, but become contracted as in

natural sleep. Frequently there is a tendency to vomit. The pulse and respirations are increased in frequency. This stage lasts rarely for more than four minutes.

2. *Stage of Depression (Anæsthesia).*—During this stage the patient becomes completely unconscious and loses all sensibility. The corneal and other reflexes are lost. The pulse and respirations become slow and feeble. The pupils are contracted. The temperature is subnormal and the skin is cold and moist. Surgical operations are performed during this stage, which can be maintained for hours. If the inhalation is stopped, the condition may last for twenty to forty minutes. Sometimes fatal results occur after the withdrawal of the inhalation.

3. *Stage of Paralysis.*—If the inhalation be still continued, the patient passes into the stage of paralysis. The muscular tone is abolished, and consequently the muscles become quite flaccid. The urine and fæces are passed involuntarily. The lips become blue. The surface is cyanosed and bathed in cold perspiration. The pupils are dilated. The respirations become slow and irregular with a long pause. The pulse is weak and irregular. Death occurs from the stoppage of the heart's action or from respiratory paralysis. It may also occur at any stage, when it may be due to the heart's paralysis or asphyxia brought about by the passage of vomited matter or blood into the air passages, or by the closure of the glottis from the pressure of the tongue, or by status lymphaticus in the case of children.

Cases of delayed chloroform poisoning have, sometimes, occurred in which death resulted some hours or days after chloroform anæsthesia from embolism or fatty degeneration of the organs, chiefly the heart, especially if the quantity administered is large and continued for a prolonged time. Such cases have occurred more often among children than among adults.

Fatal Dose.—It is difficult to ascertain the exact lethal dose. Large quantities have been inhaled during surgical operations without any deleterious effects. The concentration of two to three per cent. of chloroform in air is the limit of safety for inducing surgical anæsthesia ; whereas concentration to five per cent. or more is considered dangerous. Inhalation of 15 to 30 drops of concentrated chloroform has caused death.

Fatal Period.—The usual fatal period is less than ten minutes. The shortest period recorded is less than one minute. Death from delayed poisoning occurs from ten hours to twenty days ; the average period being five to seven days.

Treatment.—Stop inhalation, pull out the tongue forward either with a forceps or by carrying the lower jaw forward. Start artificial respiration and apply the Farradaic current. Dilatation of the sphincter ani has been lately recommended.

Post-Mortem Appearances.—Not characteristic. The signs of asthenia are usually found. The lungs emit a strong smell of chloroform. Gas bubbles may be found in the blood which is, as a rule, dark and fluid.

Symptoms when swallowed as a Liquid.—First of all there are symptoms of irritation and then coma supervenes. The patient complains of burning, pain in the mouth, throat and stomach ; this is followed by vomiting and purging. The vomited matter gives the smell of chloroform, and may contain blood. These symptoms are followed within ten minutes or so by unconsciousness and coma. The pupils are dilated. The surface is cyanosed. The skin is cold and bathed in perspiration. The pulse is feeble, frequent and irregular. The respirations are slow and stertorous. Death occurs from paralysis of the heart's action or respiration. Cases that recover may show jaundice and enlargement of the liver.

Fatal Dose.—Uncertain. The smallest recorded fatal dose is one dram in a boy four years old, and four drams in an adult. Recovery has followed even after five ounces.

Fatal Period.—The usual fatal period is 12 to 24 hours. The shortest is one hour, and the longest is 48 hours.

Treatment.—Empty the stomach and wash it out with tepid water. Give hypodermic injections of strychnine, ammonia, atropine, brandy, etc. Give an enema containing whisky. Keep up the body heat by warmth and mustard plaster. Resort to artificial respiration and galvanism.

Post-Mortem Appearances.—The mucous membrane of the alimentary canal is congested and inflamed. The stomach contents may give off the odour of chloroform. Its mucous membrane is red, softened and inflamed, and may show patches of erosion. The lungs are intensely congested. The heart, liver and kidneys may show fatty degeneration.

Chemical Test.—1. The vapour of chloroform, when passed through a red hot exit tube, is split up into chlorine and hydrochloric acid. Chlorine is known by its turning blue a piece of blotting paper moistened with starch and iodide of potassium. Hydrochloric acid gives a white precipitate to a solution of silver nitrate.

2. If B-naphthol dissolved in a small quantity of potassium hydroxide be added to a solution containing chloroform and heated, a blue colour is produced, which becomes green and finally brown.

3 Add an alcoholic solution of caustic potash and a drop of aniline to a mixture containing chloroform and heat. A disagreeable odour is given off due to the formation of isobenzonitrite. The equation representing the result is—$CHCl_3 + 3KHO + C_6H_5NH_2 = C_6H_5NC + 3KCl + 3H_2O$. The odour is perceptible when chloroform is present in the proportion of 1 : 5000.

Medico-Legal Points.—Accidental deaths occurring

during chloroform anæsthesia must be at once reported to the police, who should investigate into the cause of death for the satisfaction of the public and for exonerating the medical man from any fault or misadventure on his part. The law is not clear as regards the legal responsibility of the anæsthetist or the surgeon in such accidental deaths. At any rate the surgeon is certainly responsible, if the anæsthetist happens to be non-qualified. Unfortunately this is usually the case in outlandish branch dispensaries in India.

Chloroform inhalation is sometimes used for suicidal purposes, but, more often, such deaths are accidental owing to its having been inhaled to relieve pain or to produce sleep.

Very rarely chloroform inhalation has been used as a homicidal agent. Casper has recorded only two cases. Chloroform vapour has been frequently used to facilitate theft or rape. In such cases two questions of medico-legal importance are likely to arise ; viz. 1. whether an individual can be rendered insensible all at once by chloroform inhalation, and 2. whether a sleeping person can be anæsthetised without awaking.

1. *Whether an individual can be rendered insensible all at once by chloroform inhalation.*—Under ordinary circumstances it requires from two to ten minutes to anæsthetise a person with chloroform, properly diluted with air. Hence a person may resist if an attempt is made to chloroform him against his will, unless by some contrivance he is rendered unfit to struggle, or that he is much weaker than the assailant. On the contrary death would very likely result, if an attempt is made to render a person suddenly unconscious by a concentrated vapour of chloroform.

2. *Whether a sleeping person can be anæsthetised without awaking.*—It is a fact that operations have been performed on sleeping children after bringing them under chloroform anæsthesia without awaking them, but in the case of adults, it is

possible to do so only by skilled and experienced anæsthetists, but that too in a very few cases.

It should be borne in mind that women, when they are under the influence of chloroform anæsthesia, experience sexual excitement accompanied by hallucinations, which they remember and believe to be true after recovery from anæsthesia, and consequently accuse the physicians of an indecent assault or rape. However, such accusations may, sometimes, be true and sincere. To avoid awkwardness it is safest not to chloroform a woman alone except in the company of her near relative or another woman.

In addition to the patient suffering from toxic symptoms, the anæsthetist and other attendants may be affected by poisonous symptoms resulting in death, if chloroform was used for a long time in an ill-ventilated room lighted by gas burners or lamps.

Owing to its taste and smell liquid chloroform is very rarely used as a homicide, though it is, sometimes, used as a suicide but, more often, it is accidental.

Elimination.—Chloroform is mainly eliminated by the lungs, and may be detected there some days after death. It may be excreted in the stomach, even if introduced hypodermically into the system.

BROMOFORM, $CHBr_3$.

This is a limpid colourless, sweet liquid, which is soluble in alcohol but almost insoluble in water. It is a non-official preparation, and is used in whooping cough. Being insoluble in water and a heavy liquid, it has a tendency to settle down at the bottom and, if, taken without shaking the bottle, it is apt to produce poisonous symptoms. Almost all the cases of poisoning so far recorded have occurred among children.

Symptoms.—These very much resemble those of chloroform poisoning; the chief being vertigo, sleepiness, muscular relaxation, contracted pupils, insensibility, stertorous breathing, weak, feeble, irregular pulse, collapse and death.

Fatal Dose.—20 to 30 minims have caused death of children.

Fatal Period.—Death has occurred in 3 to 4 hours.

Treatment.—Wash out the stomach with a solution of sodium carbonate or Condy's fluid. Use hypodermically stimulants such as ether and strychnine. Apply electricity and resort to artificial respiration.

Post-Mortem Appearances.—Odour of bromoform in the organs. Congestion of the stomach and duodenum.

IODOFORM, CHI_3.

Iodoform occurs as an amorphous powder or as yellow flaky crystals, soluble in ether, chloroform and volatile oils, sparingly soluble in water and alcohol. The powdered form is more easily absorbed than the crystalline form. It is largely used as an antiseptic and disinfectant in surgical dressings. Poisoning has occurred from its use as a dressing for large raw surfaces or from the injection of its ethereal solution in chronic abcess cavities.

Symptoms.—These are giddiness, nausea, vomiting, abdominal pain, skin eruptions, elevation of temperature, dilated pupils, unconsciousness, quick pulse, stertorous breathing, coma and death. In some cases there may be convulsions, hallucinations, delirium and melancholia.

Fatal Dose.—30 grains internally have caused death though recovery has ensued from larger doses. More than one dram should not be applied to a wound at a time.

Fatal Period.—Death may occur after several days.

Treatment.—Wash out the wound. Treat the symptoms. Hypodermic injections or normal salt solutions are regarded as beneficent.

Post-Mortem Appearances.—Œdema of the lungs and acute nephritis. Occasionally fatty degeneration of the heart, liver and kidneys.

Tests.—Warmed with an alcoholic solution of caustic potash, iodoform yields free iodine after it is acidified with nitric acid.

CHLORAL HYDRATE, $CCl_3CH(OH)_2$.

This is a colourless, crystalline substance, having a peculiar odour and a bitter taste. It is freely soluble in water, alcohol and ether, and forms a liquid when rubbed up with an equal weight of camphor.

Acute Poisoning.—This occurs from swallowing a large dose all at once.

Symptoms.—The patient complains of burning pain in the mouth, throat and stomach, immediately after swallowing the poisonous dose but it is not marked, if the drug is administered in a mucilaginous mixture. This is followed by drowsiness, unconsciousness, loss of reflexes, and deep sleep passing into coma. The face is cyanosed, the pulse is slow, feeble and irregular, the breathing is stertorous, the skin is cold with subnormal temperature and the pupils are contracted. Death occurs from paralysis of the heart. Sometimes scarlatinal or urticarial rash may be seen on the skin.

Chronic Poisoning.—This occurs among persons addicted to its use owing to the habit of using the drug in medicinal doses for a long continued period.

Symptoms.—These are those of gastro-intestinal irritation with erythematous and urticarial eruptions on the skin, general weakness and dyspnœa. Clonic convulsions may, sometimes, occur. It has caused insanity and idiocy.

Fatal Dose.—3 grains in a child one year old. 20 to 30 grains have killed adults, though recovery has followed after 420 grains.

Fatal Period.—The average fatal period is 10 to 12 hours. The shortest recorded period is 20 minutes. Death may be delayed to 3 days.

Treatment.—Elimination by emetics and washing out of the stomach. Hot bottles and warmth. Hypodermic injections of ammonia, strychnine, etc. Artificial respirations. Galvanism. Hot coffee per rectum.

Post-Mortem Appearances.—Softening, reddening and erosion of the mucous membrane of the stomach. The lungs, as well as the brain, are congested and gorged with dark fluid blood. Fatty degeneration of the heart, liver and kidneys may be detected in chronic poisoning.

Chemical Tests.—1. A drop of ammonium sulphide added to a weak solution of chloral hydrate imparts an

opalescent appearance to the mixture after sometime, which subsequently assumes a yellowish or reddish-yellow appearance. This is a more delicate test.

2. Nessler's reagent gives a brick-red precipitate, which becomes lighter in colour and finally greenish-yellow.

3. Caustic potash produces chloroform known by its odour and potassium formate.

Medico-Legal Points.—Chloral hydrate has been frequently used for suicidal purposes. Accidental poisoning has resulted from an over-dose prescribed to a person suffering from heart disease, or to one who has been addicted to the drug.

The drug has not been employed criminally with the intent to cause death, but it has been administered in beer or stout with a view to stupefy the victim so as to facilitate robbery.

Chloral hydrade is eliminated by the kidneys, bile and by the stomach, even if applied to the skin.

SULPHONAL (DIMETHYL-METHANE-DIETHYL SULPHONE), $(CH_2)_2\ C\ (SO_2C_2H_5)_2$.

This occurs in colourless, tasteless, prismatic crystals, slightly soluble in water and ether, but more so in alcohol and chloroform.

Accidental cases of poisoning have occurred from large doses or from the injudicious use of the drug by the patients themselves without consulting their physician. It is considered by some authorities to have a cumulative action.

Symptoms.—These are pain and tenderness over the stomach, vomiting, thirst, ataxic gait, muscular weakness, muscular twitchings, convulsions, fall of temperature, coma and death. Eruptions are noticed on the skin The urine is reddish-brown or port-wine coloured, and contains hæmatoporphyrin, unchanged sulphonal and albumin.

Fatal Dose.—20 grains have caused death, though recovery has followed after a dose of 3 ounces. 75 grains are probably a fatal dose.

Fatal Period.—70 hours in one case, and 13 days in the other.

Treatment.—Elimination and washing out of the stomach; administration of stimulants, infusions of saline solutions, or transfusion of blood.

Post-Mortem Appearances.—Reddening and ecchymosis of the stomach and duodenum. Congestion of the liver and other internal organs. Fatty degeneration of the heart, liver and kidneys.

Chemical Tests.—1. Hydrogen sulphide is liberated if sulphonal be heated after adding iron powder and hydrochloric acid.

2. Sulphonal gives off a garlicky odour of mercaptan, if it is heated with charcoal in a test tube.

VERONAL (DIETHYL MELONYL-UREA), OR BAR BITONE, $(C_2 H_5)_2 C (COHN)_2 CO$.

This is a white crystalline powder, soluble in water with difficulty, but freely in alkaline solutions. It has a bitter and nauseating taste, but no odour.

Symptoms.—Nausea, vomiting, headache, drowsiness, ataxic gait, stupor deepening into coma, stertorous breathing, a rise of temperature even up to 103°F., and death. The lungs exhibit signs of consolidation and œdema, and may be mistaken for pneumonia. Very often a severe erythmatous rash appears on the skin and the face is cyanosed. The urine may be suppressed or may be scanty, showing the presence of albumin and hæmatoporphyrin. The pupils are usually contracted and insensible to light, but may be dilated.

Fatal Dose.—Medicinal doses of 10 and 15 grains have produced toxic symptoms in some cases. The minimum fatal dose may be regarded as 50 grains.

Fatal Period.—Death has occurred in 20 hours, but it has been delayed 6 or 7 days.

Treatment.—Eliminate the poison from the stomach by washing it out with warm water, and, then introduce castor oil and hot coffee. Use hypodermic injections of strychnine, ammonia and alcohol ; oxygen inhalation, and artificial respiration.

Post-Mortem Appearances.—The mucous membrane of the alimentary canal is congested. The lungs are in a pneumonic condition. Other internal organs are congested.

Chemical Tests.—1. On dissolving the substance containing veronal in caustic potash and adding mercuric nitrate, a thick white precipitate is formed.

2. Nitric acid and Millon's reagent (a mixture of mercuric and mercurous nitrates) give a white gelatinous precipitate soluble in excess.

Medico-Legal Points.—Veronal is a powerful hypnotic, and does not leave, as a rule, bad effects behind. Hence it is largely used by patients

as a remedy for insomnia without consulting their physician. The result is accidental poisoning from a large dose. Sometimes, it has been taken for suicidal purposes. In one case it was accidentally taken in mistake for kamala.

It should be prescribed with great caution in renal diseases. Constipation must always be avoided when the drug is being administered, so that the poisonous symptoms may not develop.

Chronic Poisoning.—By constant use of the drug the patient suffers from chronic veronal poisoning, the symptoms of which are ataxia, tremors, thick and difficult speech, visual hallucinations and delirium.

ANTIFEBRIN, ANTIPYRINE AND PHENACETIN.

Antifebrin (Acetanilide), $CH_3CONHC_6H_5$.—This is a colourless, odourless, crystalline substance, having a slightly pungent taste. It is soluble with difficulty in water but freely in alcohol, wine, ether and chloroform.

It is one of the chief ingredients in "Daisy" and other "headache" powders sold in the chemist's shop.

Antipyrine (Phenazone) $C_6H_5(CH_3)_2C_3HN_2O$.—This occurs in colourless, scaly crystals, possessing no odour but a bitter taste. It is freely soluble in water, alcohol or chloroform.

Phenacetin, $C_{10}H_{13}NO_2$.—This is a colourless, tasteless substance having flaky crystals. It is very slightly soluble in water, insoluble in glycerine, but is soluble in 20 parts of alcohol.

These three drugs are used as antipyretics, analgesics and sedatives. Poisonous symptoms have occurred from doses larger than the medicinal ones.

Symptoms.—Vomiting, vertigo, cyanosis, great prostration, slow breathing, quick, irregular and imperceptible pulse, cold, clammy skin, collapse and death. Urticarial rashes may appear on the skin.

Chronic poisoning from a continued use of the drug is characterized by cyanosis, dyspnœa, weakness, anæmia, wasting and dark-coloured urine.

Fatal Dose.—5 to 11 grains of antifebrin may cause alarming symptoms. 60 grains have caused death. 15 grains of antipyrine as well as of phenacetin have caused death.

Fatal Period.—Uncertain. Death may occur in a few hours or may be delayed for days.

Treatment.—Eliminate the poison by washing out the stomach and freely administer stimulants, such as digitalis and strychnine.

Post-Mortem Appearances.—Not characteristic.

Chemical Tests—*Antifebrin.*—1. A play of colours from red changing to brown and then to green on the addition of a drop of dichromate of potassium and strong sulphuric acid.

2. It does not give any reaction with ferric chloride.

3. Heated with a solution of caustic potash it is decomposed into aniline and potassium acetate.

Antipyrine.—1. A solution of ferric chloride produces a blood-red colour, destroyed by a mineral acid.

2. A mixture of potassium nitrate and sulphuric acid gives a green colour.

3. Heated with bleaching powder, it gives a brick-red precipitate.

Phenacetin.—1. Sulpho-vandalic acid produces an olive-green colour, turning to black on the application of heat.

2. Sodium persulphate produces a yellow colour on heating, and an orange on continued boiling.

Medico-Legal Points.—Most of the poisonous cases have been accidental from over doses or even from medicinal doses, especially if the heart happens to be diseased.

Antifebrin has produced fatal symptoms from its application as an antiseptic dressing to raw surfaces.

It is reported that one or two drams of antipyrine were used subcutaneously as a last resort by Clark of Agra to murder Fulham, after he had been unsuccessfully drugged with arsenic, gelsemine and probably with cocaine and belladonna.

ANILINE (PHENYLAMINE OR ANILINE OIL), $C_6H_5H_2$.

This is a colourless, oily liquid, becoming brown on exposure to the air. It is soluble with great difficulty in water, but freely in alcohol and ether. It is chiefly used in the arts for making several aniline dyes. It is also a basis of some synthetic drugs, such as phenazone, exalgine, etc.

Symptoms.—These appear immediately after swallowing a poisonous dose. The symptoms are nausea, vomiting, giddiness, drowsiness soon deepening into coma, slow laboured breathing, small, feeble and irregular pulse, and remarkable cyanosis of the lips, face, fingers and toes, and sometimes of the whole body, probably due to hæmeoglobin changing to methæmoglobin. The skin is cold and clammy ; the pupils are usually dilated, but are contracted in some cases. Very often convulsions occur before death.

Fatal Dose.—6 drams have proved fatal, but a smaller dose may cause death.

Fatal Period.—Uncertain. 12 hours in one case and 2 days in the other.

Treatment.—Give emetics or wash out the stomach as quickly as possible. Administer stimulants hypodermically or per rectum. Inhalation of oxygen and artificial respiration.

Post-Mortem Appearances.—Not characteristic. Hyperæmia and congestion of the bronchial tubes, as well as of the stomach. The blood is chocolate-coloured.

Chemical Tests.—1. Chloride of lime produces a deep purple colour, changing to brownish-red.

2. If a drop of strong sulphuric acid be mixed with a drop of aniline on a porcelain slab, a dirty white mass is formed. On the addition of water and potassium dichromate, it acquires a blue-violet colouration, which rapidly changes to blue and then to black (blue changing to purple and red in the case of strychnine).

Medico-Legal Points.—Aniline has been used as a suicidal poison, but never as homicidal. Accidental cases of poisoning occur from the inhalation of its fumes.

Poisonous symptoms have been produced both by swallowing it, or by its application to the unbroken surface. Toxic symptoms have also resulted from sucking an aniline pencil, as well as from the use of napkins stamped with marking ink containing aniline chloride.

Chronic poisoning occurs among those who are exposed to its fumes in industrial arts. The symptoms are eczematous ulcerations, cough, nervous symptoms and blindness.

Sulphate of aniline is regarded as non-poisonous.

BENZENE (BENZOL), C_6H_6.

This is a coal-tar product obtained by destructive distillation of coal. It is a colourless, volatile liquid, and has a suffocating, disagreeable odour, very much alike to coal-gas. It is insoluble in water, and highly inflammable. It is used in the "dry cleaning", and in the manufacture of aniline.

Poisoning is produced by inhaling its vapours, as also by swallowing it. Concentrated fumes may produce death very rapidly without causing any symptoms.

Symptoms.—Excitement, flushed face, nausea, vomiting, pain in the abdomen, giddiness, heaviness in the head, cold, clammy skin, stupor and coma. The pulse is feeble and frequent. The respirations are slow and laboured, and the breath may give off the smell of benzene. The pupils

are dilated. Twitchings of the muscles, convulsions and delirium may occur in some cases.

Workers in factories may suffer from hallucinations and delirium.

Fatal Dose.—Three drams have produced toxic symptoms, while one ounce has caused death.

Fatal Period.—Ten minutes in the case of a child two months old. A woman who took one ounce of benzene died in twelve hours.

Treatment.—Wash out the stomach. Use hypodermic injections of ether and strychnine, oxygen inhalation and artificial respiration.

Post-Mortem Appearances.—Purpuric spots may be visible on the skin. The odour like that of coal gas emanates from the body cavities. Hæmorrhages in the mucous membranes. Hyperæmia of the stomach and other organs. Œdema of the lungs may be present.

Detection.—Benzene can be recognised from its odour and from its boiling point, which is 80°C.

NITRO-BENZENE (NITRO-BENZOLE), $C_6 H_5 NO_2$

This substance is formed by the action of nitric acid on benzene. It is a yellow, oily liquid, having a pleasant odour like that of the oil of bitter almonds. It is insoluble in water, but freely soluble in alcohol. It is commercially known as artificial oil of bitter almonds, or oil or essence of mirbane. It is largely used in the preparation of aniline and perfumery and for making boot polish, scenting soaps and flavouring confectionery.

Symptoms.—The symptoms are usually delayed from one to three hours after swallowing the poison. These are nausea ; vomiting ; giddiness ; headache ; cyanosis ; cold and moist skin ; weak and rapid pulse ; hurried breathing ; drowsiness and coma. The pupils are contracted first and then dilated. The urine is dark coloured. Convulsions may occur before death.

Fatal Dose. -8 to 10 drops have caused death. Recovery has followed after an ounce.

Fatal Period.—The average fatal period is 7 hours. Death may occur in 1 hour or may be delayed 2 or 3 days.

Treatment.—Use emetics or the stomach tube. Give stimulants such as strychnine or digitaline, but avoid alcohol. Use oxygen inhalation, saline infusion and venesection.

Post-Mortem Appearances.—The smell of nitro-benzene is discernable on the cavities being opened. All the organs are greatly congested. The mucous membranes of the stomach and the duodenum are diffusely

reddened. Blood is fluid, chocolate coloured, and shows the spectrum of methæmoglobin.

Chemical Tests.—1. It is converted into aniline by reduction with nascent hydrogen according to the following equation :—

$$C_6H_5NO_2 + 3H_2 = C_6H_5NH_2 + 2H_2O.$$

2. Strong sulphuric acid does not produce any change in colour, but it gives a crimson colour to the oil of bitter almonds.

3. Ferrous sulphate does not produce Prussian blue with nitro-benzene, but it does so with hydrocyanic acid.

Medico-Legal Points.—Poisoning from nitro-benzene has been mostly accidental. A few suicidal cases have been recorded. It does not appear to have been used for homicidal purposes, though it has been used as an abortifacient.

Accidental poisoning has occurred from the inhalation of the vapour, from soap scented with nitro-benzene used in a hot bath, from wearing shoes polished with a blacking containing it, as also from its application to the skin to cure itch or to destroy parasites. It has also been swallowed accidentally in mistake for lemonades or spirits.

It is eliminated by the lungs, as well as by the kidneys. It is supposed that it is converted into aniline, when absorbed in the system.

DINITROBENZENE (DINITRO-BENZOL), $C_6H_4(NO_2)_2$.

This occurs in three forms; viz., ortho-, meta-, and para-dinitro-benzene. It is a yellow crystalline solid, and is used in the manufacture of the explosives,-roburite, bellite and sicherite, employed for blasting in coal mines. Poisonous symptoms have been produced among workmen employed in factories where it is used, either by inhaling its vapours or by handling it in their hands.

Acute Poisoning.—The symptoms are similar to those produced by nitro-benzene poisoning.

Chronic Poisoning.—The symptoms are pain in the stomach ; nausea ; vomiting ; anorexia ; headache ; giddiness ; staggering gait ; insomnia ; pale face ; blue lips and nails ; cold, clammy and yellow skin ; dark coloured urine and amblyopia.

Fatal Dose.—Unknown.

Fatal Period.—Unknown.

Treatment.—Same as in nitrobenzene.

Post-Mortem Appearances.—Not characteristic. Congestion of the organs. Chocolate-coloured blood.

Chemical Test.—In the presence of zinc and hydrochloric acid dinitrobenzene is converted into phenylene-diamine which is rendered alkaline by adding caustic soda or potash and evaporated after shaking it up with ether. The residue gives a brown colour with sodium nitrite and acetic acid.

NITRO GLYCERINE (TRINITRIN, GLONOIL OIL, NOBEL'S BLASTING OIL), $C_3H_5(NO_3)_3$.

This is a colourless oily liquid with a sweet taste, slightly soluble in water and rapidly in alcohol, ether, fats and oil. It is highly explosive and forms dynamite, when mixed with an infusuriol earth. Criminals give it in liquors to knock out the victim. Its vapours are very poisonous. Dynamite has been used to commit suicide. Two bobbins or a tablespoonful of dynamite have caused death.

Symptoms.—Nausea ; vomiting ; painful arterial throbbing in the head causing headache ; giddiness ; flushed face ; oppression in the heart ; profuse perspiration ; cyanosis ; stertorous respirations ; paralysis.

Fatal Dose.—One ounce has caused death.

Fatal Period.—Two to four hours.

Treatment.—Emetics or stomach tube ; adrenaline chloride as a physiological antidote ; fresh air and artificial respiration in poisoning from vapour inhalation.

Post-Mortem Appearances.—Ecchymosis and congestion in the stomach and intestines. The lungs are œdematous, other organs are congested.

Chemical Tests.—1. When treated with aniline and a drop of strong sulphuric acid it produces a red colour. The same reaction is obtained when treated with brucine and strong sulphuric acid.

2. Nitro-glycerine explodes violently when struck with a hammer.

PETROLEUM (ROCK OIL).

This is an oily liquid found under the ground in several parts of the earth and consists of a mixture of hydrocarbons or paraffins of the methane (marsh gas) series. This crude oil contains some inflammable and explosive products, which are removed by distillation and purification so as to render it fit for household use. The refined oil is called kerosene. During the process of purification several other products are

separated which cannot be used in lamps. Those which are lighter and boil at a lower temperature than kerosene are known as gasoline, naphtha, benzene, etc. From the heavier portions or those which boil at higher temperatures than kerosene the lubricating oils, vaseline, and paraffin are made.

Symptoms.—Pain in the throat; feeling of warmth in the stomach; vomiting; giddiness; heaviness in the head; pale or cyanosed face; drowsiness deepening into stupor; coma and death. The breath, vomit and urine give off the peculiar smell of kerosene. The pupils are at first contracted, but become dilated when coma supervenes. Convulsions may occur in some cases. A relapse and death may follow an apparent recovery.

Fatal Dose and Fatal Period.—Uncertain. An ounce and a quarter killed a child fourteen months old in one hour and fifty minutes.

Treatment.—Give emetics or pass the stomach tube or catheter in the case of children and wash out the stomach with warm water. Administer purgatives, stimulants, and artificial respiration.

Post-Mortem Appearances.—The usual signs of asphyxia may be present. The smell of petroleum may be noticed in the lungs, stomach, intestines and in the urine. The stomach may be pale or congested.

Chemical Tests.—The oil is known by its oily feeling when rubbed between two fingers, by its characteristic odour and inflammability. When treated with an alkali it does not saponify, a distinguishing feature from the animal and vegetable fats and oils.

Medico-Legal Questions.—Petroleum is not an active poison. In India accidental cases of poisoning from kerosene occur among children who crawl on the floor and manage to drink the contents from small tin lamp cans kept within their easy approach. I have seen two

such cases but both recovered. Accidental cases occur also among men, who drink it in mistake for country liquor.

The use of petrol as a hair wash has produced poisonous symptoms. Its fumes have given rise to toxic symptoms among chauffeurs and others working with motor engines. Those exposed to the fumes for a long time suffer usually from polio-neuritis. Skin eruptions are noticed on those who work constantly in petroleum distilleries.

Gasoline killed an infant 18 months old in 30 minutes, but the quantity that was taken is not known.

OIL OF TURPENTINE (SPIRITS OF TURPENTINE).

This is distilled from turpentine, an oleo-resin exuding from various species of Pinus N. O. *Coniferæ*. It is a colourless and transparent oily liquid, a mixture of several hydrocarbons of the turpene series. It has a strong peculiar odour and pungent bitter taste. It is insoluble in water, but soluble in alcohol, ether, chloroform and carbon bisulphide. It is extensively used to dissolve varnish.

When purified by distillation with lime, it is known as camphine or rectified oil of turpentine.

Sanitas is a watery solution of turpentine oxidized by exposure to the air. Hydrogen peroxide is its active principle.

Symptoms—Burning pain in the mouth, throat and stomach, thirst, vomiting; diarrhœa; giddiness; drowsiness; cold skin; muscular spasms; coma and death. Owing to its irritating action on the kidneys the patient complains of pain in the loins, difficulty of micturition, strangury and passes scanty high-coloured urine, which contains blood and albumen, and possesses the smell of violets. When a large quantity is taken, the urine may be completely suppressed.

Fatal Dose.—Four to six ounces have killed adults. A tea-spoonful killed an infant 5 months old.

Fatal Period.—Twelve hours in one case.

Treatment.—Give emetics or wash out the stomach. Administer demulcents and castor oil. Keep up the warmth of the body.

Post-Mortem Appearances.—The stomach contents may smell strongly of turpentine, and shows hæmorrhagic spots, sometimes, with erosions of its mucous membrane.

Chemical Tests.—It forms a red colour with hydrochloric acid and ferric chloride; the colour changes to violet and blue on standing. It is also known by its odour.

Medico-Legal Points.—Turpentine is not an active poison. A few accidental cases of poisoning have occurred from its medicinal use as an anthelmintic or from its administration in mistake. It has been taken to procure abortion, but has not been used for homicidal purposes. A case of suicide has been reported in which camphine was taken by a woman.

The vapour of turpentine produces toxic effects upon those who are exposed to it for some time.

It is eliminated by the lungs, kidneys and skin. The urine reduces Fehling's solution.

CHAPTER XXXI.

CEREBRAL POISONS—*Continued.*

C. Deliriant Poisons.

DATURA ALBA AND DATURA FASTUOSA (*SAFED AND KALA DHATURA*).

These plants belonging to N. O. *Solanceæ* grow commonly on waste places all over India. Datura stramonium (the thorn apple) grows in England on waste places and dung heaps. All the parts of these plants are poisonous. They yield an active principle, *daturine*, chemically identical with atropine and hyoscyamine, which is a crystalline substance, having an acid bitter taste. It is a powerful narcotic anodyne and antispasmodic.

Symptoms.—The symptoms usually appear within half an hour after swallowing the poison. Vomiting very often occurs immediately after taking the seeds, especially when crushed, as they act as a gastric irritant. Dryness of the mouth and throat, a bitter taste, burning pain in the stomach and dysphagia are the first symptoms that are complained of. These are followed by giddiness, staggering gait, inco-ordination of the muscles, peculiar flushed appearance on the face, dry, hot skin, diplopia, dilated pupils, red and injected conjunctivæ and drowsiness. The pulse is full and bounding but, later becomes weak, irregular and intermittent. The patient now becomes restless and delirious. Delirium is of a peculiar character. He is silent or mutters indistinct and inaudible words but, usually he is noisy, tries to run away from his bed, picks at the bed clothes, tries to pull imaginary threads from the tips of his fingers, and is subject to dreadful hallucinations.

In fatal cases drowsiness passes into stupor, convulsions and coma. Death occurs from paralysis of the heart or respiration. In cases, which recover, stupor passes away, and secondary delirium develops, which lasts for some hours.

Fatal Dose.—Uncertain. 125 seeds weighing sixteen grains have caused death.

Fatal Period.—Seven hours in one case; twelve to fifteen hours is more common.

Treatment.—Emetics and lavage of the stomach. Pilocarpine nitrate in $\frac{1}{4}$ to $\frac{1}{2}$ grain doses should be given hypodermically. Morphine may be administered hypodermically to allay pain and as a physiological antidote. Apply cold effusions to the head. Use stimulants and artificial respiration, if necessary. A large hot enema may be given with advantage to the patient, for it acts as a stimulant and by flushing the body, helps the elimination of the absorbed poison.

Post-Mortem Appearances.—The seeds, fragments of the seeds or leaves may be found in the stomach or duodenum. The internal organs are almost all congested.

Detection.—The seeds are very often mistaken for capsicum seeds. The datura seeds are hard, flattened, kidney-shaped, and $\frac{1}{6}$ inch broad and $\frac{1}{25}$ inch thick. They are bitter in taste and have a double-ridged convex border. The testa is dark or yellow brown in colour, is finely pitted and reticulated. On longitudinal section the seeds show the embryo curving outwards at the hilum.

The capsicum seeds are thin, smooth, roundish, the convex border being single and sharper. They have a sharp pungent taste. The testa is of a pale yellow colour. On section the seed shows the embryo curved inward, like the figure 6.

Test.—Digest the seeds or the suspected material for about half-an-hour in warm rectified spirit, filter and evaporate on an open water bath to dryness. Rub the residue with about a half-a-dram of distilled water acidulated with sulphu-

ric acid. Instil a drop of this into the eye of a cat. After about half-an-hour the pupil will be found dilated.

Medico-Legal Points.—Datura is very commonly used in India for criminal purposes. The seeds are generally used to stupefy persons to facilitate theft. They are given whole, or more often crushed, mixed with rice, *dal*, or wheat or *bajra* flour and sometimes with liquor. The seeds, as well as the leaves, are also mixed with tobacco or *ganja* and smoked in a *chilam* (pipe) for the same purpose. Occasionally liquor is adultered with datura smoke.

Suicidal cases are very rare. Accidental cases do occur among children, as also among adults, by eating datura berries or the seeds in mistake for chillies. Accidental cases also occur from the injudicious use of the seeds in medicine, as they are used by *vaids* and *hakims* in the treatment of several diseases. The seeds are reputed to have an aphrodisiac property. Medicated *ghee* is prepared with the seeds for local application. The juice of the leaves is used to subdue pain and inflammation in rheumatism.

The mydriatic principle contained in the seeds appears to be destroyed by putrefactive changes in the body, but can be obtained, after some lapse of time in the vomit or from the earth upon which the patient has vomited.

ATROPA BELLADONNA (DEADLY NIGHT-SHADE).

This plant belongs to N. O. *Solanceæ*, and grows wildly in England near villages or on old ruins. All the parts are poisonous. The plant contains two alkaloids, atropine and hyoscyamine, but the poisonous properties are chiefly due to the former.

Atropine crystallizes in odourless and colourless prismatic needles, and has a bitter taste. It is sparingly soluble in water (1 in 500), but freely in ether, alcohol and chloroform.

Its aqueous solution has an alkaline reaction, and is readily decomposed by keeping. It can be chemically split up by strong acids and alkalies into atropine and tropic acid, and may be reconstructed synthetically from these substances.

Symptoms.—Dryness of the mouth and throat with difficulty in swallowing; the face is flushed; the eyes are suffused; the eyelids are swollen; the pupils are dilated and insensible to light; the skin is hot and dry with raised temperature. Sometimes a scarlatinal rash or exfoliation of the skin is seen. The pulse is at first slow, and then becomes rapid. The respirations are slow and deep. The patient feels giddy, staggers and is unable to walk from inco-ordination of the muscles. These symptoms are followed by delirium, drowsiness, stupor, coma and death. The patient has no recollection of the symptoms after recovery.

Fatal Dose.—One teaspoonful of belladonna liniment and one dram of the tincture have caused death. Half-a-grain of atropine has proved fatal. $\frac{1}{20}$th grain of atropine injected hypodermically has caused death. Fourteen berries have also caused death.

Fatal Period.—In rapidly fatal cases death occurs in 3 to 6 hours. Ordinarily it occurs within 24 hours.

Treatment.—The same as in datura poisoning.

Post-Mortem Appearances.—The stomach may or may not be congested. The brain vessels are congested.

Chemical Tests.—1. An alcoholic solution of bromine gives a yellow crystalline precipitate to atropine.

2. Aurium perchloride gives a citron yellow precipitate to a solution containing atropine.

Medico-Legal Points.—Poisoning occurs accidentally from an over-dose of its pharmacopœial preparations or from swallowing "eye-drops" in mistake, Children suffer sometimes accidentally from eating the berries or the seeds, though they are less susceptible than adults. Cases of poisoning have

also been known to have occurred owing to idiosyncrasy, from the external application of belladonna liniment or plaster or from the decoction of its root used as an enema.

Suicidal cases have occurred from swallowing the liniment or extract. Homicidal cases are very rare. In one case a man mixed the seeds in soup, which he took to bring a false charge of poisoning against his wife. It is also supposed to have been given by Clark of Agra to Fulham to simulate the symptoms of heat apoplexy.

It is eliminated from the system chiefly by the kidneys. Consequently it can be detected in an unchanged condition in the urine.

COCAINE (BENZOYL-METHYL-ECGONINE) $C_{17}H_{21}NO_4$.

Cocaine is an alkaloid derived from the leaves of Erythroxylon Coca (N. O. *Lineæ*), growing in South America, but now cultivated in the tea districts of India and Ceylon.

It is a colourless, crystalline substance and has a bitter taste, causing numbness of the tongue and the mucous membrane of the mouth. It is soluble, with great difficulty, in water, but dissolves readily in alcohol, ether, chloroform and benzene, the solution being alkaline.

In the form of cocaine hydrochloride it is largely used as a local anæsthetic in ophthalmic practice, and in dental and minor operative surgery. The hydrochloride exists in colourless acicular crystals. It is soluble in water, alcohol, chloroform and glycerine. Its solution is neutral and decomposes in a short time, but keeps better, if mixed with half a per cent. of acid boric solution.

Acute Poisoning.—This is marked by excitement with delirium of a noisy character, followed by depression, as cocaine, when absorbed into the blood, first stimulates and then paralyses the nerve centres of the brain and spinal cord.

Symptoms.—Dryness of the mouth and throat ; dysphagia ; a feeling of tingling and numbness in the tongue, hands and feet ; nausea but rarely vomiting ; cramps in the stomach ; headache ; giddiness ; faintness ; marked cyanosis ; dilated pupils ; quick, irregular and imperceptible pulse ; shallow, gasping and convulsive respirations, profuse perspiration chiefly on the forehead ; convulsions ; paralysis. Death occurs from respiratory paralysis, or from heart failure. Delirium and hallucinations may occur.

Fatal Dose.—$\frac{2}{3}$ grain injected hypodermically has caused death. 10 and 12 grains taken by the mouth have caused death, though recovery has followed after larger doses.

Fatal Period.—Five to eight hours are probably the usual fatal period, though death has occurred from twenty to forty minutes.

Treatment.—Use emetics and the stomach tube, if poison is taken by the mouth. Keep the patient in a recumbent posture. Administer stimulants, such as ammonia, digitalis and strychnia.

Amyl nitrite is considered the best antidote and should, therefore, be given as inhalation. Carry on artificial respiration, if necessary.

Post-Mortem Appearances.—Marked hyperæmia of the brain, spinal cord and other internal organs.

Chronic Poisoning (Cocainophagia or Cocainomania).—This occurs among those who have been accustomed to its use either by internal administration or by subcutaneous injection.

Symptoms.—Insomnia ; digestive derangements ; wasting ; emaciation ; impotence ; defective memory ; physical moral degeneration ; derangement of the special senses ; hallucinations ; mania amd melancholia.

The characteristic symptom known as Magnan's symptom and complained of by the patient, is a feeling as if grains of

sand were lying under the skin, or some small insects (cocaine bugs) were creeping on the skin, giving rise to itching sensation.

Detection.—1. *Physiological Test.*—It produces numbness and local anæsthesia at the point of application. The condition lasts for about half-an-hour.

2. *Giesel's Test.*—A solution of potassium permanganate gives a fine bright, violet precipitate, which shows rhombic crystals arranged in rosettes when seen under the microscope. Dr. Hankin has elaborated a special method of carrying out this test, which he considers to be very delicate.

3. Gold Chloride (10 grains to an ounce) produces a yellow precipitate, which dissolves in boiling hydrochloric acid and gives off a vapour which smells of benzoic acid.

4. Iodine dissolved in potassium iodide solution gives a brown pink precipitate.

Medico-Legal Points.—Accidental cases of poisoning from cocaine have occurred from internal use, from hypodermic injection, and from urethral, vesical and rectal injections.

A few cases of suicide have been recorded. Like opium, cocaine is believed to be an aphrodisiac and to increase the duration of the sexual act by paralysing the sensory nerves of the glans penis. Hence young men indulge in its use. It may be used for this purpose by local application, but it is ordinarily taken in *prepared pan.* This pernicious habit has become so very common that Government forbids the sale of cocaine without a license. Even qualified medical men cannot keep it in their private dispensary without a license. When, owing to the war, supplies of smuggled cocaine became difficult to procure, anæsthesin (ethyl ester of para-amido-benzoic acid), a preparation of cocaine, was used instead. A solution of it was applied to the glans penis before intercourse. It is possible that a five per cent. solution

of this drug, thus used, might be found of benefit in cases in which owing to excessive excitability, the sexual act cannot be properly performed.

In England some persons are accustomed to use cocaine hypodermically. In Paris certain classes of people use it in the form of snuff.

A very small portion of cocaine is eliminated in the urine. It is largely decomposed in the human system; hence it is very difficult to detect it in the viscera.

Antipyrine is very often mixed with cocaine. The Chemical Examiner has frequently to examine packets of white powder suspected to be cocaine, found with cocaine smugglers.

HYOSCYAMUS NIGER (HENBANE, *KHORASANI AJWAYAN*).

This plant belongs to N. O. *Solanaceæ*, and grows wild throughout the Himalayan range. All the parts of the plant are poisonous, but the seeds are more poisonous. The seeds, leaves, and the green flowering tops yield two active principles, hyoscyamine, and hyoscine, and a fixed oil.

Hyoscyamine occurs both as a crystalline and as an amorphous alkaloidal substance. It is isomeric with atropine, into which it can be readily converted. It may be split up into hyoscine and hyoscinic acid. Hyoscine is a syrupy alkaloid synonymous with scopolamine. It is considered five times more powerful therapeutically than hyoscyamine.

Symptoms.—These are the same as in belladonna poisoning, but delirium is not so marked, while there is a greater tendency to sleep, insensibility and general paralysis of the nervous system. In addition to these, nausea, vomiting, purging, spasmodic contractions of the muscles and hallucinations may be present.

Fatal Dose.—Not certain. Owing to an individual idiosyncrasy medicinal doses of the alkaloids have produced toxic symptoms. $\frac{1}{4}$ to $\frac{1}{2}$ a grain of hyoscine may be regarded as a fatal dose.

Fatal Period.—Not known.

Treatment.—Emetics; stomach tube; tannin; tea; coffee; pilocarpine hypodermically.

Post-Mortem Appearances.—Not characteristic. The seeds may be found in the stomach. Congestion of the brain and lungs has been found.

Detection.—The seeds are kidney-shaped, about $\frac{1}{8}$" in diameter, covered with small projections and are of a brown or grey colour.

Medico-Legal Points.—An accidental fatal case has occurred from the root used as a vegetable in mistake for parsnip. The seeds have been mistaken for celery seeds, and have produced poisonous symptoms.

The dried leaves and flowers are smoked like *ganja* by depraved persons and *Fakirs* in Sind. The juice of the fresh leaves, as well as the dried leaves, are used in the treatment of irritable affections of the lungs, bowels and genito-urinary organs. The juice and the oil are also used for external applications. In 1910 hyoscine was used by Crippen, an American homeopathic doctor, in killing his wife. More than $\frac{1}{2}$ a grain was probably used.

The following plants belonging to N. O. *Solanaceæ* have produced poisonous symptoms which are due to solanine, an active principle, contained in them. It acts as a gastro-intestinal irritant and narcotic.

1. Solanum Dulcamara (Woody nightshade). The berries are known as *Anab-es-salab.*
2. Solanum Indicum (*Barhanta. Dolimoola*).
3. Solanum Jacquinii (*Katai, Bhooi ringni*).
4. Solanum Nigrum (*Mako*).
5. Solanum Tuberosum (*Alu*).

Symptoms.—Nausea; vomiting; diarrhœa; colic; tenesmus; giddiness; widely dilated pupils; cramps in the legs; muscular spasms; drowsiness; delirium; coma. Death occurs from respiratory paralysis.

Fatal Dose and Period.—Uncertain. Two berries of solanum dulcamara have caused death of a child four years old in thirty-two hours.

Treatment.—Wash out the stomach. Give morphine hypodermically. Keep up the body warmth and use stimulants.

CANNABIS SATIVA OR INDICA (INDIAN HEMP).

The plant belongs to N. O. *Cannabinaceæ*, and is cultivated largely all over India. It yields two active principles, *cannabin* and *cannabinon.* Cannabin is an alkaloid, and occurs as a brown syrupy liquid. Cannabinon occurs as a dark brown resin. Both are used as sedatives.

The forms in which cannabis Indica is used in India are—

1. *Bhang, Siddhi or Sabji.*—This consists of the dried leaves and fruiting shoots. It is used as an infusion in the form of *Hashish*, which produces intoxication of a sensuous character. It is rubbed on a stone slab with sugar, black pepper and dried leaves and is taken in the form of a bollus or pill, or is mixed with water and strained through a muslin cloth before it is drunk. This is the favourite beverage, especially of the Hindus in the Northern parts of India.

The intoxication produced by it is of the most cheerful kind causing the individual to sing and dance, to eat food with great relish and to seek sexual enjoyment. The intoxication lasts about three hours, when sleep supervenes.

2. *Majun.*—This is a sort of confection prepared from *bhang* after treating it with sugar, flour, milk and butter. It has an agreeable odour and sweet taste. It is sold in the *bazar* in small lozenge-shaped pieces. One to three drams are enough to intoxicate a person, who feels great appetite and a sexual desire. He also feels quite happy and contented as though he belongs to some *raja's* family, and has got all what he wants. Sometimes *dhatura* is mixed with *majun.*

3. *Ganja.*—This consists of the flowering tops of the plant. It is mixed with a little tobacco, and is usually smoked in a pipe (*chilam*). The person using the smoke feels heavy and lazy, and indulges in pleasant reveries, though he is able to discharge his ordinary duties. It is largely indulged in by *Sadhus* and *Fakirs*.

4. *Charas.*—This is the resin exuding from the leaves and stems of plants, which grow on mountainous regions from six to eight thousand feet above the sea-level. It is smoked with tobacco, and acts as a strong narcotic.

Symptoms.—Persons not accustomed to its use or from an over-dose suffer from toxic symptoms. These are charac-

terized by two stages : stage of intoxication and stage of narcosis.

The first stage is characterized by excitement with hallucinations, laughing and foolish talk. The patient becomes widely delirious, gets dreadful hallucinations and, sometimes, has a homicidal tendency. He then feels giddy, complains of tingling and numbness of the skin, becomes drowsy and then passes into the second stage of narcosis with dilated pupils. In severe poisoning there may be general anæsthesia. Recovery usually follows a deep sleep.

Chronic Poisoning.—In chronic poisoning the symptoms are loss of appetite, general weakness, trembling, loss of sexual power, hallucinations and insanity.

Fatal Dose.—Unknown. Seven minims and a half of the tincture of cannabis Indica have produced toxic symptoms.

Fatal Period.—Death is very rare, but it has been recorded to have ensued in twelve hours. It has been delayed till the nineteenth day.

Treatment.—Evacuation, stomach tube, cold affusion to the head, strychnine hypodermically and artificial respiration.

Post-Mortem Appearances.—Not characteristic.

Detection.—Extract resin by digesting the suspected material in alcohol. The resin when given to a dog will produce narcosis with swaying of the head from side to side.

Bhang and *ganja* can be detected under the microscope as fragments of green leaves covered thickly with curved claw-shaped, sharp pointed hairs.

Medico-Legal Points. – Poisoning from *bhang* is mostly accidental. Probably it has never been used for homicidal purposes, but it has been used by road poisoners to stupefy persons to facilitate robbery.

Sometimes people take it to steady their nerves before committing a crime. Very rarely people, after taking *bhang*

in India and *hashish* in Malay States, run *amok*, *i.e.*, they first kill a person or persons against whom they have entertained fancied or real enmity and then go on killing everybody that comes in their way until the homicidal tendency lasts. They then commit suicide or quietly submit themselves to the police.

ARTEMISIA MARITIMA (WORM-WOOD).

This plant belonging to N. O. *Compositæ* grows on the coasts of England, and yields an active principle, *santonin*, chiefly from santonica, the dried unexpanded flower heads.

Santonin is a glucoside and occurs as flat, glittering, prismatic crystals. It is either tasteless or faintly bitter. It is colourless, but becomes yellow on exposure. It is slightly soluble in water, but is easily soluble in alcohol, chloroform and alkalies.

Symptoms.—Giddiness, pain in the stomach, vomiting, yellow vision (xanthopy), dilated pupils, cold skin bathed in perspiration, feeble and slow pulse and respirations, convulsions, delirium, stupor, coma, death ending the scene from failure of the heart or respiration. The urine is greenish, yellow or saffron if acid, and purple-red if alkaline.

Fatal Dose and Period.—Two grains administered twice killed a child five and-a-half years old in twelve hours. Recovery has followed one ounce.

Treatment.—Emetics, stomach tube, stimulants, potassium bromide and chloral hydrate.

Pest-Mortem Appearances.—Not characteristic.

Tests.—Strong H_2So_4 + Heat + Ferric chloride forms a red colour, becoming yellow and lastly brown.

Medico-Legal Points.—Cases of poisoning occur accidentally among children from an over-dose given as an athelmintic. Adults have been poisoned by taking it in mistake for Epsom salt as also by taking the infusion of the plant.

Poisonous symptoms have occurred among persons addicted to the use *of absinthe*, a French liqueur, containing oil of wormwood. It owes the poisonous properties to the presence of santonin.

CAMPHOR (*KAFOOR*), $C_{10}H_{16}O$.

This is stearopten obtained from the wood of Cinnamonum camphora (Camphora officinarum) belonging to N. O. *Lauraceæ*. It is

artificially produced by the direct union of oil of turpentine and hydrochloric acid. It occurs as white crystalline masses, having a pungent, bitter taste and a peculiar, fragrant, penetrating odour. If floats on water in which it is almost insoluble, but it is dissolved by alcohol, ether, chloroform and oils. It is extremely volatile and inflammable, burning with a bright light and much smoke.

Camphor is widely used as a personal disinfectant and as a preservative of clothing against an attack of moths.

Borneo Camphor or *Borneol*, $C_{10}H_{18}O$, is derived from Dryobalanops aromatica, and is ordinarily met with in commerce in place of camphor, from which it can be distinguished by sinking in water.

Symptoms.—Pain in the mouth and stomach, vomiting, pale face, cyanosed lips, dilated pupils, vertigo, convulsions, delirium, unconsciousness, coma and death. The vomit and urine smell of alcohol.

Fatal Dose.—20 grains have proved fatal, though recovery has followed larger doses. One dram of camphorated oil killed a child five years old.

Fatal Period.—Seven to eighteen hours.

Treatment.—Emetics, lavage of the stomach, warmth to the body, cold affusions to the head, stimulants and artificial respiration, if necessary.

Post-Mortem Appearances.—Signs of gastro-intestinal inflammation with erosion or ulceration of the stomach. The stomach contents may show a solid piece of camphor, or may give off the odour of camphor.

Medico-Legal Points.—Accidental cases of camphor poisoning have occurred from the pharmacopœial preparations (liniment and spirit) having been drunk in mistake for other preparations, such as castor oil, etc.

Poisonous symptoms resulting in death in some cases have followed its use as an abortifacient.

POISONOUS FUNGI.

Fungi owe their poisonous properties to the presence of active principles, *phallin* contained in Agaricus phalloides, and *muscarine* contained in Agaricus or Amanita muscarinus, Agaricus pantherinus, Boletus luridus, etc. Phallin has a hæmolytic action and muscarine produces contraction of the pupils and affects the nervous system.

Symptoms.—These are divided into two groups, irritant and neurotic.

1. *Irritant symptoms.*—The symptoms are usually delayed for six to ten hours or in some cases for thirty hours. These are constriction of the throat, burning pain in the stomach, nausea, painful retchings,

vomiting and diarrhœa, the stools containing blood, the urine may contain blood and albumin. These are followed by the cyanosed face, small pulse laboured respirations, convulsions, profuse sweating, collapse and death. Sometimes there may be anuria.

2. *Neurotic Symptoms.*—These are giddiness, headache, delirium, diplopia, dilatation, sometimes contraction, of the pupils, tetanic spasms, insensibility and coma.

In some cases irritant symptoms may be present and in others, neurotic only. The predominance of one or the other group of symptoms depends on the nature of the alkaloids present.

Fatal Dose.—Uncertain.

Fatal Period.—Death usually occurs within twenty-four hours.

Treatment. - Wash out the stomach with water containing potassium permanganate. Give common salt as an emetic, and castor oil to clean the bowels. Atropine should be injected hypodermically as a physiological antidote. Morphine may be administered hypodermically to relieve pain. Give stimulants and saline infusion subcutaneously.

Post-Mortem Appearances.—Signs of inflammation of the mucous membrane of the alimentary canal are present, if the irritant signs have been predominant. Fatty degeneration of the solid organs, such as the liver may also be found. In cases of neurotic symptoms congestion of the brain vessels, aud subpleural and subpericardial hæmorrhages are very likely to be met with.

Medico-Legal Points.—Poisoning occurs accidentally from eating non-edible or poisonous fungi, as it is difficult for an ordinary man to distinguish between edible and non-edible (poisonous) fungi. The following are the characters by which they may be known :—

Edible Fungi.	Non-edible (Poisonous) Fungi.
1. Grow solitary in dry airy places.	1. Grow in clusters in woods and dark damp places.
2. White or brownish in colour.	2. Green or scarlet colour of unusual brilliancy.
3. Compact, firm, but brittle in consistence.	3. Tough, soft and watery, and liable to decompose.
4. The colour does not change on exposure to the air after they are cut.	4. The colour changes to brown, green or blue when cut and exposed to the air.

Edible Fungi	Non-edible (Poisonous Fungi.)
5. Watery juice.	5. Milky juice.
6. Agreeable odour.	6. Offensive and repulsive odour, but masked by cooking.
7. Acrid, saltish or astringent taste, but not bitter.	7. Bitter, styptic taste, burning and parching the throat, frequently masked by cooking.
8. Plain round spores, when seen under the microscope.	8. Irregular, or round, pink, rusty brown or white spores, when seen under the microscope.

There are some poisonous fungi which lose their toxic properties, when they are boiled, or when they are steeped in salt and vineger for sometime, while the edible ones become poisonous by being cooked twice.

The urine of a person, who has taken the agaricus fungus possesses intoxicating properties. Hence it is very often used by the people of Kamaschatka to produce intoxication.

POISONOUS FOOD GRAINS.

Lathyrus Sativus (*Kesari Dal*).—This is a variety of pulse belonging to N. O. *Leguminosæ*, and used as an article of food by the people in Sind and other parts of India. Its continued use gives rise to a train of symptoms, known as *lathyrism*, or spastic paraplegia, but the *post-mortem* examination does not show any lesion of the spinal cord. It owes its toxic properties to a volatile alkaloid, which is dissipated by heat, or when the pulse is removed of its husk and properly cooked.

Lolium Tenulentum (*Darnel, Mochni*).—This is a kind of grain belonging to N. O. *Graminaceæ*. Its seeds contain a glucoside, loluin, to which its poisonous properties are believed to be due. Accidental cases of poisoning have occurred from these seeds being ground in mistake with wheat or rye, and thus made into bread.

Symptoms.—Giddiness, muscular weakness, tremors, symptoms of gastro-intestinal irritation, dilatation of the pupils and stupor. No case of death has yet been recorded.

Stigmata Maides (*Maize, Indian Corn, Maccai or Butta*).—This corn belongs to N. O. *Graminæ* and is cultivated every where. It is affected by a special kind of fungus, which causes pellagra, when eaten.

Paspalum Scrobiculatum (*Kodra*).—The poison is supposed to reside in the husk of the grain, which is very often used by poor people as an article of food. The poison is removed by boiling.

Symptoms.—These are giddiness, intoxication, dilated pupils, tremors, delirium, convulsions, stupor and coma.

There is another variety of grain called *Kodu* which, when eaten, produces symptoms very much similar to *datura*, and causes death.

CHAPTER XXXII.

SPINAL POISONS.

STRYCHNOS NUX VOMICA (*KUCHILA*).

This tree belongs to the N. O. *Loganiaceæ*, and grows in the jungles of Manbhoom, in the Madras Presidency, Malabar and Coromandel Coasts.

Its ripe fruit contains the nux vomica seeds, which are poisonous. They are flat circular discs or slightly concave on one side and convex on the other, being $\frac{7}{8}$ to 1″ in diameter, and $\frac{1}{4}$″ in thickness. They are ash-grey in colour and have a shining surface with short satiny hairs. Internally they are tough, horny and slightly transluscent, having no odour but possessing a bitter taste. They yield two principal alkaloids, *strychnine* and *brucine*, united with styrchnic or igasuric acid as igasurates. Besides, the seeds contain to a small extent a glucoside, named *loganine*. The bark, wood and the leaves contain brucine, but no strychnine.

The following trees belonging to N. O. *Loganiaceæ* also contain the same alkaloids :—

1. Strychnos Colubrina (Snake wood, *Kuchila-lata or Gogarilakdi*).

2. Strychnos Ignatii (St. Ignatius' Beans, *Papita*).

3. Strychnos Tiute (Upas tree).—This is used as an arrow poison in Java.

Strychnine, $C_{21}H_{22}N_2O_2$. This crystallizes in white rhombic prisms, without odour, but with an intensely bitter taste. It dissolves in 5760 parts of cold water, and in 2500 parts of chloroform. It is very stable, and does not change in the process of putrefaction, if present in the dead body. Hence it can be detected some years after death.

Strychnine is largely used to destroy wild animals and vermin and, therefore, forms one of the chief constituents of several "vermin killers", which are usually mixed with some colouring material, such as Prussian blue, indigo or soot. These are sold in the chemist's shop as "Barber's, Battle's, Butler's, Gibson's, Hunter's and Marsden's vermin killers and Miller's rat powders".

Brucine, $C_{23}H_{26}N_2O_4$, $4H_2O$.—This occurs in colourless, prismatic crystals, with an intensely bitter taste. It is soluble in 3200 parts of cold water, in 150 parts of boiling water, and freely in chloroform and amyl alcohol, but not in ether. It has the same toxic effects as strychnine, but possesses only one twenty-fourth of its physiological action.

Both strychnine and brucine form salts, many of which are soluble in water.

Symptoms.—These supervene immediately after, or within five or ten minutes after, swallowing the poison; sometimes they may be delayed for an hour or so. The hot and intensely bitter taste is experienced during the act of swallowing, if it happens to be in solution. This is followed by a choking sensation in the throat. The most marked effects due to its direct action on the spinal cord are the convulsions affecting all the muscles at a time. These are at first clonic, but eventually become tonic, as the intervals become shorter and the paroxysms longer. During the paroxysms the face becomes cyanosed, and wears an anxious look, the eyes are staring, the eye balls prominent and the pupils are dilated. The features are drawn into a grin (the *risus sardonicus*), and the mouth is covered with froth, frequently stained with blood. The body is arched back in the position of *opisthotonos*, the unfortunate patient resting on his heels and occiput. The spasms of the diaphragm, drawing upon the ensiform cartilage, cause epigastric pains. The contractions of the respiratory muscles produce a sense of suffocation, which may end in

asphyxia. Sometimes the spasms of the abdominal muscles may bend the body forward *(emprosthotonos)* while, less frequently, the body may be flexed to the side *(pleurosthotonos)*. The mind remains clear to the last, and the patient is conscious of the pain and impending danger of death. The reflex excitability is so great that the slightest movement of the patient, a sudden noise or the touch of a glass of water to the lips or even a flash of light is enough to induce the convulsions. Vomiting is readily induced, and persists when once excited. Death may occur from asphyxia during the first paroxysm, or any subsequent attack, or from exhaustion during the intervals, as a result of painful spasms.

In the cases that tend to recovery, the convulsions become shorter and less active, and the period of intermissions is much longer.

Fatal Dose.—The usual fatal dose of strychnine is ½ to 2 grains. The smallest amount known to have proved fatal is ¼ grain. On the other hand recovery has ensued from a dose of 20 grains. 30 to 50 grains of the powdered nux vomica seeds prove fatal; but the entire seeds, owing to the presence of the hard, insoluble testa may pass out of the bowel without producing poisonous symptoms. 3 grains of the extract nux-vomica and 6 drams of the tincture have caused death.

Fatal Period.—The usual period is 2 to 4 hours. The shortest period is 5 minutes in one case and 10 in another. The longest period is 6 hours.

Diagnosis.—Strychnia poisoning has to be diagnosed from tetanus. The chief distinguishing points between the two are as follows:—

Strychnine Poisoning.	Tetanus.
1. All the muscles are affected at a time.	1. Lock-jaw is first affected.
2. During the intervals the muscles are relaxed.	2. During the intervals the muscles are rigid.
3. The progress is much more rapid.	3. The progress is slow.

Treatment.—Give chloroform inhalation to check the spasms, and then introduce the stomach tube to wash out the stomach with warm water containing potassium permanganate (4 grains in 11 fluid ounces), charcoal or tannin. In the absence of a tube, give emetics of mustard or zinc sulphate, or apomorphine hypodermically. Potassium bromide and chloral hydrate should be administered by the mouth or per rectum or even hypodermically. Gentle narcosis and perfect quiet are very essential.

Post-Mortem Appearances.—Relaxation of the muscles usually occurs after death but, in some cases, rigidity of the muscles passes into rigor mortis without the initial stage of relaxation, which also lasts for a very long time. There may be livid patches on the body, which may be mistaken for bruises caused by violence.

The heart is found empty or distended with dark fluid blood. The lungs, the brain and the spinal cord are congested.

Tests.—*Strychnine.*—1. A bitter taste will be perceptible in a solution of 1 in 70,000 of water.

2. Sulphuric or nitric acid does not produce any colour change.

3. Strong sulphuric acid and potassium bichromate produce a violet colour, which gradually changes to bright red, then to rose pink and lastly to yellow. This is a delicate test and reveals 1 : 50,000. Instead of potassium bichromate potassium permanganate, manganese dioxide, lead peroxide or any other oxidizing agent may be used.

Physiological Test.—A few drops of the suspected mixture injected subcutaneously into the abdomen or the thoracic cavity of a frog will induce tetanic spasms.

Brucine.—1. Strong sulphuric acid or nitric acid gives a blood red colour, which disappears on the addition of stannous chloride.

2. *Blyth's Test.*—Methyl iodide, when added to an alco-

holic solution of brucine, produces circular, rosette-shaped crystals. Strychnine does not respond to this test, nor does it interfere with the test, if present along with brucine.

Medico-Legal Questions.—Strychnine is one of the most deadly poisons. Accidental poisoning has resulted from an over-dose or from it having been dispensed in medicine in mistake for some other harmless drug, such as quinine, salicin, caffein, etc. Only a short time ago at the John's Mills in Agra strychnine was accidentally dispensed instead of quinine with the result that seven people died within an hour. Poisonous symptoms have also occurred accidentally from incompatible prescriptions, containing potassium iodide or liquor arsenicalis and strychnine, when the latter precipitates to the bottom of the mixture and is taken with the last dose. To avoid these accidents I would suggest that all the preparations of strychnine should be expunged from the British Pharmacopœia except only one preparation, viz., $\frac{1}{60}$ grain tabloids of strychnine hydrochloride.

Suicidal cases are very common in England on account of the facility with which packages of "vermin killers" containing strychnine are obtainable in a chemist's shop.

Owing to the ignorance of the people about strychnine suicidal poisoning is rare in India, though a few cases have lately been reported. It has been very rarely administered with homicidal intent.

Accidental cases from nux vomica have occurred from an over-dose, for it is largely used in medical practice by *vaids* and *hakims*. The bark of the tree has been mistaken for *kurchi* bark (holarrhena antidysenterica) or for angostura bark.

Not only has poisoning occurred from the administration of strychnine by the mouth or hypodermically, but also from its application to the eye or from the inhalation of steam issuing from a hot mixture containing strychnine. It has also

resulted from the application of a nux vomica paste to a wound.

The poisonous effects depend on an individual idiosyncrasy, and tolerance is established by habitually taking it for a long time.

Strychnine is eliminated in the urine, as well as in the bile and saliva and possibly in the sweat. An infant may be affected by sucking its mother, who has been taking medicinal doses of strychnine. It acts as a cumulative poison owing to its slow elimination.

When taken together with an opiate, its symptoms are delayed, or are modified. Very often the symptoms of morphine poisoning have supervened, when it has been administered in the treatment of strychnine poisoning.

PHYSOSTIGMATIS SEMINA (CALABAR BEAN).

This is the ripe seed of Physostigma venenosum belonging to N. O. *Leguminosæ*. It is known as the Ordeal Bean of West Africa, as it is used there as a test in suspected witchcraft. It is blackish-brown in colour, and slightly kidney-shaped, having a black groove along its convex border, measures $1\frac{1}{4}'' \times \frac{3}{4}'' \times \frac{1}{2}''$ and weighs about $1\frac{1}{2}$ to 2 drams. It has no odour, nor has it any distinctive taste. If cut longitudinally, it is seen to consist of a brown rind, containing two hard, white, brittle cotyledons which adhere to the shell.

The poisonous properties are due to two alkaloids, *physostigmine* or *eserine* and *calabarine* contained in the cotyledons of the seed.

Physostigmine (Eserine), $C_{15}H_{22}N_3O_2$.—In a pure state this is a white crystalline substance, but becomes yellowish on exposure to air and light. It is bitter in taste and alkaline in reaction. It is slightly soluble in water, but readily dissolves in alcohol, chloroform and ether. With acids it forms salts, which are soluble in water.

Symptoms.—These are giddiness, salivation, thirst, pain in the stomach, vomiting, sometimes diarrhœa, slow, feeble irregular pulse, cold clammy skin, contracted pupils, muscular twitchings and paralysis of the voluntary muscles. The intellect remains clear till last. Death occurs from paralysis of the respiratory muscles.

Fatal Dose.—Not known.

Treatment.—Give emetics or wash out the stomach. Atropine and chloral hydrate are both regarded as physiological antidotes. Give stimulants and artificial respiration may be resorted to, if necessary.

Post-Mortem Appearances —Negative.

Tests.—1. Bromine water produces a red orange-coloured turbid solution which will clear away on heating.

2. Chlorine water gives a red colour.

3. If dropped into the eye of an animal, it produces contraction of the pupils.

Medico-Legal Questions.—Accidental cases of poisoning have occurred among children from eating the beans. Accidental poisoning has also resulted from the eserine solution having been instilled into the eyes or sprayed into the nose.

Suicidal cases have occurred, but no homicidal case has yet been recorded.

Physostigmine has a paralysing action on the spinal cord. It is eliminated from the system by the urine, fæces and saliva.

Calabarine acts as a stimulant to the cord, and produces convulsions just like strychnine.

GELSEMIUM SEMPERVIRENS OR NITIDUM (YELLOW OR CAROLINA JESSAMINE OR JASMINE.)

This is a plant belonging to N. O. *Loganiaceæ*, and grows in North America. Its root is official, and yields active principles ; viz., gelsemine, gelseminine and gelsemic acid.

Gelsemine.—This is a white, very bitter, inodorous, amorphous alkaloidal substance, sparingly soluble in water, but freely in alcohol and ether. With acids it forms crystalline salts.

Gelseminine.—This is a highly poisonous alkaloid occurring as a yellowish-brown, amorphous powder, or in yellowish-white minute crystals. It is slightly soluble in water, but freely soluble in alcohol and ether. Its salts are freely soluble in water.

Gelsemic Acid.—This is a colourless, tasteless, odourless, crystalline body. It is slightly soluble in cold water, more in hot water and freely in ether and chloroform. It forms salts, but with few metals.

Symptoms.—Nausea, frontal headache, giddiness, ptosis, strabismus, diplopia, dilatation of the pupils, great muscular weakness, inco-ordination, paralysis, difficulty of articulation and swallowing due to the paralysis of the mouth and throat, depression of the temperature, pulse and respirations,

and general prostration. Death occurs from asphyxia, the mind remaining clear. Sometimes clonic convulsions may be seen.

Fatal Dose.—One-sixth grain of gelsemine, thirty-five drops of the tincture and three teaspoonfuls of the fluid extract have each caused death.

Fatal Period.—The average fatal period is about three hours. The shortest is one hour, and the longest is seven hours and a half.

Treatment.—Emetics or thorough washing out of the stomach. Hypodermic injections of digitalis and atropine. Digitalis will strengthen the heart, and atropine, the respiration. Hot applications to the epigastrium and extremities. Oxygen inhalation and artificial respiration, if necessary.

Post-Mortem Appearances.—No characteristic appearances.

Analysis.—1. *Chemical Test.*—The alkaloids of gelsemium when touched with concentrated alcohol on a white plate, yield a yellow-brown colour. A fragment of potassium chromate changes the colour to red, purple, and lastly to green.

2. *Physiological Test.*—Administered to frogs, cats or rabbits, the alkaloids cause prostration, convulsions, dilated pupils and asphyxia.

Medico-Legal Points.—Poisoning by gelsemium has been mostly accidental. During the investigation of Clark-Fulham murder case in Agra in 1912, it was suspected that Clark had administered gelsemium to Fulham with criminal intent.

Gelsemine paralyses the spinal cord and the respiratory centre, but has no action on the heart and the brain. Sometimes, it causes tetanic spasms.

It is eliminated in the urine.

CHAPTER XXXIII.

CARDIAC POISONS.

NICOTIANA TABACUM (TOBACCO, *TAMBAKU*).

This belongs to N. O. *Solanceæ*, and is originally a native plant of America, but is now cultivated largely all over India.

The dried leaves of tobacco are used in India as an article of luxury by almost all classes of people, who use it either in the form of smoke or snuff, or chew it with lime alone or with lime and *pan*. The leaves are manufactured as cigars (cheroots) in Trichinopoly and Burma, which are popular with Europeans also.

The leaves yield two active principles : *nicotine* and *nicotianine*.

Nicotine, $C_{10}H_{14}N_2$.—This is present in the tobacco leaves from 6 to 8 per cent., from which it is prepared by distilling the aqueous extract with milk of lime. It is a colourless, volatile, oily alkaloid, turning brown on exposure. It has a burning acrid taste, and a penetrating disagreeable odour. It is soluble in water, alcohol and ether, the solution being alkaline in reaction. It first stimulates and then depresses the vagal and vasomotor ganglia. Similarly it first stimulates and then paralyses the cerebral and spinal centres. In smaller doses it contracts the pupils but, when toxic symptoms develop, it dilates them.

Nicotianine.—This is also known as tobacco-camphor, and is a volatile crystalline substance, unimportant from a medico-legal point of view.

Duboisia Hopwoodii belonging to N. O. *Solanaceæ* and growing in Australia contains piturine, a volatile liquid alkaloid, acting exactly like nicotine.

Symptoms.—These are burning, acrid sensations in the mouth and throat, salivation, headache, nausea, vomiting, sometimes diarrhæa, giddiness, faintness, numbness, muscular weakness, tremors, dimness of vision, dilated pupils, diuresis, collapse with cold, clammy skin, small, quick and thready pulse, unconsciousness and stupor. Death occurs from heart failure. Sometimes there may be delirium and convulsions.

Chronic Poisoning.—This occurs from chewing tobacco or from smoking cigarettes for a long time. It may also occur among persons employed in cigarrette factories.

Symptoms.—These are dyspepsia, anæmia, faintness, cardiac irritability and weakness, and a quick, irregular pulse. Eye-sight may be affected, leading to amblyopia. There may be epilepsy.

Fatal Dose.—Two or three drops of nicotine taken into the stomach are sufficient to cause death. An infusion of thirty grains of tobacco leaves given as an enema has resulted in death.

Fatal Period.—Three to five minutes after swallowing nicotine, and fifteen minutes after an infusion taken as an enema. Death has been delayed four or five days.

Treatment.—Elimination by washing out the stomach with warm water containing tannin, or a solution of iodine in potassium iodide. The drugs render the alkaloid insoluble. Keep the patient in a recumbent posture, apply warmth to the body and cold affusion to the head. Administer hypodermically diffusible stimulants, such as strychnine. Oxygen by inhalation, artificial respiration and galvanism must be resorted to, if necessary.

Post-Mortem Appearances.—The odour of tobacco is usually noticed on opening the stomach, which may contain fragments of the leaves. The mucous membrane of the stomach and intestines is congested and inflamed, if death

has not ensued rapidly. The brain, lungs and liver are congested. The blood is dark and fluid.

Chemical Tests.—1. Nicotine gives an orange colour with nitric acid, and a violet colour with hydrochloric acid.

2. A solution of iodine in ether mixed with an ethereal solution of nicotine yields an oily resin of brownish colour, which in a few minutes crystallizes in long needles of a ruby red colour by transmitted, and dark blue by reflected light.

3. Mercuric chloride gives a white precipitate, becoming crystalline yellow on standing for some time.

Medico-Legal Points.—Tobacco poisoning has been accidental from excessive smoking, from the infusion given as an enema, or from the application of the leaves or their infusion to a wound, an abraded skin or even to the unbroken skin. Children have, sometimes, been poisoned by accidentally sucking the juice of the tobacco pipe, or by drinking *hookah* water.

Cases of suicide from tobacco have not been recorded, though one or two suspected homicidal cases have been noted. Tobacco has been used to procure abortion.

Nicotine is eliminated partly by the lungs, but chiefly in the urine, the secretion of which it increases.

Putrefaction has no effect on nicotine, which can be detected in the body some years after death.

A non-poisonous alkaloid resembling nicotine has been isolated from the human body, and a ptomaine similar to nicotine has been found, but is not so poisonous.

LOBELIA INFLATA (LOBELIA, INDIAN TOBACCO).

This herb belongs to N. O. *Lobeliaceæ*, and grows in North America.

Lobelia Nicotianæ folia (*Dhawal*) belonging to the same natural order grows in Southern and Western India and the mountain ranges of Ceylon. Its leaves are serrated and hairy, and are very much alike tobacco leaves.

Both these plants contain an active principle, lobeline united with lobelic acid.

Lobeline.—This is a volatile, oily, yellow, liquid alkaloid, possessing a pungent taste and an odour like that of tobacco. It is slightly soluble in water, but freely in ether.

Symptoms.—Burning pain in the stomach, vomiting, distressing nausea, headache, giddiness, small, feeble and rapid pulse, pupils contracted and insensible to light, muscular twitchings, unconsciousness, collapse and death ending the scene. Diarrhœa and dysuria are sometimes present.

Fatal Dose.—A dram of the powdered leaves has caused death.

Fatal Period.—The shortest period is half-an-hour. The longest is thirty-six hours.

Treatment.—Produce vomiting, if it is not already set up. Wash out the stomach. Recumbent posture; external warmth and hypodermic stimulants, such as strychnine.

Post-Mortem Appearances.—Softening and inflammation of the mucous membrane of the stomach and intestines. Congestion of the vessels of the brain.

Tests.—1. Strong sulphuric acid gives a red colour. 2. Sulphomolybdic acid produces a deep violet colour which, after many hours, passes into brown and then yellow.

Medico-Legal Points.—Lobelia is very largely used in England and the United States, and has consequently given rise to fatal accidental poisoning. It has also proved fatal when administered as an abortifacient.

DIGITALIS PURPUREA (DIGITALIS OR FOXGLOVE).

This is a poisonous plant belonging to N. O. *Scrophulariaceæ*, and growing wild in the hedges in the South of England.

Its root, leaves and seeds contain as active principles the glucosides, digitoxin, digitalin, digitalein, digitonin and some other bodies of an alkaloidal nature. All these glucosides are met with in commerce, and are used in medicine.

Digitoxin, C_{21} H_{32} O_7.—This is the most active and poisonous of all the four glucosides. It occurs commercially in a crystalline form. It is soluble in water, slightly in ether, but readily in alcohol and chloroform. Digalen has the same chemical composition as digitoxin.

Digitalin, C_{54} H_{84} O_{27}.—This is a crystalline glucoside,

and is also known as *digitalin verum.* It is almost insoluble in water, slightly soluble in ether, and readily in chloroform and in a mixture of chloroform and alcohol. It is the chief constituent of Homelle's digitaline.

Digitalein, $C_{21}H_{46}O_{11}$.—This is an amorphous bitter glucoside, soluble in water and alcohol, but soluble with difficulty in ether, chloroform and benzene.

Digitonin, $C_{31}H_{52}O_{17}$.—This glucoside is both amorphous and crystalline. The amorphous form is soluble in water, but not the crystalline. It is a cardiac depressant, and hence antagonistic to the first three active principles, which have a stimulating action on the heart.

Symptoms.—The toxic symptoms produced by digitalis are gastro-intestinal at first, and are then referable to its action on the heart. These are thirst, nausea, vomiting followed by severe abdominal pain and perhaps watery diarrhœa, vertigo, severe headache, fainting and oppression in the prœcordial region. The pulse is at first accelerated and then slowed, intermittent, irregular and small, the beat falling even to 25 per minute. The respirations are slow and sighing. The pupils are dilated, and visual derangements, such as dimness of vision and changes in the perception of colour, are present. These are followed by drowsiness and coma. There may be delirium or hallucinations and convulsions. The urine may, in some cases, be suppressed. Death usually occurs from sudden syncope. It may take place on slight exertion during apparent convalescence.

Fatal Dose.—Thirty-eight grains of the powdered leaves, nine drams of the tincture, $1\frac{1}{4}$ grains of digitalin have each proved fatal, though recovery has ensued after much larger doses. $\frac{1}{16}$ grain of digitoxin has also caused death.

Fatal Period.—Death rarely occurs in less than twenty-two hours, but, in one case it occurred in forty-five minutes. It may be delayed for 5 to 16 days.

Treatment.—This consists in the use of the stomach tube, or emetics followed by aperients, and the free use of vegetable infusions containing tannin. Tea or coffee may also be given with advantage. Keep the patient in a recumbent posture, administer stimulants, and apply sinapism to the chest. Give aconite, a physiological antidote, cautiously, because it exhausts the nerve centres.

Post-Mortem Appearances.—Not characteristic. There may be fragments of the digitalis leaves in the stomach, which may be found congested aud inflamed.

Chemical Tests.—Strong sulphuric acid produces a green colour, changing to purple red on the addition of bromine water. The physiological test should be tried on a frog or a dog.

Medico-Legal Points.—Poisoning by digitalis is not a frequent occurrence. A few suicidal cases have occurred from an over-dose of one of the medicinal preparations or from eating the leaves by mistake.

It has been rarely used for suicidal purposes, and has been used only once as a homicide, when a homœopathic physician, La Pomerais killed a widow in Paris in 1864 by giving her digitalin. He had pecuniary interest in her death.

Digitalis is not excreted by the kidneys as fast as it is absorbed into the system, and hence it is regarded as a cumulative poison. Persons, who have been taking it for a long time, may suddenly develop the symptoms of poisoning without any subsequent increase in the dose. In such cases the quantity of the urine should be measured to find out if it is diminished, or digitalis should be prescribed with a diuretic, or should be omitted for one week in every four weeks.

NERIUM ODORUM (WHITE OR SWEET-SCENTED OLEANDER, *KANER*).

This plant belongs to N. O. *Apocynaceæ* and is grown in gardens in India for its beautiful white or pink flowers,

which are given as an offering to gods by Hindu worshippers.

It contains as active principles three glucosides, neriodorin, neriodorein and karabin. Neriodorin and karabin have a paralysing action on the heart like digitalin.

Symptoms.—Difficulty of swallowing and articulation, abdominal pain, vomiting and diarrhœa. The pulse is first slowed and later becomes rapid and weak. The respirations are hurried from the beginning. These are followed by dilated pupils, muscular twitchings, tetanic spasms, drowsiness, unconsciousness, coma and death. Lock-jaw and diarrhœa are usually absent.

Fatal Dose.—Uncertain. Three crushed seeds have proved fatal. Half an ounce of the root has caused death. 5 grains of karabin are fatal.

Fatal Period.—Uncertain. From six hours to five days.

Treatment.—Evacuation by washing out the stomach. Give stimulants, such as ether, and treat the symptoms.

Post-Mortem Appearances.—Not characteristic. There may be congested patches in the stomach and the upper portion of the small intestine.

Tests.—1. Strong sulphuric acid gives a chocolate colour which, on standing, becomes rich purple.

2. Strong nitric acid gives an orange colour.

3. *Physiological Test.*—If a watery solution is injected hypodermically into a frog, it becomes limp and powerless, the heart beat becomes weak but not slow, and it soon dies.

Medico-Legal Points.—Accidental poisoning has occurred from swallowing the decoction of the leaves, used for reducing swelling by an external application.

The root is used in the form of a paste in the treatment of cancers and ulcerations. It is used as an abortifacient both internally and as a local application. It has also been used for suicidal and homicidal purposes and as a cattle

poison. Sometimes the root juice is smeared on a rag which is then inserted into the anus of an animal.

CERBERA THEVETIA OR THEVETIA NERIIFOLIA (EXILE OR YELLOW OLEANDER, *PILA KANER.*)

This is a plant belonging to N. O. *Apocynaceæ*, and is widely cultivated as an ornamental shrub in gardens in the plains of India. The plant is highly poisonous and contains an active principle, thevetin, which is a glucoside. All parts of the plant yield a milky juice in which the glucoside resides. Its action is very much like digitalin, but has a convulsant effect also.

Symptoms.—Burning pain in the mouth and dryness of the throat, numbness of the tongue, vomiting and often diarrhoea, headache, dizziness, dilated pupils, and fainting. The pulse is soft, and slow, later becomes rapid, weak and irregular. Collapse sets in, and death occurs from heart failure. Tetantic convulsions are sometimes observed.

Fatal Dose.—The probable dose is three seeds One seed killed a child three years old. An adult woman died from eating eight to ten seeds.

Fatal Period.—Usually twelve to fifteen hours.

Treatment.—Same as white oleander poisoning. Ether hypodermically.

Post-Mortem Appearances.—Not characteristic.

Tests.—1. Boiling hydrocholoric acid produces a deep bluish green colour, which disappears on adding potassium permanganate.

2. *Hankin's Test.*—Sulphuric acid and alcohol produce a crimson colour.

Medico-Legal Points.—The seeds have been used for procuring criminal abortion, and lately for suicidal and homicidal purposes. They have also been used as a cattle poison.

The bark is used as an antiperiodic in small doses, 2 grains of the powdered bark being equivalent to an ordinary dose of cinchona. In large doses it acts as a purgative and emetic and produces toxic effects.

ACONITUM FEROX (ACONITE, *VACHHANAG* OR *BISH.*

This is a plant two to five feet high, belonging to N. O. *Ranunculaceæ* and growing in the Himalayas. Its root, which is a conical, fusiform tuber, two to five inches in length, is extensively used both externally and internally by *vaids* and *hakims* in the treatment of muscular rheumatism, neuralgia and paralysis. It is administered after it is soaked in cow's milk, whereby it loses its poisonous properties. The root thus treated appears crinkled and dark in colour.

The root contains a number of alkaloids, the chief of which is aconitine.

Aconitine (Acetyl-Benzoyl-Aconine), $C_{33}H_{45}NO_2$.—This is one of the most deadly known poisons. It occurs as a colourless crystalline solid, readily soluble in alcohol and chloroform, less readily in ether and almost insoluble in water. With acids it forms crystalline salts, of which the nitrate is used in medicine.

It produces paralysis of the intramuscular terminations of the nerves, as also of the central system.

Aconitum Napellus, (Monk's hood, *mitha zahar*) is another poisonous variety very similar to aconitum ferox. It grows in England, as well as in the Himalayan regions. The root is officinal and largely used in Indian medicine. It yields the same active principles.

Symptoms.—The symptoms supervene immediately or within a few minutes after swallowing a poisonous dose of aconitine or a preparation of the aconite root. These are

severe burning and tingling of the lips, tongue, mouth and throat, followed by numbness and anæsthesia of these parts. Nausea, salivation, pain in the abdomen and vomiting usually occur, but diarrhœa is rare. Later tingling and formication spread over the whole body, causing great uneasiness to the patient. The pupils contract and dilate alternately, and vision is impaired. The patient complains of vertigo, restlessness, great prostration, and pain and weakness of the muscles with twitchings and spasms. The pulse is slow, feeble and irregular, and the respirations are first rapid, but soon become slow, laboured and shallow. The skin is cold and damp, with subnormal temperature. Death occurs usually from syncope or, in some cases, from asphyxia. In most cases consciousness is retained till near the end but, sometimes, delirium or convulsions, insensibility and coma have been observed.

Fatal Dose.—Two grains of the non-alcoholic extract, 4 grains of the alcoholic extract, one dram of the tincture, 60 grains of the root and $\frac{1}{16}$ grain of aconitine have each caused death.

Fatal Period—The average fatal period is from one to five hours. The shortest recorded period is less than seven minutes. In non-fatal cases the symptoms of numbness and tingling may persist for a long time up to 15 days, after the severe toxic symptoms have subsided.

Treatment.—Use emetics or wash out the stomach with a solution of iodine in potassium iodide, or a solution containing animal charcoal or tannic acid. Maintain the recumbent posture, administer amyl nitrite by inhalation or atropine and diffusible stimulants, such as digitalis, strychnia and ether hypodermically. Keep up the body heat by hot water bottles, friction and by covering the body with blankets. Artificial respiration may be resorted to, if necessary.

Post-Mortem Appearances.—Not characteristic.

Fragments of the root may be found in the stomach contents. The mucous membrane of the stomach and small intestine may be congested and inflamed. There is usually marked general venous congestion with dark fluid blood.

Tests.—1. Tingling and numbness of the tongue and lips for several hours is produced, if a minute quantity is placed on the tongue or a smallest fragment of the root is chewed between the front teeth.

2. It causes toxic effects when a solution containing a very minute quantity of aconitine is injected under the skin of a frog.

3. Acetic acid and potassium permanganate produce a red crystalline precipitate, but this chemical test is not reliable.

Medico-Legal Points.—Accidental poisoning by aconite is not a rare occurrence, seeing that it is largely used in Indian medicine. The root has been mistaken for horse radish. The tincture has been swallowed in over-doses, and the liniment has been taken internally by mistake. The external application of neuraline, a preparation containing Fleming's tincture has caused death.

Suicidal and homicidal cases have also been recorded. It is sometimes added to Indian liquors to increase the intoxicating effect. It has also been used as a cattle poison.

Aconitine is destroyed by putrefactive processes. Hence it is often difficult to detect it *post-mortem.* It is also decomposed by alkali. Wood ashes which are usually added to vomit destroy aconite owing to the presence of alkali. Hence Dr. Hankin recommends the mixing of the vomit and wood ashes with alcohol and acetic acid which have the power of checking this decomposition.

HYDROCYANIC ACID (PRUSSIC ACID), H C N.

This is prepared by the action of strong sulphuric acid on potassium or mercuric cyanide, but it is now obtained by the action of sulphuric acid on potassium ferrocyanide.

It is a colourless, volatile liquid, possessing a very characteristic odour like oil of bitter almonds or peach-blossom. It dissolves freely in water, the solution being called prussic acid. It is called anhydrous to distinguish it from the official form, acidum hydrocyanicum dilutum, which contains 2 per cent. of the pure acid. Scheele's prussic acid contains 4 to 5 per cent. of the acid. The anhydrous acid is a powerful poison; hence it is not kept in the drug stores in a pure state.

Bitter almonds, cherry leaves, laurel, peach, apricot and some other plants belonging to N. O. *Rosaceæ* contain a crystalline glucoside, amygdaline, which is broken up into hydrocyanic acid and other compounds under the influence of an enzyme, emulsin.

Hydrocyanic acid is also contained in the proportion of 01 per cent. in cherry-laurel water and from 5 to 15 per cent. in oil of bitter almonds.

It forms cyanides with metals. Of these potassium cyanide, mercuric cyanide and silver cyanide are used in photography, electroplating and dyeing. These are highly poisonous, are soluble in water and alkaline in reaction.

Symptoms.—This is the most rapid of all poisons Hence with a large dose the symptoms usually appear within a few seconds or even during the act of swallowing. They are rarely delayed beyond one or two minutes. During the interval the patient may be able to walk or speak or perform some volitional act. The first symptoms are an odour of hydrocyanic acid from the breath, loss of muscular power and giddiness The patient staggers about, the eyes are wide open, bright and shining, and the pupils are dilated and do not react to light. Consciousness is lost. The respirations become slow and stertorous, with sudden and short inspirations and prolonged expirations. Froth comes out of the mouth. Tonic convulsions affect the jaw rendering it stiff. The pulse is weak and feeble. These symptoms are followed by cyanosis,

cold, clammy skin and relaxation of the sphincters. Death occurs from failure of respiration. Some say it is due to failure of internal tissue respiration brought on by a change of blood due to the formation of cyan-methæmoglobin.

When a small poisonous dose is taken, the patient experiences a hot, bitter taste and constriction of the throat and complains of salivation, giddiness, nausea, headache, confusion of ideas, a sense of oppression in the chest, loss of muscular power and insensibility. These are followed by stupor, coma and death. Vomiting may be present in some cases.

The spasmodic or the piercing cry, which is commonly observed in cattle poisoning, is rarely met with in human poisoning.

The inhalation of the gas causes poisonous symptoms followed by death.

In addition to the symptoms of hydrocyanic acid, potassium cyanide produces gastric irritant symptoms, such as pain and vomiting but, sometimes, it causes corrosion of the lips and mouth due to the corrosive action of potassium carbonate or caustic potash.

Chronic poisoning occurs among photographers who constantly handle potassium cyanide and among workmen exposed to its action. The symptoms are headache, vertigo, anæmia, fœtid breath and dyspnœa.

Fatal Dose.—Thirty minims of the officinal dilute acid equivalent to .6 grain of the anhydrous acid have caused death. Recovery has occurred after taking 2 drams of the dilute acid. Five grains of potassium cyanide, ten grains of mercuric cyanide, and thirty drops of the oil of bitter almonds have also proved fatal.

Fatal Period.—Two to five minutes. It is possible that life may be prolonged for three and a-half hours, but in most cases the patient will recover, if death does not occur within an hour.

Treatment.—There is hardly time for treatment, if strong prussic acid is taken. In the case of potassium cyanide or dilute hydrocyanic acid poisoning wash out the stomach immediately with a dilute solution of hydrogen peroxide or potassium permanganate. Vinegar may be added if the poison is potassium cyanide. If the syphon tube is not available, produce vomiting by mustard and water aided by tickling the fauces or by the hypodermic injection of apomorphine hydrochloride.

Cold affusions to the head and chest, and inhalations of ammonia should be followed by hypodermic injections of $\frac{1}{50}$ grain of atropine and ether or brandy, and artificial respiration.

If death is delayed, sodium hyposulphite or ferrous sulphate with carbonate of potassium may be given as an antidote to produce the innocuous Prussian blue.

Post-mortem Appearances.—The skin presents a peculiar violet colour. The *post-mortem* stains are bright pink, due to cyanhæmatin of the blood and to the fact that the tissues cannot take up the oxygen of the blood, leaving it red even in the veins. The fingers are clenched, the jaws are firmly closed and there is froth at the mouth. The eyes may be bright, glistening and prominent with dilated pupils. Rigor mortis sets in early and lasts longer.

Internally there are no characteristic lesions but, usually an odour of the acid is noticed on opening the body. The mucous membrane peels off from the gums, lips and stomach. The mucous membrane of the stomach is often bright red and swollen, and the contents have a soapy feel. There may be bloody froth in the larynx. The right side of the heart is full and engorged with venous blood, which is fluid and red. The lungs are congested.

Tests.—1. Silver nitrate produces a white precipitate of silver cyanide, soluble in strong, boiling nitric acid. It does

not turn dark on exposure to light, but shows prismatic needles under the microscope while silver chloride is amorphous, and turns dark on exposure to light.

2. *Prussian-blue Test.*—Caustic potash and ferrous and ferric sulphate produce a brown precipitate, which becomes deep blue (Prussian blue) on the addition of hydrochloric acid.

3. *Liebig's Test.*—If a little ammonia and ammonium sulphide be added to a solution containing hydrocyanic acid and heated to dryness, a blood-red colour will be developed on further adding a drop of ferric chloride ; the colour will disappear if treated with mercuric chloride.

Medico-Legal Points.—Hydrocyanic acid and potassium, mercury and silver cyanide have been used by chemists, photographers and medical men for suicidal purposes. They have been rarely used with homicidal intent.

Oil of bitter almonds and cherry laurel water (aqua laurocerasi) are used as a flavouring agent, and hence have caused accidental poisoning.

Accidental p isoning has occurred from inhaling the vapour of the acid, from its application to a wound or raw surface, and from the injection of potassium cyanide into the rectum.

Hydrocyanic acid is not a cumulative poison. Being a volatile and unstable compound it is readily decomposed in the body, especially if it is putrefying. It is usually converted into thiocyanic acid during life and formic acid after death.

CHAPTER XXXIV.

ASPHYXIANTS (IRRESPIRABLE GASES).

CARBON DIOXIDE (CARBONIC ACID GAS, CARBONIC ANHYDRIDE), CO_2.

This is a colourless suffocating gas with a slightly acid taste. It is a constituent of the atmospheric air in which it exists to an extent of .04 per cent, and air containing 2 per cent. causes discomfort, while more than 20 per cent. causes death, but if air is contaminated with carbon dioxide from respiration or combustion, five per cent. of it may be fatal. It is given off in the process of respiration, combustion, fermentation and putrefaction of animal matter. It occurs frequently at the bottom of old wells, and forms the choke-damp or after-damp of the coal mines. It is also evolved in the neighbourhood of lime kilns on account of decomposition of carbonates.

Symptoms.—These are heaviness in the head, throbbing of the temporal arteries, giddiness, ringing of the ears, a sense of oppression, muscular weakness, drowsiness and insensibility passing into coma with stertorous breathing. Death occurs from asphyxia or apoplexy. Sometimes there may be convulsions and delirium.

When inhaled in a concentrated form, immediate insensibility occurs followed by death from spasm of the glottis causing suffocation.

Treatment.—The patient must at once be removed to fresh, air, and artificial respiration should be practised with inhalation of oxygen. This ought to be assisted by galvanism and friction of the extremities. After breathing has been established, the body should be well covered with warm

blankets, and coffee or brandy should be administered internally. If a patient is seen lying unconscious at the bottom of a well or pit used for storing grain, an attempt should be made to discharge oxygen from an oxygen holder into the bottom of the well or pit by means of a hose that it may not only revivify the patient but displace the carbon dioxide, so that others can descend to render him help.

Post-Mortem Appearances.—The body heat is retained for a longer period. The face is usually pale and placid, but may be swollen and cyanosed. The pupils are found dilated. The brain and lungs are usually congested. The right side of the heart contains dark fluid blood, with venous engorgement, and the left is empty. Ecchymosed patches are noticed in the small intestine.

Tests—1. Carbon dioxide makes lime water milky.

2. A burning candle will be extinguished in the air containing more than 6 per cent. of carbon dioxide.

3. Barium nitrate gives a white precipitate of barium carbonate with carbonic acid, soluble with effervescence in hydrochloric or nitric acid.

4. Silver nitrate gives a white precipitate of silver carbonate.

Medico-Legal Points.—Cases of poisoning from carbon dioxide are mostly accidental. One thief in Agra died from carbon dioxide poisoning by sleeping near a lime kiln.

CARBON MONOXIDE (CARBONIC OXIDE GAS), CO.

This is a very poisonous gas, and is formed when carbon is burnt in a limited supply of air or oxygen. It is evolved in some industrial processes as in the manufacture of acetone and in the Leblanc Soda process.

It is a colourless, tasteless, inodorous gas. It is almost insoluble in water and alcohol. It burns with a blue flame, forming CO_2 and explosive mixtures with air or oxygen.

Symptoms.—When the gas is inhaled in a concentrated form, insensibility supervenes immediately followed by coma, and death. When inhaled in a diluted form, the symptoms are dizziness, headache, noises in the ears, nausea, sometimes vomiting, weakness, drowsiness, retarded breathing, coma and death. In some cases tremors and convulsions may precede death.

Chronic Poisoning.—This form of poisoning occurs among persons, who are constantly exposed to the action of the gas as in gas houses and among those inhabiting ill-ventilated rooms, in which fire is burning.

Symptoms.—These are headache, nausea, mental torpidity, loss of memory, wasting of the muscles, anæmia, and in some cases symptoms of peripheral neuritis and glycosuria.

Treatment.—Fresh air, inhalation of oxygen, artificial respiration, injections of hydrogen peroxide or normal saline solution per rectum and transfusion of blood.

Post-Mortem Appearances.—Patches of bright red colour on the body but not on the dependent parts as in *post-mortem* stains. The blood is fluid and of a cherry red colour. The organs are hyperæmic and appear bright red owing to the colour of the blood. There is serous effusion in the ventricles of the brain, and the lungs are œdematous.

Tests.—1. *Spectroscopic Tests*—The spectrum of the blood will show two absorption bands similar to those of oxyhæmoglobin, but placed nearer the violet end. The addition of ammonium sulphide does not alter the spectrum.

2. *Hoppe-Seyler's Test.* Caustic soda of specific gravity 1.3 produces a greenish colour, if added to normal blood, but retains the bright red colour, if carbon monoxide is present in the blood.

Medico-Legal Points.—Poisoning from carbon monoxide is mostly accidental. One case occurred at Hardwar and another at Agra some time ago.

Suicidal cases by persons locking themselves up in rooms, where fire or stoves have been burning, have been recorded in France and on the Continent.

Sometimes carbon monoxide poisoning causes mental excitement to such a degree as to lead one to an act of violence to oneself or to others. It should also be remembered that the effects of the gas vary in different individuals, who are exposed to the same action.

It has a great affinity for hæmoglobin of the blood forming a stable compound, carbonic oxide hæmoglobin which prevents internal respiration.

It is said to retard putrefaction, but it is doubtful if this is true for an Indian climate.

Poisoning from water gas and coal gas is mostly due to carbon monoxide, which is the chief constituent of these gases.

CARBON DISULPHIDE (CARBON BISULPHIDE), CS_2.

This is a colourless, highly refractive, volatile, mobile liquid, with a disgusting odour. It boils at 46°C. Being highly inflammable it burns with a blue flame, forming carbon dioxide and sulphur dioxide. It is not miscible with water but freely dissolves in alcohol, ether, chloroform, the hydrocarbons of the benzene family and most of the essential oils. It is used in the arts as a solvent for caoutchouc. India-rubber, phosphorus, sulphur, etc., and for extracting essential oils, spices and perfumes.

Acute Poisoning.—This form of poisoning occurs from swallowing the liquid.

Symptoms.—These are intense burning pain in the throat, headache, giddiness, drowsiness, unconsciousness, dilated pupils, cyanosed lips, cold damp skin, laboured respirations, muscular weakness, odour of carbon disulphide in the breath, as well as in the urine and fæces. These are followed by convulsions, coma and death.

Fatal Dose.—Half an ounce.

Fatal Period.—Two hours and a quarter.

Treatment.—Wash out the stomach. Warmth, stimulants and artificial respiration.

Post-Mortem Appearances.—Odour of carbon disulphide on opening the body cavities. Blood is dark and fluid. Congestion and punctiform hæmorrhages in the stomach.

Tests.—On heating with lead acetate and caustic potash, it produces a black precipitate.

Chronic Poisoning.—This form of poisoning occurs among workmen by constant exposure to its fumes in ill-ventilated India-rubber and caoutchouc factories.

Symptoms.—Nausea ; anorexia and sometimes vomiting with abdominal pain ; headache ; noises in the ears ; tremors ; muscular weakness ; ataxia ; tingling, numbness and burning sensation in the hands and feet (peripheral neuritis) ; paralysis of the extensor muscles ; delirium ; mania and even dementia ; Amblyopia with optic atrophy occurs in some cases.

HYDROGEN SULPHIDE (SULPHURETTED HYDROGEN), H_2S.

This is a colourless, transparent gas, having the disgusting odour and taste of rotten eggs. It dissloves in water, forming an acid solution, which is sometimes called sulphhydric acid. It burns in air with a pale blue flame, forming sulphur dioxide and water.

It is formed during the decomposing process of organic substances possessing sulphur. It is a constituent of sewer air and the gas of privies, and burial vaults.

Symptoms.—If inhaled pure, the patient becomes weak and insensible, and dies immediately. Even when diluted to one per cent., it causes death but slowly. The symptoms are dizziness, headache, nausea, vomiting, abdominal pain, muscular prostration, cold extremities, laboured breathing, irregular pulse, dilated pupils, tetanic convulsions, delirium, stupor, coma and death. It has the power of reducing the hæmoglobin of the blood corpuscles and paralyses the nerve centres of the lungs and heart.

Chronic Poisoning.—This affects persons exposed to the constant inhalation of the gas for a long time.

Symptoms.—These are conjunctivitis, headache, dyspepsia, anæmia and furunculosis.

Treatment.—Fresh air, oxygen inhalation, artificial respiration, warmth to the extremities and stimulants. The cautious use of chlo-

rine by inhalation is recommended, but should not be tried, because it is itself a powerful irritant.

Post-Mortem Appearances. - Putrefaction sets in much more rapidly. The offensive smell is noticed on opening the body. The blood is liquid and dark brown in colour, from the conversion of hæmoglobin into sulphmethæmoglobin as shown by the spectrum. The lungs are œdematous. The other organs are dark and congested.

Tests.—1. It is recognised by its offensive smell, which is perceptible when one part is present in 10,000 of air.

2. A piece of white filter paper moistened with lead acetate or carbonate turns black on bringing it into contact with the stomach or other organs.

NITROGEN MONOXIDE (NITROUS OXIDE, OR LAUGHING GAS), N_2O.

This is a colourless gas with a sweetish taste and odour. It does not break up and give oxygen to the body.

Symptoms.—When inhaled mixed with air, it produces a condition of hysterical excitement often accompanied by noisy laughter and gay intoxication, and hence is known as *laughing gas*. When pushed beyond this hysterical stage it causes anæsthesia, and is used in minor surgery, especially dentistry.

When inhaled pure and for a long time it causes cyanosis, cold, clammy sweats, and death by paralysing the heart or respiratory centre.

Treatment.—This consists in the inhalation of oxygen and artificial respiration.

Tests.—It does not burn, but supports combustion, and has an anæsthetic action.

SULPHUR DIOXIDE (SULPHUROUS ANHYDRIDE), SO_2.

This is a colourless gas, having a peculiar suffocating odour and a persistent taste. It is very destructive to plant life, high and mould. It is used as an aërial disinfectant and vermin-killer. It is also a powerful bleaching agent.

Symptoms.—Feeling of suffocation, dyspnœa, coryza. cough, opacity of cornea, cyanosis and convulsions.

Tests.—Starch-paper moistened with a solution of iodic acid turns blue on exposure to sulphur dioxide gas.

CHAPTER XXXV.

PERIPHERAL (NEURAL) POISONS.

CONIUM MACULATUM (SPOTTED HEMLOCK).

This plant belongs to N. O. *Umbelliferæ*, and grows in Europe and America. The chief alkaloids which it contains are conine and methyl-conine.

Conine, $C_8H_{17}N$.—This is extracted from the leaves and the fruit of the plant by distillation with soda. It is a colourless, volatile oil, but changes to brown on exposure to air. It has an acrid bitter taste, a penetrating mousy odour and is slightly soluble in water but freely in alcohol, ether and chloroform. Its salts are stable and crystalline, and are soluble in water and alcohol. It paralyses the motor nerve-endings and subsequently the motor centres.

Methyl Conine, $C_9H_{19}N$.—This is a colorless liquid alkaloid.

Symptoms.—Burning sensation in the mouth, constriction of the throat, dizziness, headache, staggering gait, weakness or paralysis of the extremities, great prostration, dilated pupils, ptosis, convulsions and coma. Death occurs from paralysis of the respiratory muscles. The intellect remains clear till last. Nausea and vomiting may occur during the course of the symptoms.

Fatal Dose.—Two grains would probably prove fatal. One ounce of succus conii has caused death.

Fatal Period.—Death may occur within a few minutes. The usual fatal period is one to three hours.

Treatment.—Give emetics or wash out the stomach after giving tannic acid or vegetable astringents. Administer

strychnine hypodermically and strong coffee. Carry on artificial respiration, if necessary.

Post-Mortem Appearances.—Not characteristic. The mucous membrane of the stomach may be reddened and ecchymosed. The other organs are congested with venous engorgement and dark fluid blood.

Tests.—1. It is recognised by its mousy odour.

2. Alloxan produces a purple-red colour, which forms white needle-shaped crystals on standing. These crystals, touched with caustic potash, turn purple and give off the mousy odour.

3. Warmed with sulphuric acid and potassium bichromate, conine produces butyric acid, which is known by its peculiar odour.

Medico-Legal Points.—Poisoning from hemlock is very rare in India. In Europe and America accidental poisoning has occurred from hemlock leaves having been made into salad in mistake for parsnip, or from the root having been used for parsley, fennel and asparagus. Children have also been, sometimes, poisoned from using whistles made of its stem. The seeds have been accidentally mixed with caraway, anise and dill seeds.

It was administered to Socrates. Hence it is regarded as a classical poison.

It is eliminated unchanged by the urine.

CURARA (CURARI OR WOURALI).

This is a blackish, brown resinous extract produced from species of strychnos, cocculus and other plants. It has a bitter taste and is nearly soluble in water. It is used as an arrow poison by South America Indians. It contains an active principle, curarine or curarina, which is a most powerful poison and occurs as a yellowish-brown powder or in deliquescent prisms, with an intensely bitter taste. It is soluble in water and alcohol.

Symptoms.—Taken internally it is supposed to be harmless but it is extremely poisonous, when injected into the blood stream. It acts on the

motor nerve endings causing paralysis of the voluntary muscles, and causes death by paralysis of respiration. It was formerly used in physiological laboratories for the purpose of abolishing voluntary movements of animals required for experiments ; but its use is now prohibited by the Vivisection Act.

Fatal Dose.—$\frac{3}{4}$ to 1 grain is probably a fatal dose.

Treatment.—This consists in the use of strychnine hypodermically and artificial respiration, if necessary.

Tests.—1. Sulphuric acid and potassium bichromate produce first a blue colour, then violet and lastly cherry-red. Strychnine undergoes the same reaction, but takes a longer time.

2. Sulphuric acid imparts a red colour to curarine.

Medico-Legal Questions.—It is reported that in 1917 a plot was laid to poison Mr. Lloyd George, the Prime Minister with curarine.

APPENDIX I.

ORDERS PERTAINING TO MEDICO-LEGAL WORK.

(FROM MANUAL OF GOVERNMENT ORDERS).

Para 845 to 857.

DYING DECLARATIONS.

(1) Dying declarations should, if possible, be written by the persons making them. Such statements should be signed or marked by the declarant and attested by respectable witnesses.

(2) Where a dying declaration is recorded by a police or medical officer, it should be recorded, in full detail in the vernacular in the words of the declarant in the form of question and answer, and in the presence of respectable witnesses. It should then be read over to the declarant, who should affix his signature or mark to it. The accused or his pleader, if present, should be allowed to put questions to the declarant. The declaration when concluded should be signed by the police or medical officer recording it, who should also obtain the signatures of respectable witnesses. It should then be forwarded in a sealed envelope direct to the magistrate who would ordinarily hold inquiry into the case. If it can be avoided, no police officer who is engaged in the investigation into the case should be present, when the dying declaration is recorded.

Procedure to be observed in recording a Dying Declaration.—

(*a*). **For Police.**—The officer investigating a case in which a person has been seriously injured should, if there is any probability of the person dying before he can reach a dispensary where his dying declaration can be recorded, at once himself record the declaration in the presence of two respectable witnesses, obtaining the signature or the mark of the declarant at the foot of the declaration.

The prosecuting inspector, on being warned that a dying declaration is to be taken, should at once go to the hospital with the police papers of the case, and, if possible, arrange for the attendance of the accused and his pleader.

(*b*). **For Magistrates.**—The District Magistrate, or senior Magistrate

present in the station, on receiving notice that a dying declaration is necessary, should at once himself proceed to take it, or depute some stipendiary Magistrate, if possible, above the rank of tahsildar to take it. He should at the same time cause the prosecuting inspector to attend with the police papers of the case.

Every Magistrate on receiving an order or requisition to take a dying declaration from the District Magistrate or medical authority, respectively, must at once proceed to the hospital or dispensary to record the dying declaration.

(*c*). **For the Medical Authorities**—(1) The civil surgeon or the assistant surgeon in charge of the sadar hospital, should at once call on the District Magistrate or the senior Magistrate present at the station, to arrange for the record of the dying declaration of such persons as are likely to die and are in a fit state to make a statement.

If in the opinion of the civil surgeon or assistant surgeon, there is no time to call on the District Magistrate or the senior Magistrate present at the station, the nearest Magistrate may be sent for to take the dying declaration, a stipendiary Magistrate being called, if possible.

If, in the opinion of the civil surgeon, or assistant surgeon, there is no time to call any Magistrate, he may himself record the declaration.

In cases where there is no time to call on the District Magistrate or senior Magistrate present at the sadar, he should be informed of the action taken.

(2) The sub-assistant surgeon in charge of an outlying dispensary should at once call on the tahsildar or in his absence, the nearest Honorary Magistrate, to record the dying declarations of such persons as are likely to die and are in a fit state to make a statement.

If there is, in his opinion, no time to call on the tahsildar or an Honorary Magistrate, he may record the dying declaration himself.

FROM POLICE REGULATIONS.

SECTION 118A.—Where the identity of a corpse or of a person killed by accident or who has met with death under suspicious circumstances or in the commission of crime, has not been fully ascertained by ordinary enquiries, the finger prints should be taken on search slip forms, and sent to the Bureau for search. Ordinarily there is not much difficulty in taking impressions from the fingers of a corpse, but it sometimes happens that the skin of the fingers is so contracted and wrinkled that decipherable prints cannot be obtained. In such cases the medical

officer holding the *post-mortem* should be asked to remove the skin from the fingers. He should place each piece in a separate sealed envelope marking on the outside the finger to which it belongs. These envelopes should then be sent to the Finger Print Bureau at Allahabad for opinion.

The finger prints of unidentified bodies should invariably be taken under the supervision of an officer not below the rank of a Sub-Inspector. Finger Prints of all digits must be taken, and the supervising officer shall certify by his signature on the search slip that impressions have been correctly taken in his presence. The supervising officer will further note in the remarks column of the search slip the condition of the body, whether in an advanced stage of decomposition or otherwise.

SECTION 121.—(Cf. 858 PARA, MANUAL OF GOVERNMENT ORDERS).—The following instructions prescribe the procedure to be observed by the police when sending in a dead body to the civil medical officer for *post-mortem* examination, and for the conduct of such examination by that officer :—

1. The body shall be laid in the shell and shall be protected by either (1) charcoal and sulphate of iron (*kasis*), (2) phenyle and mustard oil, or (3) carbolic acid, according as these articles are available, and payment for these can be made out of the permanent advance of the station.

2. The body sent in for examination shall be accompanied by a police constable and a chaukidar. If the *thana* is over twenty miles distant from head quarters, the constable and chaukidar may be relieved at one or more intermediate stations ; but the number of reliefs should be kept as low as possible.

3. The names of the police constable and of the chaukidar, and of the relieving constables and chaukidars, if any, shall be always entered in police form, No. 13.

4. They shall be instructed by the *thanedar* sending in the body to make it over, on arrival at the police head quarters, to the civil medical officer after despatch of the usual requisition, but will remain in charge of the body until the medical officer has completed the examination, and will arrange for the disposal of the remains in the absence of relatives of the deceased.

5. Before commencing the examination, the medical officer shall ask the police constable and the chaukidar whether the body to be examined is the body which they accompanied from the police-station, and their replies shall form part of the civil medical officer's declaration.

6. After the formal identification by the police constable and the

chaukidar, the medical officer shall compare the body with the *hulia* or descriptive roll sent from the police station, and he shall certify that the body about to be examined agrees with the descriptive roll with it.

7. The greatest care and precision is enjoined on all police officers in describing the body; any marks or natural conditions by which it may be readily identified should be noted; and this descriptive-roll should contain particulars for identification distinct from any injuries that may be apparent.

8. The officer in charge of the station from which the body is despatched, shall not send both copies of the descriptive-roll with the police constable, who accompanies the body, but shall send only one copy of the roll by the constable and forward the other by post to the officer in charge of the police head quarters.

9. The medical officer shall be furnished with a detailed translation on the appearance and the situation of the body when it was first discovered, and on the cause of death, as far as ascertainable at the time.

Note.—Superintendents of police are authorized to call on civil surgeons to make *post-mortem* examinations.

10. *The post-mortem* examination in cases in which an Indian has been killed by a soldier (British) shall be conducted by the civil surgeon himself, and the police shall give that officer the information necessary to show him that the case is one in which his personal conduct of the *post-mortem* is required.

SECTION 121A.—1. All substances or articles connected with the commission of an offence and required to be put in as evidence at the trial should be sent under a sealed cover with the contents noted outside, by the investigating officer under a *chalan* or invoice to the prosecuting inspector. The prosecuting inspector shall sign the *chalan* in token of having received the parcel and shall enter it in his register. The *chalan* should show the name of the constable who brought the sealed cover.

2. If the article is one in which no medical or Chemical Examiner's examination is required the prosecuting inspector shall retain the article until it is wanted for production in court.

3. If the article is one of which examination by the Civil Surgeon or Chemical Examiner appears to be necessary, the prosecuting inspector shall send it on to the Civil Surgeon with a letter requesting him to examine it. The prosecuting inspector shall note in his register the agency by which the parcel was sent, and shall obtain the Civil Surgeon's receipt for it.

4. The Civil Surgeon on receiving the article shall open and inspect it. If he finds that he can examine it, he can do so, and return the article unless it be offensive matter, such as stomach washing, vomited matter, viscera, etc., with the report of his examination to the prosecuting inspector who shall then produce the report, and where it has been returned, the article, when required by the court. If the article is of such a nature that examination by the Chemical Examiner appears desirable, the Civil Surgeon shall inform the court to that effect, and return the article pending orders from the court.

5. On receipt of orders from the court requiring him to send the article to the Chemical Examiner, the Civil Surgeon shall proceed as laid down in the existing rules on the subject (paragraphs 868-886, Manual of Government Orders.)

6. If the court intimates that it does not consider an examination by the Chemical Examiner necessary, the Civil Surgeon shall return the article to the court for disposal, obtaining a receipt for it from the court.

The Civil Surgeon shall be the custodian of substances of an offensive nature as long as the medical analysis is under consideration. Once the analysis has been made and the report and substances presented in court, the police should take charge of the exhibits, the *malkhana* being the repository for such matter.

In accordance with G. O. No. 586 VI—82C dated 3rd March 1904 such substances should be destroyed by the Civil Surgeon without orders from the court after being detained for six months but the District Magistrate's assent must first be obtained.

SECTION 123.—The medical officer should give an abstract of his report to the constable accompanying the injured person or dead body for communication to the investigating officer. The constable should be instructed by the investigating officer to ask for such an abstract.

SECTION 125.—No person may be sent by the police for medical examination against his or her will. No person should be sent for examination to an employee of the Dufferin Fund.

CIRCULAR NO. 24 OF 1903 OF THE INSPECTOR GENERAL, CIVIL HOSPITALS.

1. The form of certificate in use in these Provinces for the reports of medical officers to the police in cases of "hurt," requires that an opinion should be expressed as to whether the injury is "*simple*" or

"*grievous*," and definitions of these terms, as explained in the Indian Penal Code, are printed on the form for information.

2. It has been found in practice that the police usually press for an immediate opinion as to whether an injury is "*simple*" or "*grievous*," to enable them to decide whether to take cognizance of an offence or not, with the result, in the case of Hospital Assistants particularly, that wrong opinions are often given, and much subsequent trouble caused both to the police and to the medical subordinates. The latter are frequently suspected, and sometimes accused, of having been bribed by interested parties if their sworn evidence in Court differs from that given in their original certificate.

3. It goes without saying, that in some cases it is impossible for the most experienced surgeon to give an opinion *at once* as to whether an injury is "*simple*" or "*grievous*" as defined by the Indian Penal Code; while in many, probably the most, it is perfectly possible to do so.

4. Medical officers of the subordinate grades should understand that what is wanted from them is a description of the injury presented to them, an opinion as to how it was caused, and what will be the *probable* immediate and remote results. If they are unable to diagnose the actual injury, or to say how it was caused, or to give an immediate and reliable prognosis as to results, they are perfectly justified in reporting to that effect, and are hereby authorized to do so. No pressure from subordinate police officials should induce them to make a report founded on imperfect knowledge or insufficient observation.

5. If these instructions are borne in mind, there will be fewer cases of Hospital Assistants adhering in Court to an obviously incorrect original opinion, or being suspected or accused of dishonesty, because they honestly changed their views as to the nature of a case between the time of their original examination and that of giving evidence in Court.

APPENDIX II.

SPECIAL RULES OF EVIDENCE.

(FROM OUDH CRIMINAL DIGEST).

MEDICAL EVIDENCE IN CRIMINAL CASES.

105. The following instructions in regard to obtaining and taking medical evidence in criminal cases are to be followed (sections 509 and 510 of C. P. Code) :—

(1) When a case arises requiring medical opinion, the subject shall be forwarded to the proper medical officer, with such a general description of what is known of the case that the attention of the medical officer may be turned in the right direction. This description may be in English or vernacular, as the case may be.

(2) The medical officer shall reply by letter or memorandum on the back of the reference, or at any rate attach his reply to the reference, in order that there may be no doubt of the case to which his remarks apply.

(3) Whenever the cause of death, or the nature of the injury, is the subject of inquiry, the medical officer shall be summoned as a witness and examined by the Magistrate.

(4) The Magistrate shall look into the case, and make himself acquainted with its particular features, before the medical officer is examined, in order that the proper questions may be asked.

(5) The deposition of the medical officer shall be recorded on a separate piece of paper. The Magistrate shall set out accurately the official designation of the witness, and before the witness leaves the Court his deposition shall be translated and read over to the accused, who shall be allowed to cross-examine, and the deposition shall show that he has had the opportunity of doing so. The translation shall form part of the record.

(6) The report (if any) of the Chemical Examiner or Assistant Chemical Examiner shall be put on the record.

(7) The reply of the medical officer shall be put on the record, and may be used to refresh the memory of the medical officer at the time of giving his deposition, and to assist the Magistrate or Judge in framing his questions. It is not sufficient to read it over to the medical officer and

swear him to the truth of it, his deposition must be fully recorded in the presence of the accused.

(8) If, in any particular case, the evidence of a medical witness is not to be had, the details, such as fact of death, symptoms, appearances, wounds, must be made out as correctly as possible from the evidence of non-medical eye-witnesses. The court cannot assume any such facts from mere reports not admissible as evidence, and it is of no use proceeding in the trial until the *corpus delicti* is made out. Police officers can always be put into the witness-box to bear testimony to what they saw.

(9) In cases committed to the Court of Session, the medical witness shall not be bound over by the Magistrate to appear before the Court of Session, but the Court, if it think fit, may on its own motion or on the application of either side, summon and examine such witness.

107. **Expenses payable to Witnesses.**—The following rules have been made under section 544, Criminal Procedure Code, by the Local Government, with the previous sanction of the Governor-General in Council, for the payment of the expenses of complainants and witnesses attending before any Criminal Court for the purpose of an inquiry or a trial provided that no such payment shall be made from public funds to any witness in cases where under the provisions of any law in force the reasonable expenses of such witness have by order been deposited in court as a condition precedent to the issue of process to compel his attendance.

(*a*) For the ordinary labouring class of Indians two annas per diem.

(*b*) For Indians of higher rank in life, four annas per diem.

(*c*) For Europeans and Eurasians and Indians of superior rank, a diet allowance according to circumstances up to about of Rs. 3 per diem.

2. Diet money shall be paid for the days of actual detention as well as for the time occupied in the journeys to and from the court. The number of days which should be allowed for the journey to and fro will be determined by the officer ordering payment in each case.

3. Travelling expenses shall be given only when the journey could not, with reasonable care and expedition, have been performed on foot, or in the case of persons whose age, position and habits of life render it impossible for them to walk. In such cases, in addition to diet allowance, travelling allowance shall be given at the following rates :—

(*a*) When the journey is by rapid dak by road the actual expenses incurred up to a maximum limit of four annas a mile, or in the case of Europeans, Eurasians, and Indians of superior rank up to eight annas

a mile. In towns where licensed hackney carriages ply for hire the actual cost of hiring a vehicle suited to the rank of a witness may be allowed if, in the opinion of the presiding officer of the court, the use of such a vehicle was necessary.

(*b*) Where the journey is wholly or partially by rail—

(*i*) For Indians generally, railway fare by the lowest class ;

(*ii*) For Europeans, Eurasians and Indians of higher rank, intermediate or second class railway fare according to circumstances ; but the court may, in its discretion allow first class railway fare when the persons concerned, from their social position, would ordinarily travel by that class.

4. Notwithstanding anything contained in the foregoing rules—

(*a*) Government servants (not the police officers on duty as witnesses, patwaries, or rural jamadars or chowkidars) shall receive nothing beyond actual expenses.

(*b*) Police officers on duty as witnesses shall not receive from the court any allowances or expenses whatsoever. The court shall, upon application, give such officers a certificate of attendance, and they will receive departmentally any travelling allowance to which they may be entitled under the provisions of article 1133 read with articles 1038 of Civil Service Regulations.

(*c*) Witnesses following any profession such as medicine or law shall receive a special allowance according to circumstances and custom.

173. **Rules for regulating the periods for which youthful offenders may be sent to Reformatory School.**

"No boy shall be sent to a reformatory school, if under ten years of age, for a less period than seven years ; if over ten years for a less period than five years, unless he shall sooner attain the age of 18 years."

(Notification No. 611/VI-4003 republishing Notification of Government of India, Home Department Jails, no. 173, dated 14/3/1889).

APPENDIX III.

QUESTIONS TO BE PUT TO MEDICAL WITNESSES.

(FROM OUDH CRIMINAL DIGEST.)

NO I.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF SUSPECTED POISONING AFTER *POST-MORTEM* EXAMINATION OF THE BODY.

1. Did you examine the body of late a resident of and, if so, what did you observe?

2. What do you consider to have been the cause of death? State your reasons.

3 Did you find any external marks of violence on the body, if so, describe them?

4. Did you observe any unusual appearance on further examination of the body? If so, describe them.

5. To what do you attribute these appearances; to disease, poison or other cause?

6. If to poison, then to what classes of poisons?

7. Have you formed an opinion as to what particular poison was used?

8. Did you find any morbid appearances in the body besides those which are usually found in cases of poisoning by.....? If so, describe them.

9. Do you know of any disease, in which the *post-mortem* appearances resemble those which you observed in this case?

10. In what respect do the *post-mortem* appearances of that disease differ from those which you observed in the present case?

11. What are the symptoms of that disease in the living?

12. Are there any *post-mortem* appearances usual in case of poisoning by.....but, which you did not discover in this instance?

13. Might not the appearances you mention have been the result of spontaneous changes in the stomach after death?

14. Was the state of the stomach and bowels compatible or incompatible with vomiting and purging?

15. What are the usual symptoms of poisoning by.....?

16. What is the usual interval between the time of taking the poison and the commencement of the symptoms?

17. In what time does.....generally prove fatal?

18. Did you send the contents of the stomach and bowels (or other matters) to the Chemical Examiner?

19. Were the contents of the stomach (or other matters) sealed up in your presence immediately on removal from the body?

20. Describe the vessel in which they were sealed up, and what impression did the seal bear?

21. Have you received a reply from the Chemical Examiner? If so, is the report now produced that which you received?

22. (If a female adult) what was the state of the uterus?

NO II.

QUESTIONS THAT MAY BE PUT TO A NON-PROFESSIONAL WITNESS IN A CASE OF SUSPECTED POISONING.

1. Did you know , late a resident of ? If so, did you see him during his last illness and previously?

2. What are the symptoms from which he suffered?

3. Was he in good health previous to the attack?

4. Did the symptoms appear suddenly?

5. What was the interval between the last time of eating or drinking and the commencement of the symptoms?

IF DEATH OCCURRED.

6. What was the interval between the commencement of the symptoms and death?

7. What did the last meal consist of?

8. Did any one partake of this meal with.....?

9. Were any of them affected in the same way?

10. Had he ever suffered from a similar attack before?

If any of the following symptoms have been omitted in answer to question 2, special questions (11-14) may be asked regarding them as follows:—11. Did vomiting occur? 12. Was there any purging? 13. Was there any pain in the stomach? 14. Was—very thirsty?

15. Did he become faint?

16. Did he complain of headache or giddiness?

17. Did he appear to have lost the use of his limbs?

18. Did he sleep heavily?

19. Had he any delirium?

20. Did convulsions occur?

21. Did he complain of any peculiar taste in the mouth?

22. Did he notice any peculiar taste in his food or water?

23. Was he sensible in the intervals between the convulsions? (This is with reference to Nux Vomica).

24. Did he complain of burning or tingling in the mouth and throat, or of numbness and tingling in the limbs? (Aconite).

NO III.

QUESTIONS WHICH MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF SUPPOSED DEATH BY WOUNDS OR BLOWS AFTER *POST-MORTEM* EXAMINATION OF THE BODY.

1. Did you examine the body of , late resident of , and, if so, what did you observe?

2. What do you consider to have been the cause of death? State your reasons.

3. Did you find any external marks of violence on the body? If so, describe them.

4. Are you of opinion that these injuries were inflicted before or after death? give your reasons.

5. Did you examine the body internally? Describe any unnatural appearance which you observed.

6. You say that in your opinion—was the cause of death; in what immediate way did it prove fatal?

7. Did you find any appearance of disease in the body?

8. If so, do you consider that, if the deceased had been free from this disease, the injuries would still have proved fatal?

9. Do you believe that the fact of his suffering from this disease lessened his chance of recovery from the injuries sustained?

10. Are these injuries taken collectively, or any one of them ordinarily and directly dangerous to life?

11. Have they been caused by manual force or with a weapon

12. Did you find any foreign matter in the wound?

13. By what sort of weapon has the wound been inflicted?

14. Could the injuries have been inflicted by the weapon now before you (number—in the police charge sheet)?

15. Could the deceased have walked (so far) or spoken, etc., after the receipt of such an injury?

16. Have you chemically, or otherwise, examined the stains (or the weapon, clothes, etc.,) now before you (No————in the police charge sheet)?

17. Do you believe the stains to be those of blood?

18. What time do you think elapsed between the receipt of the injuries and death?

19. What was the direction of the wound, and can you form an opinion as to the position of the person inflicting such a wound with respect to the person receiving it?

20. Is it possible for such a wound to have been inflicted by any one on his own person? Give your reasons.

21. (In gun shot wounds), give precise direction of the wound.

22. Did the appearance of the wound indicate that the gun had been discharged close to the body or at some distance from it?

23. Did you find any slug, bullet, wadding, etc., in the wound or had —made its exit?

24. Did you think it possible that you could have mistaken the aperture of entrance for that of exit?

NO. IV.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF SUPPOSED INFANTICIDE AFTER *POST-MORTEM* EXAMINATION OF THE BODY.

1. Did you examine the body of a (male or female) child sent to you by the District Superintendent of police on the——of——19——? And, if so, what did you observe?

2. Can you state whether the child was completely born alive, or born dead? State the reasons for your opinion.

3. What do you consider to have been the cause of death? Give your reasons.

4. What do you believe to have been the uterine age of the child? State your reasons.

5. What do you believe to have been the extra-uterine age of the child? Give reasons.

6. Did you find any marks of violence or other unusual appearances externally? If so, describe them accurately.

7. Did you find any morbid or unusual appearances on examination of the body internally? If so, describe them accurately?

8. Do you believe the injuries you observed to have been inflicted before or after death? Give reasons.

9. Can you state how they were inflicted? Give reasons.

10. Do you consider that they were accidental or not? Give reasons.

11. Had the infant respired fully, partially, or not at all?

12. Did you examine the person of the alleged mother of the infant? If so, have you reason to suppose that she was recently delivered of a child? Can you state approximately the date of her delivery? Give reasons.

NO. V.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF SUPPOSED DEATH BY HANGING OR STRANGULATION.

1. Did you examine the body of——, late a resident of——, and if so, what did you observe?

2. What do you consider to have been the cause of death? State the reasons for your opinion.

3. Did you observe any external mark of violence upon the body?

4. Did you observe any unnatural appearance on examination of the body internally?

5. Was there any rope or other such article round the neck when you saw the body?

6. Can you state whether the mark or marks you observed, were caused before or after death?

7. By what sort of articles do you consider the deceased to have been hanged (or strangled)?

8. Could the mark you observed have been caused by the rope or other article now before you (No.....of the police charge sheet)?

9. Do you think that this rope could have supported the weight of the body?

10. If strangulation—Would great violence be necessary to produce the injuries you describe?

11. What, as far as you can ascertain, were the general characteristics of his previous disposition?

12. Does he appear to have had any previous attacks of insanity?

NO. VI.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF SUPPOSED DEATH BY DROWNING, AFTER *POST-MORTEM* EXAMINATION OF THE BODY.

1. Did you examine the body of—, late resident of—, and if so, what did you observe ?

2. What do you consider to have been the cause of death ? State your reasons.

3. Were there any external marks of violence upon the body ? If so, describe them.

4. Describe any unnatural appearances which you observed in further examination of the body.

5. Did you find any foreign matters, such as weeds, straw, etc., in the hair, or clenched in the hands of the deceased or in the air passages or attached to any other part of the body ?

6. Did you find any water in the stomach.

NO. VII.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF ALLEGED RAPE.

1. Did you examine the person of mussamat—? If so, how many days after the alleged rape did you make the examination and what did you observe ?

2. Did you observe any marks of violence about the vulva or adjacent parts ?

3. Are these injuries such as might have been occasioned by the commission of rape ?

4. Was the hymen ruptured ?

N. B. This question is only to be asked in the case of the rape of a girl of tender years.

5. Did you observe any further marks of violence upon the person of the woman ?

6. Had she passed the age of puberty ?

7. Can you state approximately what her age is ?

8. Did you find her to be a strong, healthy woman, or so weakly as to be unable to resist an attempt at rape ?

9. Did you examine the person of the accused ?

10. Did you observe any marks of violence upon his body ?

11. Was he suffering from any venereal disease ?

12. Did you find the woman to be suffering from a similar or other venereal disease ?

13. Had a sufficient time elapsed when you examined the person of the woman, for venereal disease to have made its appearance, in case of her having been infected ?

14. Can you state approximately how long the accused had been suffering from this complaint ?

15. Can you state approximately how long the woman had been suffering from this (venereal) complaint ?

16. Have you examined the stained articles forwarded to you and now in court (No....of police charge sheet) ?

17. What is the result of your examination ?

18. Do you believe that rape has been committed or not ? State your reasons.

NO. VIII.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN CASE OF SUSPECTED INSANITY.

1. Have you examined—?

2. Have you done so on several different occasions, so as to preclude the possibility of your examination having been made during lucid intervals of insanity ?

3. Do you consider him to be capable of managing himself and his personal affairs ?

4. Do you consider him to be of "unsound mind" ; in other words intellectually insane ?

5. If so, do you consider his mental disorder to be complete or partial ?

6. Do you think he understands the obligation of an oath ?

. Do you consider him, in his present condition, competent to give evidence in a Court of Law ?

8. Do you consider that he is capable of pleading to the offence of which he now stands accused ?

9. Do you happen to know how he was treated by his friends (whether as a lunatic, an imbecile or otherwise) prior to the present investigation and the occurrences that have led to it ?

10. Is he subject to insane delusions ?

11. If so, what is the general character of these ? Are they harmless or dangerous ? How do they manifest themselves ?

12. Might such delusion or delusions have led to the criminal act of which he is accused ?

13. Can you discover the cause of his reason having become affected ? In your opinion was it congenital or accidental ?

14. If the latter, does it appear to have come on suddenly, or by slow degrees ?

15. Have you any reason for believing that his insanity is of hereditary origin ? If so, please to specify the grounds for such an opinion ; and all the particulars bearing on it as to the insane parents or relations of the accused ; the exciting cause of his attack ; his age when it set in ; and the type which it assumed.

16. Have you any reason to suspect that he is, in any degree, feigning insanity ? If so, what are the grounds for this belief ?

17. Is it possible, in your opinion, that his insanity may have followed the actual commission of his offence, or been caused by it ?

18. Have you any reason to suppose that the offence could have been committed during a lucid interval during which he could be held responsible for his act ? If so, what appears to you to have been the duration of such lucid interval ? Or, on the contrary, do you believe his condition to be such as altogether to absolve him from legal responsibility ?

19. Does he now display any signs of homicidal or of suicidal mania or has he ever done so to your knowledge ?

20. Do you consider it absolutely necessary, from his present condition, that he should be confined in a lunatic asylum ?

21. Do you think that judicious and unremitting supervision, out of an asylum, might be sufficient to prevent him from endangering his own life or the property of others ?

NO. IX.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS. IN A CASE OF ALLEGED CAUSING MISCARRIAGE.

1. Did you examine the person of mussamat—? If so, when ? What did you observe ?

2. Are you of opinion that a miscarriage has occurred or not ? Give your reasons.

3. In what mode do you consider the miscarriage to have been produced, whether by violence per vaginam or by external violence, or by the use of irritants internally? Give your reasons.

4. It is alleged that a drug called—was used, state the symptoms and effects which the administration internally of this drug would produce. Do you consider that it would produce miscarriage?

5. Can you state whether the woman was quick with child when miscarriage was produced? State your reasons.

6. Did you see the fœtus? If so, at what period of gestation do you consider the woman to have arrived?

NO. X.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF GRIEVOUS HURT.

1. Have you examined—? If so, state what you observed?

2. Describe carefully the marks of violence which you observed.

3. In what way do you consider the injuries to have been inflicted? If by a weapon, what sort of weapon do you think was used?

4. Do you consider that the injuries inflicted could have been caused by the weapon now shown to you (No.—of police charge sheet)?

5. What was the direction of the wound, and can you form an opinion as to the position of the person inflicting such a wound with respect to the person receiving it?

6. Is it possible for such a wound to have been inflicted by any one on his own person? Give your reasons.

7. Do you consider that the injuries inflicted constitute any of the form of "grievous hurt" defined in S. 320 of the Indian Penal Code? If so, which of them? Give your reasons. The Magistrate in putting this question will show the Indian Penal Code to the witness, or the Magistrate may vary the form of the question so as to elicit the required information without calling the witness's attention to the code.

8. Do you consider that the person injured is now out of danger?

9. It is alleged that the injuries were caused by—. Could they have been caused in the manner indicated?

10. Have you chemically or otherwise examined the stains on the weapon, clothes, etc., now before you (No—in the police charge sheet)?

11. Do you believe the stains to be those of blood?

N. B.—In case of the injuries being gun shot wounds, questions 21 to 24 under the head of No. III (Death by wounds) may be put to the witness.

NO. XI.

QUESTIONS THAT MAY BE PUT TO A MEDICAL WITNESS IN A CASE OF DEATH FROM THE RUPTURE OF SPLEEN.

1. What appearances of external violence were perceptible on the body?

2. What was the size and weight of the spleen after death?

3. How far did it project beyond the ribs?

4. What was the consistency of the spleen—hard, firm, soft, pulpy or diffluent?

5. How long after death was the body examined, and what was the temperature of the air?

6. Was the body much putrefied?

7. What was the position of the rupture?

8. What was the length and depth of the rupture?

9. Is it your opinion that the rupture was caused by external violence or not? State your reasons for your opinion.

10. Were there any adhesions about the spleen, if so, were they older than the rupture or not?

APPENDIX IV.

FORMS FOR MEDICO-LEGAL REPORTS.

POLICE FORM NO. 34.

UNITED PROVINCES POLICE.

No......

FROM

THE SUPERINTENDENT OF POLICE,

.....

TO

THE CIVIL SURGEON OF

.....

Dated..... *192* .

SIR,

I HAVE the honour to request the favour of your examining.....

.....

.....sent to hospital on the.....

192 , and of your furnishing me with a report on reverse of the nature and extent of bodily injury sustained by the said

I have the honour to be,
SIR,
Your most obedient servant,

Superintendent of Police.

1	2	3	4	5	6	7
Nature of injury, whether cut, wound, bruise, fracture or dislocation.	Size of each injury in inches, being length, breadth and depth.	On what part of the body inflicted.	Simple, grievous or dangerous (see foot-note I).	By what weapon inflicted.	Whether the weapon was dangerous or not (*vide* foot-note II).	Remarks.

NOTE NO. I.—Description of grievous hurt—

Firstly—Emasculation.
Secondly—Permanent privation of the sight of either eye. *Civil Surgeon.*
Thirdly—Permanent privation of the hearing of either ear.
Fourthly—Privation of any member or joint.
Fifthly—Destruction or permanent impairing of the powers of any member or joint.
Sixthly—Permanent disfiguration of head or face.
Seventhly—Fracture or dislocation of a bone or tooth.
Eighthly—Any hurt which endangers life, or which causes the sufferer to be, during the space of twenty days, in severe bodily pain or unable to follow his ordinary pursuits.

NOTE NO. II.—Description of dangerous weapon.

Any instrument for shooting, stabbing or cutting, or any instrument which, used as a weapon of offence, is likely to cause death.

POLICE FORM NO. 34 (A).

UNITED PROVINCES POLICE.

No. .....

FROM

THE OFFICER IN CHARGE
OF POLICE STATION,

.....

TO

THE SUB-ASSISTANT SURGEON
IN CHARGE OF DISPENSARY,

.....

Dated ..... *192* .

SIR,

I HAVE the honour to request the favour of your examining.....
..... sent to hospital on the ..... 192 ,
and of your furnishing me with a report on reverse of the nature and extent of bodily injury sustained by the said .....

I have the honour to be,
SIR,
Your most obedient servant,

Officer in Charge of Police Station.

1	2	3	4	5	6	7
Nature of injury, whether cut, wound, bruise, fracture or dislocation.	Size of each injury in inches, being length, breadth, and depth.	On what part of the body inflicted.	Simple, grievous (see foot-note I) or dangerous.	By what weapon inflicted.	Whether the weapon was dangerous or not. (*Vide* foot-note II.)	Remarks.

NOTE NO. I.—Description of grievous hurt—

Firstly.—Emasculation.
Secondly.—Permanent privation of the sight of either eye.
Thirdly.—Permanent privation of the hearing of either ear.
Fourthly.—Privation of any member or joint.
Fifthly.—Destruction or permanent impairing of the powers of any member or joint.
Sixthly.—Permanent disfiguration of head or face.
Seventhly.—Fracture or dislocation of a bone or tooth.
Eighthly.—Any hurt which endangers life or which causes the sufferer to be, during the space of twenty days, in severe bodily pain, or unable to follow his ordinary pursuits.

NOTE NO. II.—Description of dangerous weapon—Any instrument for shooting, stabbing or cutting, or any instrument which used as a weapon of offence is likely to cause death.

Signed

Sub-Assistant Surgeon
in Charge of Dispensary.

OUDH JUDICIAL FORM NO. 157.

LETTER REQUESTING CIVIL SURGEON TO EXAMINE AND REPORT INJURIES TO A WOUNDED PERSON.

No......

FROM

THE MAGISTRATE OF

.....

TO

THE CIVIL SURGEON OF

.....

SIR,

I have to request you to examine.....sent to the hospital on the..... Be so good as to fill up the columns on the reverse of this letter and to return it to me, with such remarks as you may consider necessary to show clearly your opinion of the cause of

2. All that is at present known of the case is as follows :—

I have the honour to be
Sir,
Your most obedient Servant,

MAGISTRATE'S OFFICE,
The.....*19* .

MAGISTRATE.

1	2	3	4	5	6
Nature of Injury, that is, whether a cut, a bruise, or a burn, etc.	Size of each injury in inches, that is length, breadth, and depth.	On what part of the body inflicted.	Simple, grievous, or dangerous.	By what kind of weapon inflicted.	Remarks.

NOTE.—Description of grievous hurt—

Firstly.—Emasculation.
Secondly.—Permanent privation of the sight of either eye.
Thirdly.—Permanent privation of the hearing of either ear.
Fourthly.—Privation of any member or joint.
Fifthly.—Destruction or permanent impairing of the powers of any member or joint.
Sixthly.—Permanent disfiguration of head or face.
Seventhly.—Fracture or dislocation of bone or tooth.
Eighthly.—Any hurt which endangers life, or which causes the sufferer to be, during the space of 20 days, in severe bodily pain, or unable to follow his ordinary pursuits.

HOSPITAL :
The.....*19* .

Civil Surgeon.

POLICE FORM NO. 238.

ABSTRACT IN THE VERNACULAR OF REPORT OF MEDICAL OFFICER'S EXAMINATION TO BE MADE OVER TO THE CONSTABLE ACCOMPANYING THE INJURED PERSON.

No. and date of injury letter to Civil Surgeon.	Name of Police Station.	Name of injured person.	Abstract of examination report in Vernacular.

POLICE FORM NO. 33.

UNITED PROVINCES POLICE.

---

*No.*_____

FROM

THE SUPERINTENDENT OF POLICE,

TO

THE CIVIL SURGEON OF

*Dated*_____ *191* .

SIR,

You are requested to hold a *post-mortem* examination on the body of_____ sent herewith and to furnish a report of your examination in the accompanying form. A translation of the police officer's report on the appearance and situation of the body and on the cause of death as far as ascertainable at the time is annexed.

I have the honour to be,
SIR,
Your most obedient servant,

Superintendent of Police.

N. B.—In case of poisoning, (1) the date and hour of onset of symptoms, (2) the date and hour of patient's death, and in cases of exhumation, (3) the dates of burial and exhumation should be submitted with this to the Civil Surgeon.

Post-mortem report

on the body of

Place Date

Body identified by Police constable

No. and Chaukidar

Probable age

Probable time since death

I.—EXTERNAL APPEARANCES.

1.	1. Condition of subject—Stout, emaciated, decomposed.
2.	2. Wounds, position, size, diameter.
3.	3. Bruises, position, size, nature.
4.	4. Marks of ligature on neck, etc.

II.—CRANIUM AND SPINAL CANAL.

1.	1. Scalp, skull, vertebræ.
2.	2. Membranes.
3.	3. Brain and Spinal cord.*

III.—THORAX.

a. Walls, ribs, cartilages	*a.*
b. Pleura	*b.*
c. Larynx and Trachea	*c.*
d. Right-lung	*a.*
e. Left-lung	*e.*
f. Pericardium	*f.*
g. Heart and large vessels	*g.*

* Spinal canal need not be examined unless any indication of disease or injury exist.

IV.—ABDOMEN.

1.	Walls.	1.	
2.	Peritoneum	2.	
3.	Mouth, pharynx and œsophagus.	3.	
4.	Stomach and its contents.	4.	
5.	Small intestine and its contents.	5.	
6.	Large intestine and its contents.	6.	
7.		7.	Liver.
8.		8.	Spleen.
9.		9.	Kidneys.
10.		10.	Bladder.
11.		11.	Organs of generation, external and internal.

V.—MUSCLES AND BONES.

Injury, disease or deformity.

Fracture or dislocation.

VI.—Date and hour of onset of symptoms, Ditto of death.

To be answered in cases of poisoning*

VIII. Remarks by Civil Surgeon,

Place—

Civil Surgeon.

Date—

* In cases or exhumation the dates of burial and exhumation should be furnished.

POLICE FORM NO. 289.

ABSTRACT OF *POST-MORTEM* TO BE FORWARDED TO LOCAL POLICE WITHOUT DELAY.

Name of thana.	Name of deceased.	Date of *Post-mortem*.	Probable cause of death. (To be recorded in English by the Civil Surgeon immediately after holding *post-mortem*.)	Urdu translation of column 4.

APPENDIX V.

RULES FOR TRANSMISSION OF SUBSTANCES FOR ANALYSIS TO THE CHEMICAL EXAMINER AND GOVERNMENT ANALYST, UNITED PROVINCES, AND TO THE IMPERIAL SEROLOGIST TO THE GOVERNMENT OF INDIA, CALCUTTA.

RULES FOR MAGISTRATES.

1. Substances ought not to be sent to the Chemical Examiner for analysis when there is neither a reasonable suspicion that poison has been used nor anything in the *post-mortem* examination of the bodies leading to such a supposition. Magistrates should limit their references to that officer to cases of necessity, and in which the local medical officer cannot afford the information required.

2. Civil Surgeons and Superintendents of Police are to remember that the duty of making a reference to the Chemical Examiner, and of requiring that officer to make a report which shall be admissible under section 510 of the Criminal Procedure Code, is one which lies solely within the province of the Magistrate conducting the inquiry for which information on the character of the suspected substance is required. Such references should not, under any circumstances, be made by them directly.

3. When in the course of any proceeding under the Criminal Procedure Code a Magistrate decides that a reference to the Chemical Examiner is required, he shall at once, in form no. 1, call on that officer for a report, and shall request the Civil Surgeon or officer in civil medical charge by endorsement to form no. 1 to forward to the Chemical Examiner the substance of which analysis is required.

4. The Magistrate conducting the proceedings is responsible for furnishing the Chemical Examiner with every fact and detail obtainable either from deponents, or from the medical officer, or from the police investigation, which may afford the Chemical Examiner the slightest clue or may indicate the direction in which analytical inquiry may yield a positive result. The information will be given in the annexure to form no. 1, which must invariably be filled up by the Magistrate himself.

Conformably with this rule the words "supplied by the police" in the heading of the annexure to form no. 1 should be omitted.

5. Cases have occurred in which the usefulness of the analyses made by the Chemical Examiner has been impaired by the omission to furnish him with sufficient details as to the facts of the case. Magistrates should not, therefore, be content to send a mere precis of the facts as disclosed by the police or by the medical examination, but should satisfy themselves that all ascertained facts which may be useful to the Chemical Examiner are embodied in the report. If additional facts are discovered in time to be useful a supplementary report should be forwarded. Magistrates should invariably consult the Civil Surgeon, even if the latter has not himself seen the case, as to the symptoms and other pathological facts which it is necessary to embody in the report, and as to whether it is necessary to ask the Chemical Examiner for a quantitative analysis. If the case has been seen by a medical officer, the latter should add a report, stating his opinion as to what poison has been used.

6. Magistrates should not address to the Chemical Examiner questions, of a medico-legal nature. It is the Chemical Examiner's business to ascertain and report facts, and to draw inferences. If a Magistrate wishes for expert assistance in the interpretation of facts reported by the Chemical Examiner he should call the Civil Surgeon as a witness.

7. In cases of analysis of portions of a dead body, besides a copy of the *post-mortem* report in the handwriting of a medical officer or medically trained subordinate, the Chemical Examiner should be furnished with replies to the querries printed on the annexure to form no. 1.

RULES FOR CIVIL SURGEONS.

A.—General.

1. Articles sent for examination should as a rule, if under 10 seers in weight, be sent by registered post. If above this weight they should be sent by rail (passenger train, freight prepaid). In the latter case the railway receipt should be enclosed in the letter advising despatch of parcel.

2. In all cases a letter advising despatch of parcel must be sent to the Chemical Examiner. Chemical Examiner's form no. 2 should be used for the letter, and it should be sent by post and not enclosed in the parcel. The number and date of this forwarding letter must always be written on the outside of the parcel, preferably on the label.

3. Great care should be used in packing substances sent to the Chemical Examiner to avoid any risk of the parcel becoming offensive or

dangerous to post office or railway officials. Such an accident would render the sender liable to prosecution under section 61 of the Post Office Act (VI of 1898). The Chemical Examiner is directed to report the name of any officer who fails to comply with these instructions.

4. The duty of preparing and despatching the articles to be sent for analysis devolves on the Civil Surgeon or officer in civil medical charge. In all cases the parcel should be packed and sealed in presence of the Civil Surgeon or other responsible medical officer. The cost of preparation, packing and postage, or railway freight should be charged in the Magistrate's contingent bill. Despatching officers will be held personally responsible that the subjoined instructions are carefully followed.

5. If, in the opinion of the Civil Surgeon, the results of a *post-mortem* examination are such as to give reasonable grounds for suspecting poison to have been used, he should immediately communicate with the District Magistrate with a view to obtain authorization to send portions of the viscera to the Chemical Examiner. Such portions of the viscera should be despatched immediately this authorization has been obtained.

6. A declaration of the nature of the contents of the parcel to the post office or railway authorities is unnecessary and should not be made.

7. Remains of viscera sent for examination are preserved by the Chemical Examiner for a period of six months after receipt.

8. Articles belonging to separate cases must on no account be packed in the same box or parcel.

9. These rules apply equally whether the articles are sent by post or by rail.

B.—Directions for preserving and packing viscera and other articles.

10. Special bottles for holding viscera, and boxes for holding these bottles, are supplied by the Chemical Examiner. Serial numbers are etched into the glass both of the bottle and of the stopper. The boxes are also marked with serial numbers.

11. On receipt by the Chemical Examiner of a box from the Civil Surgeon, the viscera bottle or bottles will be at once taken out and replaced by an empty bottle or bottles. The box will then be returned to the Civil Surgeon by passenger train.

12. All bottles will be issued from the Chemical Examiner's office containing a sufficient quantity of rectified spirit. Motor grease will be placed on the stoppers to prevent their sticking. In case the bottles

are used and cleaned in the Civil Surgeon's office, care should be taken to treat the stoppers similarly with vaseline or any other suitable grease.

13. The top of the box, which has a pent-roof shape, is not meant to be opened. The box is furnished with a door at the side, through which the bottle or bottles can be taken out and replaced. The box is lined with cushions which press against the bottle firmly on all sides, so that no further packing material is necessary.

14. The door of the box has a lock whose key will remain permanently in the possession of the Civil Surgeon. A duplicate key is kept in the Chemical Examiner's office. The key should therefore not be sent with the letter advising despatch of parcel.

15. A serial number is marked on each box and also on its key. This number should be quoted in the letter advising despatch of parcel.

16. After locking the door of the box a piece of tape is to be passed across the keyhole and sealed in position. Depressions in the wood near the keyhole are provided for the seal impressions. The special medico-legal seal should be used.

As this seal is of a large size it is apt to stick to the wax. To avoid this, and to ensure a clear impression being obtained, the seal, before use, should be dusted over with powdered French chalk (*salem kharia*).

17. The address label (Chemical Examiner's form no. 7) should be pasted (not gummed) to the door of the box in such a position as to cover the keyhole. On this label the number and date of the letter advising despatch should always be inserted to prevent mistakes in identification.

18. A label (Chemical Examiner's form no. 6) will be pasted on to each bottle before issue from the Chemical Examiner's office. When the bottle is brought into use this label must be filled up (giving especially the name of the deceased, etc.) by the Civil Surgeon or other responsible medical officer. The number that is etched into the glass of the bottle should be copied on to the label.

19. The stopper should be securely tied in position by tape or string, or a piece of leather or bladder should be stretched over it and tied securely in position.

20. Chemical Examiner's form no. 6 is a label that is intended to be attached to each bottle or other article sent to the Chemical Examiner. It should not be attached to the outside of any box or parcel, neither should it be sent in an envelope.

21. If orders are received by the Civil Surgeon to destroy viscera that have been placed in a bottle, further supply of spirit must be ob-

tained locally when the bottle again comes into use. The cost of this spirit will be met from the Magistrate's contingent bill. In such cases a sample of the spirit used must be sent to the Chemical Examiner in a small bottle properly sealed and labelled. Should the spirit contain any sediment care should be taken that some of this is sent in the sample bottle of spirit.

22. The quantity of the spirit used should be equal to that of the viscera in bulk. The viscera and spirit together should not fill the bottle, but only reach to two-thirds of its height, in order to diminish the risk of the bottle bursting in case any gas is given off.

23. Spirit that has been denaturalized by the addition of caoutchoucine should not be used for preserving viscera.

24. The pieces of viscera sent should be slashed or cut into small pieces to ensure penetration of the spirit. The stomach should be cut open with a similar object.

25. In cases of suspected alcohol and phosphorus poisoning, spirit must not be used as a preservative. A saturated solution of common salt is to be employed. The salt should be dissolved in water, preferably with the aid of heat. A note to the effect that salt solution has been employed should be made in the letter to the Chemical Examiner advising despatch of the parcel. In such cases great care must be taken that the bottle employed does not contain any trace of spirit. It should be washed by repeatedly filling with water and emptying.

26. Before despatch each bottle is to be put into the cardboard case in which it was received from the Chemical Examiner. It should be noted that the number stencilled on the cardboard case is the same as that of the bottle.

27. The pieces of tape attached to the sides of the cardboard case should be brought together on the top of the cover of the cardboard case and sealed in position, using the special medico-legal seal. No knot should be made in the tape.

28. A piece of wide newar tape is attached by one end to the inside of the box near the hinge of the door. When putting the cardboard case into the box care should be taken that the free end of the newar tape encircles the case. By pulling the extremity of this tape the cardboard case can easily be taken out of the box.

29. The serial numbers of the viscera bottles used (which are etched into the glass of the bottle and of the stopper) should always be quoted in the letter advising despatch of parcel.

30. The special medico-legal seal that is issued to each Civil Surgeon

and the keys of the boxes should be kept in a locked cupboard in the *post-mortem* room, and should never be allowed to come into the hands of unauthorized persons.

C.—Material to be sent.

31. In human poisoning cases two bottles will be used, except in the case of infants when one bottle will be sufficient. In the former alternative the stomach and contents are to be placed in one bottle. The other bottle will contain pieces of the liver, spleen, kidney and of the upper part of the small intestine. The quantity of viscera sent should be sufficient, when an equal amount of spirit has been added, to fill the bottle up to two-thirds of its height. Any suspicious substance found in the stomach should be sent in a separate phial.

32. Fæcal matter should not, as a rule, be sent for examination.

33. Vomit, if received in a moist condition, may be diluted with spirit and sent in a viscera bottle. If received in a dry state, it may be sent in the original package, after labelling, sealing and enclosing in a suitable box. Or it may be unpacked and placed, with a sufficiency of spirit, in a viscera bottle. The bottle may then be packed and despatched in accordance with foregoing rules.

Attention is drawn to the fact that permanganate of potash or Condy's fluid are unsuitable for preservation of viscera or vomit or other substances sent to the Chemical Examiner owing to their power of destroying organic poisons. Vomit received mixed with earth and in a dry condition may be forwarded without addition of a preservative. Vomit received in a moist condition should be mixed with three times its volume of rectified spirit or with half its volume of common salt before despatch. Vomit received mixed with ashes should be wetted with a mixture of rectified spirit two parts and acetic acid one part owing to the fact that the alkali present in the ashes tends to destroy any aconite that may be present.

34. In abortion cases, besides the specimens of viscera ordinarily sent, portions of the generative organs should be despatched if considered advisable by the medical officer.

35. In ordinary cases of cattle poisoning one viscera bottle is sufficient. This should contain pieces of the stomach, liver, spleen and intestine. In cases of suspected "sui" poisoning, or in cases in which death is supposed to have been caused by introduction of foreign bodies into the rectum, the injured parts only need be sent, together with any foreign bodies found. Such foreign bodies should be dried when prac-

ticable, and sent without any preservative, as the poisons used in these cases are likely to be harmed by the action of alcohol.

D.—Blood and seminal stains.

36. Articles of clothing, etc., having suspected blood or seminal stains should be thoroughly dried before being sent to the Civil Surgeon for transmission to the Chemical Examiner. Exposure to the open air for a couple of hours will be sufficient in dry weather. Drying before a fire may be necessary in the rains, but, when so doing, great care should be taken that the articles of clothing are not scorched. Unless the clothing is thoroughly dried, putrefaction is likely to set in and render recognition of the source of the stains either difficult or impossible. Civil Surgeons should open all parcels of clothing before despatch to see whether the above precaution has been taken. Further drying may then be carried out, if necessary, but it must be borne in mind that this precaution is useful before rather than after putrefaction has occurred.

37. In both blood and seminal stain cases Chemical Examiner's form no. 6 should be used as a label and attached to each article sent. In both classes of stains the whole of such garment, not cut out pieces, should be despatched. In the case of blood stains on mud floors, earth, etc., the piece containing the suspected stain should be cut out and wrapped in cotton wool, before packing in a box for transmission to the Chemical Examiner. [Special attention should be paid to this point, as a small blood stain, which of itself may be quite easy to recognize, is no longer recognizable if shaken up with a quantity of loose earth.]

38. Clothing and other articles having suspected stains may either be packed in a box with suitable packing material, or they may be sewn up in a cloth parcel. In either case the package must be sealed with the medico-legal seal.

39. Clothes and other articles sent in blood stain cases are to be returned to the District Magistrate after examination by the Chemical Examiner. Each article of clothing before return is to be marked by the Chemical Examiner with a special stamp showing date of examination.

E.—Miscellaneous.

40. Weapons, food and other miscellaneous objects should be packed in boxes, over which a covering of *gara* cloth is to be sewn. Yellow wax cloth is liable to contain traces of arsenic, and therefore should not be used in packing substances sent in poisoning cases. Seal impressions are

to be made along the seams of the cloth covering at distances not exceeding three inches. In cases in which any other than the prescribed medico-legal seal is used, a pattern of the impression of the seal should be made in ink rather than in wax. The device on the seal must in no case be that of the current coin, or merely a series of straight, curved or crossed lines.

41. For packing glass bottles the best material is thin wood shavings known commercially as "wood wool." Dry grass or straw may also be used. Cotton wool, though suitable for light articles, is quite unsuitable for packing heavy fragile bottles, etc. The packing material should be tightly pressed in, especially at the sides, so that there is no chance of the bottle coming in contact with any part of the inside of the box.

42. All officers requiring substances to be analysed in which the quantities of constituents have to be determined, such as potable waters, should remember that such analyses take up a great deal of time, and therefore no needless analysis should be demanded. In such cases a certificate should be obtained from the Magistrate of the district that the analysis is absolutely necessary. Without this certificate the Government Analyst is empowered to decline undertaking quantitative analysis.

43. Any municipal board requiring an analysis to be made shall forward to the Government Analyst, with the letter asking for the analysis, the treasury officer's receipt for the prescribed fee of ten rupees for each article examined. [This rule does not apply to the routine analysis of water from water works for which a special arrangement has been made.]

44. Analysis desired by the Military department will be performed under sanction of the Principal Medical Officer of His Majesty's Forces in India. In urgent cases the analysis should be carried out forthwith and sanction obtained later.

45. The results of analyses of substances other than those relating to criminal cases will be reported on Chemical Examiner's form no. 9

46. In the event of a viscera bottle being cracked or broken, it should be completely destroyed in the presence of the Civil Surgeon. A certificate that this has been done should be sent to the Chemical Examiner, who thereupon will issue another bottle in replacement.

RULES FOR DESPATCH OF ARTICLES TO THE IMPERIAL SEROLOGIST TO THE GOVERNMENT OF INDIA, CALCUTTA

I. The articles believed to be blood-stained, which are exhibits in cases under Sections 302, 304, 307, 312 to 316, 318, 376 and 377, Indian

Penal Code, should be referred direct to the Imperial Serologist, Medical College, Calcutta. But if seminal stains, or blood and seminal stains, are suspected to be present, or if the articles believed to be blood stained happen to be exhibits in cases under sections other than the above-mentioned ones, the articles should be sent to the Chemical Examiner at Agra in the first instance, together with the complete medico-legal history of the case, leaving it to that officer to determine which of such articles should be forwarded to the Imperial Serologist.

II. *Letters of advice* should be sent by post *registered,* and should invariably convey the information on the following points :—

(*a*) Complete list of articles in English.

(*b*) Whether any of these is suspected to be stained with semen.

(*c*) Whether any of these is suspected to be stained with blood other than human, and if so, what animal is suspected to be involved.

(*d*) Full description, or facsimile of the seal impressions affixed to the parcels in which the articles have been sent. This seal impression must on no account be one of a coin, small weight, wafer or spatula, etc.

(*e*) Complete translation of the Police Report, if it be in the vernacular.

(*f*) Section of the Indian Penal Code under which the case has been registered.

(*g*) Full account of the medico-legal aspects of the case.

III. *Articles sent for examination* should be treated thus :

1. Large and heavy articles such as doors, cart-yokes etc , should so far as possible have only their stained portions cut out and sent.

2. Articles of *wearing apparel* should be sent entire. In no case should such article be used as a cover for the parcel. All stains on apparel should be covered with paper, which should be stitched (*not pinned*) to the fabric. Care must be taken that the stitching of the covers of a parcel containing articles of wearing apparel does not penetrate these articles.

3. Stains on a *hard surface*, such as the blade of a knife, a sheet of tin, a piece of wood should be covered with a pledget of cotton wool which, in its turn, should be covered with paper, whose margins should be pasted on to the article well clear of the cotton wool.

4. *Earth or plaster* should be despatched carefully packed in cotton wool in a wooden or tin receptacle. If possible the earth or plaster should be sent in one piece.

5. *Cutting weapons* should have their edges well covered with hemp or jute packing.

Any article that is damp at the time of despatch should be carefully covered with wax-cloth and sent separately.

6. The parcel containing the articles, or the railway receipt therefor, must be sent by post registered. The postage charges or railway freight for each parcel must be paid by the despatching officer. On the parcel must be noted the number and date of its letter of advice.

7. When *flesh* or *skin* is sent for examination it must not be sent in alcohol, but should be sent in a fairly strong solution of common salt.

APPENDIX VI.

STATEMENT OF THE CONDITIONS OF MEDICO-LEGAL ENQUIRY IN INDIA AS COMPARED WITH SUCH ENQUIRY IN ENGLAND :

(Extract from the report of Chemical Examiner, Punjab for 1878).

I. Condition of Enquiry in India compared with Europe.—The investigation and proof of medico-legal cases in India are generally conducted under very different conditions and by very different means from those in most countries of Europe, and it is very necessary for the officers engaged in this enquiry to understand the value and the significance of the various parts of the investigation that each has to perform and especially for the Magistrate to know how his decision is to be modified by the way in which the investigation has been conducted.

The proof of poisoning, though it may be clear by other evidence depends mainly on establishing the cause of certain symptoms or of death that is, it rests principally on scientific evidence. Of this evidence there are three parts,—the symptoms, the *post-mortem* appearances if death occurred, and the chemical evidence from the proper investigation and correlation of which the unknown cause may be established.

II. Evidence as to Symptoms in Europe.—In Europe there is a class of qualified medical practitioners, diffused almost universally, who certify to the causes of death, the public registration of which is compulsory. When a person is seized with sudden illness followed or not by death, there is almost always a medical attendant, sufficiently skilled in diagnosis to recognise the symptoms as those of some known disease or, if not, he is able in one class of cases to give an opinion that those symptoms are not those of any known disease, but that they are those of certain injury or poison, or certain class of poisons ; while in another class of cases he may only be able to say that they may possibly be those of a certain disease, but that they suspiciously resemble those of some poison or injury.

III. Evidence as to Symptoms in India.—In India, qualified practitioners not being generally diffused among the people, the causes of sudden illness or death are not recognised by the ignorant relations and attendants. In this way many cases of disease, may be attributed to poison or

injury or witchcraft and from ignorance, doubt or enmity, be reported to the police. On the other hand cases of real poison may be passed over as cases of disease. This part of the investigation has generally to be conducted by police who cannot be supposed to be skilled in the observation and estimation of symptoms. In addition, they have to get an account of the symptoms after they have occurred and from ignorant witnesses, and they have to contend with a difficulty in getting them to speak the truth unknown in Europe. The evidence so far is, therefore, greatly defective and must be so till there will be a class of practitioners spread among the people sufficiently skilled to certify to the causes of deaths. In all possible cases the police should have the assistance or advice of a medical officer, and the evidence of attendant hakims, who often show considerable acuteness in observation, should be taken down and signed by them.

IV. Post-mortem Examination in Europe.—The second part of the investigation, the *post-mortem* examination, is generally made in Europe, by the medical attendant along with another doctor. In one class of cases an opinion can be affirmed that the *post-mortem* appearances are, or are not, those of the suspected disease, but they are not, or are, those of the suspected injury, poison, or class of poisons. In another in which the *post-mortem* appearances are not so diagnostic, an opinion can only be given, expressing probability or uncertainty.

V. Post-mortem Examination in India.—In India the evidence from *post-mortem* examination is also generally less definite from various causes. Not only is the evidence regarding symptoms, which ought to guide in distinguishing suspected and possible causes of death being numerous, it is in such cases only possible to give an opinion of certainty or probability when marked and profound lesions are left by disease, injury, and poison, and there is a chance of uncommon lesions or slight appearances which might prove important in evidence being overlooked. Again, the body often reaches the medical officer advanced in decomposition when the slighter appearances left by disease, injury or poison, may not be recognisable. But in all cases it is distinctly to be understood that the examination should be made, as even in such cases many causes of death may be established or negatived. Also in all cases a complete and not a partial examination is more necessary in this country on account of the imperfectness of the preliminary evidence as to the possible causes of death Different causes may afterwards be suggested in the evidence regarding which judicial enquiries may be made.

In order to render this part of the evidence more definite and valuable,

it is necessary that the police, in handing over the body for examination, should, at the same time hand over an account of all that is known as to the suspicious circumstances of death, and it should be noted by the medical officer whether he was in possession of this information or not when making the *post-mortem* examination.

VI. **Chemical Evidence in Europe.**—In Europe the third part of the evidence—the chemical—is one of the most definite in its results. The symptoms and *post-mortem* appearances recorded by duly qualified and informed observers are laid before the Chemical Examiner, and the question asked is whether one poison, or at most one of a class of poisons, be present in the substances sent; and he certifies the presence or absence of those of the poisons indicated, which can be identified by chemistry.

VII. **Chemical Evidence in India.**—In India from the imperfectness of the preceding evidence, the problem proposed is more indeterminate and often insoluble. As a general rule substances have hitherto been sent for analysis with no information as to what poisons might possibly have been used. This problem, which is seldom met with in a life time by an expert in Europe, resolves itself into a search for the poisons commonly used in the country, unless some suspicious appearances or particles lead to a conjuncture in another direction. The number of substances that may cause death being practically indefinite, it would be impossible, with a limited amount of material and time, to attempt anything else.

VIII. **Position of Magistrate in England.**—The position of Magistrate as regards the scientific witness differs in India and England. In England the scientific witnesses are really cross-examined by the defence both as to the facts they have observed and the opinions they bring forward, and similar witnesses may be brought forward to challenge their statement.

IX. **Position of Magistrate in India.**—In India this is very seldom possible. The Civil Medical Officer has practically functions rather resembling those entrusted to him in some countries of Europe He is a government official charged with the investigation of facts regarding which he has to give evidence in the same way as the Police officer. In addition he has to interpret to the court the precise value, significance and limits of the scientific evidence, and it is his duty to bring forward with judicial carefulness any conclusions or opinions connected with the facts. In India, also it is physically impossible for the Chemical Examiner to be cross-examined, and his evidence has therefore to be taken without any other proof of attestation than his signature. He should, therefore, restrict himself to a statement of observed or demonstrated facts, and should on no

account, make mention of probabilities or opinions, unless specially asked; but it is his duty to reply to any questions regarding the meaning or limits of the scientific evidence which the local medical officer may wish to be referred or which the court may choose to propose.

X. Estimation of the Value of the Evidence.—If the cause of death be not satisfactorily proved by the scientific evidence, the Magistrate has to consider to what extent it proves or disproves anything. It is purely negative in value in the case of poisons not detectable by chemistry which do not produce symptoms and *post-mortem* appearances distinguishable with certainty from those of disease or injury. It is also negative in the case of detectable poisons of which the symptoms and *post-mortem* appearances alone are not decisive, when the Chemical Examiner has not been led to examine for those poisons. In this class of cases the proof principally depends on whether the medical officer was in possession of the suspicious circumstances of death when making the *post-mortem* examination and whether the Chemical Examiner knew both these when examining for poisons. If the latter had no information he could not certify to the absence of common poisons; and it is to be remarked that the large number of poisoning cases proved in this country is due to the ignorance of the natives of India and that as intelligence spreads, uncommon poisons will be used more frequently.

XI. Meaning of "No Poison Found."—If no poison has been found, it should be noted that it may have been administered in the following cases:—

1st.—If a poison has been given for which there are no chemical tests. 2nd.—If a detectable poison were used for which the Chemical Examiner was not led to examine. 3rd.—If a volatile poison has been used which has been placed in circumstances in which it might have volatilized. 4th.—If certain organic poisons have been used, and a sufficient time has elapsed for their decomposition. 5th—In the case of most organic poisons it is only the part left in the stomach after death that can be discovered, that which is absorbed into the stomach becomes chemically changed; so that it is really the part that does not cause death that is detected. Consequently if the stomach has been well cleared out by the stomach pump or vomiting or if sufficient time has elapsed before death to allow the poison to be absorbed, none may be detected. 6th.—Even in the case of metallic poisons which can be detected after absorption, if sufficient time (three weeks to a month) elapse before death, the whole of the poison may be eliminated from the system by the kidneys, etc.; and the patient may die from the lesions caused by the poison.

APPENDIX VII.

INDIAN EVIDENCE ACT.

(ACT I OF 1872.)

Definition.—Evidence means and includes—

(1) All statements which the Court permits or requires to be made before it by witnesses, in relation to matters of fact under inquiry; such statements are called oral evidence.

(2) All documents produced for the inspection of the Court; such documents are called documentary evidence.

SEC. 32. Statements written or verbal, of relevant facts made by a person who is dead, or who cannot be found, or who has become incapable of giving evidence, or whose attendance cannot be procured without an amount of delay or expense which under the circumstances of the case appears to the Court unreasonable, are themselves relevant facts.

SEC. 33. Evidence given by a witness in a judicial proceeding, or before any person authorized by law to take it, is relevant for the purpose of proving, in a subsequent judicial proceeding, or in a later stage of the same proceeding, the truth of the facts which it states, when the witness is dead or cannot be found or is incapable of giving evidence, or is kept out of the way by the adverse party, or if his presence cannot be obtained without an amount of delay or expense which, under the circumstances of the case, the Court considers unreasonable.

Provided—

that the proceeding was between the same parties or their representatives in interest;

that the adverse party in the first proceeding had the right and opportunity to cross-examine;

that the questions in issue were substantially, the same in the first as in the second proceeding.

SEC. 45. OPINIONS OF EXPERTS.—When the court has to form an opinion upon a point of foreign law, or of science or art, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting or finger impressions, are relevant facts. Such persons are called experts.

SEC. 46. FACTS BEARING UPON OPINIONS OF EXPERTS.—Facts not otherwise relevant, are relevant if they support or are inconsistent with the opinions of experts, when such opinions are relevant.

SEC. 59. PROOF OF FACTS BY ORAL EVIDENCE.—All facts, except the contents of documents may be proved by oral evidence.

SEC. 60. ORAL EVIDENCE MUST BE DIRECT.—Oral evidence must, in all cases whatever, be direct; that is to say—

if it refers to a fact which could be seen, it must be the evidence of a witness who says he saw it;

if it refers to a fact which could be heard, it must be the evidence of a witness who says he heard it;

if it refers to a fact which could be perceived by any other sense or in any other manner, it must be the evidence of a witness who says he perceived it by that sense or in that manner;

if it refers to an opinion or to the grounds on which that opinion is held, it must be the evidence of the person who holds that opinion on those grounds:

Provided that the opinions expressed in any treatise commonly offered for sale, and the grounds on which such opinions are held, may be proved by the production of such treatises if the author is dead or cannot be found, or has become incapable of giving evidence, or cannot be called as a witness without an amount of delay or expense which the Court regards as unreasonable:

Provided also that, if oral evidence refers to the existence or condition of any material thing other than a document, the Court may, if it thinks fit, require the production of such material thing for its inspection.

SEC. 61. PROOF OF CONTENTS OF DOCUMENTS..—The contents of documents may be proved either by primary or by secondary evidence.

SEC. 62. PRIMARY EVIDENCE.—Primary evidence means the document itself produced for the inspection of the Court.

SEC. 63. SECONDARY EVIDENCE.—Secondary evidence means and includes:—

1. Certified copies given under the provisions hereinafter contained;
2. Copies made from the original by mechanical processes which in themselves insure the accuracy of the copy, and copies compared with such copies;
3. Copies made from or compared with the original;
4. Counterparts or documents as against the parties who did not execute them;

5. Oral accounts of the contents of a document given by some person who has himself seen it.

SEC. 107 When the question is whether a man is alive or dead, and it is shown that he was alive within thirty years; the burden of proving that he is dead is on the person who affirms it.

SEC. 108. [Provided that when] the question is whether a man is alive or dead, and it is proved that he has not been heard of for seven years by those who would naturally have heard of him if he had been alive, the burden of proving that he is alive is [shifted to] the person who affirms it.

SEC. 112. The fact that any person who was born during the continuance of a valid marriage between his mother and any man or within 280 days after its dissolution, the mother remaining unmarried, shall be conclusive proof that he is the legitimate son of that man, unless it can be shown that the parties to the marriage had no access to each other any time when he could have been begotten.

OF WITNESSES.

SEC. 118. WHO MAY TESTIFY.—All persons shall be competent to testify unless the court considers that they are prevented from understanding the questions put to them, or from giving rational answers to those questions, by tender years, extreme old age, disease, whether of body or mind, or any other cause of the same kind.

Explanation.—A lunatic is not incompetent to testify, unless he is prevented by his lunacy from understanding the questions put to him and giving rational answers to them.

SEC. 119. DUMB WITNESS.—A witness who is unable to speak may give his evidence in any other manner in which he can make it intelligible, as by writing, or by signs; but such writing must be written and the signs made in open court. Evidence so given shall be deemed to be oral evidence.

SEC. 124. OFFICIAL COMMUNICATION.—No public officer shall be compelled to disclose communications made to him in official confidence, when he considers that the public interests would suffer by the disclosure.

SEC. 126 PROFESSIONAL COMMUNICATION.—No barrister, attorney, pleader, or vakil shall at any time be permitted, unless with his client's express consent to disclose any communication made to him in the course and for the purpose of his employment as such barrister, attorney, pleader or vakil, by or on behalf of his client, or to state the contents or condition of any document with which he has become acquainted in the course and for the purpose of his professional employment,

or to disclose any advice given by him to his client in the course and for the purpose of such employment.

Provided that nothing in this section shall protect from disclosure

(1) any such communication made in furtherance of any illegal purpose;

(2) any fact observed by any barrister, pleader, attorney or vakil, in the course of his employment as such, showing that any crime or fraud has been committed since the commencement of his employment.

It is immaterial whether the attention of such barrister, pleader, attorney, or vakil was or was not directed to such fact by or on behalf of his client.

Explanation.—The objection stated in this section continues after the employment has ceased.

SEC. 132. WITNESS NOT EXCUSED FROM ANSWERING ON GROUND THAT ANSWER WILL CRIMINATE.—A witness shall not be excused from answering any question as to any matter relevant to the matter in issue in any suit or in any civil or criminal proceeding, upon the ground that the answer to such question will criminate or may tend directly or indirectly to criminate such witness, or that it will expose, or tend directly or indirectly to expose, such witness to a penalty or forfeiture of any kind: Provided that no such answer which a witness shall be compelled to give, shall subject him to any arrest or prosecution, or be proved against him in any criminal proceeding, except a prosecution for giving false evidence by such answer.

SEC. 137. EXAMINATION-IN-CHIEF.—The examination of a witness by the party who calls him shall be called his examination-in-chief.

Cross-Examination.—The examination of a witness by the adverse party shall be called his cross-examination.

Re-Examination.—The examination of a witness, subsequent to the cross-examination by the party who called him shall be called his re-examination.

SEC. 138. ORDER OF EXAMINATIONS.—Witnesses shall be first examined-in-chief, then—if the adverse party so desires—cross-examined, then—if the party calling him so desires—re-examined.

The examination and cross-examination must relate to relevant facts, but the cross-examination need not be confined to the facts to which the witness testified on his examination-in-chief.

Direction of Re-examination.—The re-examination shall be directed to the explanation of matters referred to in cross-examination, and if

new matter is, by permission of the court, introduced in re-examination, the adverse party may further cross-examine upon that matter.

SEC. 141. LEADING QUESTIONS.—Any question suggesting the answer which the person putting it wishes or expects to receive is called a leading question.

SEC. 142. WHEN THEY MUST NOT BE ASKED..—Leading questions must not, if objected to by the adverse party, be asked in an examination-in-chief, or in a re-examination, except with the permission of the Court.

The Court shall permit leading questions as to matters which are introductory or undisputed, or which have, in its opinion, been already sufficiently proved.

SEC. 143. WHEN THEY MAY BE ASKED.—Leading questions may be asked in cross-examination.

SEC 146. QUESTIONS LAWFUL IN CROSS-EXAMINATION.—When a witness is cross-examined, he may in addition to the questions hereinbefore referred be asked any questions which tend

(1) to test his veracity,

(2) to discover who is and what is his position in life,

(3) to shake his credit, by injuring his character, although the answer to such question might tend directly or indirectly to expose him to a penalty or forfeiture.

SEC. 152. QUESTIONS INTENDED TO INSULT OR ANNOY.—The court shall forbid any question which appears to it to insult or annoy, or which though proper in itself, appears to the court needlessly offensive in form.

SEC. 159. REFRESHING MEMORY.—A witness may, while under examination, refresh his memory by referring to any writing made by himself at the time of the transaction concerning which he is questioned, or so soon afterwards that the court considers it likely that the transaction was at that time fresh in his memory.

The witness may also refer to any such writing made by any other person, and read by the witness within the time aforesaid, if when he read it, he knew it to be correct.

Whenever a witness may refresh his memory by reference to any document, he may, with the permission of the court, refer to a copy of such document.

Provided the court be satisfied that there is sufficient reason for the non-production of the original.

An expert may refresh his memory by reference to professional treatises.

SEC. 160. TESTIMONY TO FACTS STATED IN DOCUMENNT MENTION-

ED IN SECTION 159.—A writing may also testify to facts, mentioned in any such document in section 159, although he has no specific recollection of the facts themselves if he is sure that the facts were correctly recorded in the document.

SEC. 161. RIGHT OF ADVERSE PARTY AS TO WRITING USED TO REFRESH MEMORY.—Any writing referred to under the provisions of the two last preceding sections must be produced and shown to the adverse party if he requires it ; such party may, if he pleases, cross-examine the witness thereupon.

SEC. 165. JUDGE'S POWER TO PUT QUESTIONS OR ORDER PRODUCTION.—The judge may, in order to discover or to obtain proper proof of relevant facts, ask any question he pleases, in any form, at any time, of any witness, or of the parties about any fact relevant or irrelevant ; and may order the production of any document or thing ; and neither the parties nor their agents shall be entitled to make any objection to any such question or order, nor without the leave of the court, to cross-examine any witness upon any answer given in reply to any such question :

Provided that the judgment must be based upon facts declared by this Act to be relevant, and duly proved :

Provided also that this section shall not authorize any Judge to compel any witness to answer any question, or to produce any document which such witness would be entitled to refuse to answer or produce under sections 121 to 131, both inclusive, if the question were asked or the document were called for by the adverse party; nor shall the Judge ask any question which it would be improper for any other person to ask under section 148 or 149 ; nor shall he dispense with primary evidence any document, except in the cases hereinbefore excepted.

SEC. 166. POWER OF JURY OR ASSESSORS TO PUT QUESTIONS.—In cases tried by jury or with assessors, the jury or assessors, may put any questions to the witnesses, through or by leave of the judge, which the judge himself might put and which he considers proper.

APPENDIX VIII.

THE CODE OF CRIMINAL PROCEDURE.

(ACT V. OF 1898.)

SECTION 4. *(f)* "Cognizable offence" means an offence for, and "cognizable case" means a case in, which a police officer, within or without the presidency towns, may, in accordance with the second schedule, or under any law for the time being in force, arrest without warrant.

SEC. 6. CLASSES OF CRIMINAL COURTS,—Besides the High Courts and the Courts constituted under any law other than this Code for the time being in force, there shall be five classes of Criminal Courts in British India, namely :—

I.—Courts of Session.

II.—Presidency Magistrates.

III.—Magistrates of the first class.

IV.—Magistrates of the second class.

V.—Magistrates of the third class.

SEC. 31. SENTENCES WHICH HIGH COURTS AND SESSIONS JUDGES MAY PASS.—(1) A High Court may pass any sentence authorized by law.

(2) A Sessions Judge of Additional Sessions Judge may pass any sentence authorized by law, but any sentence of death passed by any such Judge shall be subject to confirmation by the High Court.

(3) An Assistant Sessions Judge may pass any sentence authorized by law, except a sentence of death or transportation for a term exceeding seven years, or of imprisonment for a term exceeding seven years.

32. *Sentences which Magistrates may pass.*—(1) The Courts of Magistrates may pass the following sentences, namely :

(a) Courts of Presidency Magistrates and Magistrates of the first class.	Imprisonment for a term not exceeding two years, including such solitary confinement as is authorized by law. Fine not exceeding one thousand rupees. Whipping.
(b) Courts of Magistrates of the second class.	Imprisonment for a term not exceeding six months, including such solitary confinement as is authorized by law Fine not exceeding two hundred rupees. Whipping (if specially empowered).

(*c*) Courts of Magistrates of the third class. { Imprisonment for a term not exceeding one month. Fine not exceeding fifty rupees.

(2) The Court of any Magistrate may pass any lawful sentence, combining any of the sentences which it is authorized by law to pass.

(3) No Court of any Magistrate of the second class shall pass a sentence of whipping unless it is specially empowered in this behalf by the Local Governnmet.

SEC. 57. IMPRISONMENT.—There are two grades of imprisonment, *viz.*, vigorous (hard labour) and simple. Hard labour consists chiefly in grinding corn, oil pressing, soorkhi pounding paper pounding and polishing, digging and carrying earth, drawing water, cutting firewood, latrine work, bowing wool, blacksmith's work, etc. Simple imprisonment means nothing more than confinement in jail, subject to the jail rules as to diet, etc., and prisoners undergoing such a sentence cannot lawfully be put to any work against their will. There is, however, no objection to their being employed on any trade or occupation permitted by the jail rules, if they, of their own free will, express their desire for employment.

SEC. 61. WHIPPING.—In the Indian Act there is no provision as to how the punishment of whipping has to be inflicted on youthful offenders, but the Local Government is authorized to prescribe it. According to the English law whipping has to be carried out in private by a policeman in the presence of an Inspector and the number of stripes to be inflicted have been fixed according to the age. Thus six stripes for a child of six, twelve for a boy under fourteen.

THE POWERS OF POLICE TO INVESTIGATE.

SEC. 160 POLICE-OFFICERS' POWER TO REQUIRE ATTENDANCE OF WITNESSES.—Any police officer making an investigation under this Chapter may, by order in writing, require the attendance before himself of any person being within the limits of his own or any adjoining station who, from the information given or otherwise, appears to be acquainted with the circumstances of the case, and such person shall attend as so required.

SEC. 161. EXAMINATION OF WITNESSES BY POLICE.—Any police officer making an investigation under this Chapter (power to investigate) may examine orally any person supposed to be acquainted with the facts and circumstances of the case.

(2) Such person shall be bound to answer all questions relating to such case put to him by such officer, other than questions the answers to

which would have a tendency to expose him to a criminal charge or to a penalty of forfeiture.

SEC. 164. POWER TO RECORD STATEMENTS AND CONFESSIONS.—Every Magistrate not being a police-officer may record any statement or confession made to him in the course of an investigation under this Chapter or at any time afterwards before the commencement of the inquiry or trial.

(2) Such statements shall be recorded in such of the manners hereinafter prescribed for recording evidence as is, in his opinion, best fitted for the circumstances of the case. Such confessions shall be recorded and signed in the manner provided in section 364 and such *statements and confessions* shall then be forwarded to the Magistrate by whom the case is to be inquired into or tried.

(3) No Magistrate shall record any such confession upon questioning the person making it, if he has reason to believe that it was not made voluntarily; and when he records any confession, he shall make a memorandum at the foot of such record to the following effect :—

"I believe that this confession was voluntarily made. It was taken in my presence and hearing, and was read over to the person making it and admitted by him to be correct, and it contains a full and true account of the statement made by him.

(Signed) A. B.
Magistrate."

174. POLICE TO INQUIRE AND REPORT ON SUICIDE, ETC.—The officer in charge of a police-station, or some other police-officer specially empowered by the Local Government in that behalf, on receiving information that a person—

(*a*) has committed suicide, or

(*b*) has been killed by another, or by an animal, or by machinery, or by an accident, or

(*c*) has died under circumstances raising a reasonable suspicion that some other person has committed an offence, shall immediately give intimation thereof to the nearest Magistrate empowered to hold inquests, and, unless otherwise directed by any rule prescribed by the Local Government, or by any general or special order of the District or Sub-divisional Magistrate, shall proceed to the place where the body of such deceased person is, and there, in the presence of two or more respectable inhabitants of the neighbourhood, shall make an investigation, and draw up a report of the apparent cause of death, describing such wounds, fractures, bruises and other marks of injury as may be found on the body,

and stating in what manner, or by what weapon or instrument (if any), such marks appear to have been inflicted.

(2) The report shall be signed by such police-officer and other persons, or by so many of them as concur therein, and shall be forthwith forwarded to the District Magistrate or the Sub-divisional Magistrate.

(3) When there is any doubt regarding the cause of death, or when for any other reason the police-officer considers it expedient so to do, he shall, subject to such rules as the Local Government may prescribe in this behalf, forward the body, with a view to its being examined, to the nearest Civil Surgeon, or other *qualified* medical man appointed in this behalf by the Local Government, if the state of the weather and the distance admit of its being so forwarded without risk of such putrefaction on the road as would render such examination useless.

(4) In the Presidencies of Fort St. George and Bombay, investigations under this section may be made by the head of the village, who shall then report the result to the nearest Magistrate authorized to hold inquests.

(5) The following Magistrates are empowered to hold inquests, namely, any District Magistrate or Sub-divisional Magistrate, and any Magistrate specially empowered in this behalf by the Local Government or the District Magistrate.

THE CORONER'S ACT.- In the Presidency towns of Bombay and Calcutta the Coroner's Act IV of 1871 is in force. The following are some of the sections of the Act in connection with the investigation.

8. *Jurisdiction to inquire into deaths.*—When a Coroner has reason to believe that the death of any person has been caused by accident, homicide, suicide, or suddenly by means unknown or that any person, being a prisoner has died in prison, and that the body is lying within the place for which the Coroner is so appointed, the Coroner shall enquire into the cause of death Every such enquiry shall be deemed a judicial proceeding within the meaning of section 193 of the Indian Penal Code.

9. *Coroner to be sent for when prisoner dies.*—Whenever a prisoner dies in a prison situate within the place for which a coroner is so appointed, the Superintendent of the prison shall send for the Coroner before the body is buried. Any Superintendent failing herein shall, on conviction before a Magistrate, be punished with fine not exceeding five hundred rupees. Nothing in the former part of this section applies to cases in which the death has been caused by cholera or other epidemic disease.

10. *Power to hold inquests on bodies within local limits wherever cause of death occurred.*—Whenever an inquest ought to be held on any body lying dead within the local limits of the jurisdiction of any Coroner,

he shall hold such inquest, whether or not the cause of death arose within his jurisdiction.

11. *Power to order body to be disinterred.*—A Coroner may order a body to be disinterred within a reasonable time after the death of the deceased person, either for the purpose of taking an original inquisition where none has been taken, or a further inquisition where the first was insufficient.

12. *Summoning jury.*—On receiving notice of any death mentioned in section 8, the Coroner shall summon five, seven, nine, eleven, thirteen, or fifteen respectable persons to appear before him at a time and place to be satisfied in the summons, for the purpose of enquiring when, how, and by what means the deceased came by his death. Any inquest under this Act may be held on a Sunday.

14. *Jurors to be sworn.*—When a sufficient jury is in attendance, he shall administer an oath to each juror to give a true verdict according to the evidence, and shall then proceed with the jury to view the body.

15. *View of the body.*—The Coroner and the jury shall view and examine the body at the first sitting of the inquest, and the Coroner shall make such observations to the jury as the appearance of the body requires.

17. *Summoning witnesses.*—It shall be the duty of all persons acquainted with the circumstances attending the death to appear before the inquest as witnesses; the Coroner shall enquire of such circumstances and the cause of death; and if, before or during the enquiry, he is informed that any person, whether within or without the local limits of his jurisdiction, can give evidence or produce any document material there to, may issue a summons requiring him to attend and give evidence or produce such document on the inquest.

18. *Post-mortem examinations: Fees to medical witnesses.*—The Coroner may direct the performance of a *post-mortem* examination, with or without an analysis of the contents of the stomach or intestines, by any medical witness summoned to attend the inquest; and every medical witness other than the Chemical Examiner to Government, shall be entitled to such reasonable remuneration as the Coroner thinks fit.

19. *Evidence to be on oath: Evidence on behalf of accused.*—All evidence given under this Act shall be on oath, and the Coroner shall be bound to receive evidence on behalf of the party (if any) accused of causing the death of the deceased person.

Questions suggested by jury.—After each witness has been examined, the Coroner shall enquire whether the jury wish any further questions to

be put to the witness ; and if the jury wish that any such questions should be put, the Coroner shall put them accordingly.

20. *Coroner to take down evidence in writing.*—The Coroner shall commit to writing the material parts of the evidence given to the jury, and shall read or cause to be read over such parts to the witness, and then procure his signature thereto.

22. *Coroner to sum up to jury.*—When all the witnesses have been examined, the Coroner shall sum up the evidence to the jury, and the jury shall then consider their verdict.

23. *Coroner to draw up inquisition.*—When the verdict is delivered, the Coroner shall draw up the inquisition according to the finding of the jury, or when the jury is not unanimous, according to the opinion of the majority.

24. *Contents of inquisitions.*—Every inquisition under this Act shall be signed by the Coroner with his name and style of office and by the jurors, and shall set forth—(1) where, when, and before whom, the inquisition is holden, (2) who the deceased is, (3) where his body lies, (4) the names of the jurors, and that they present the inquisition upon oath, (5) where, when, and by what means, the deceased came by his death, and (6) if his death was occasioned by the criminal act of another, who is guilty thereof. If the name of the deceased be unknown, he may be described as a certain person to the jurors unknown.

25. *Procedure where verdict amounts to murder, culpable homicide, or killing by negligence.*—When the verdict is that the death has been caused by culpable homicide amounting to murder, or by culpable homicide not amounting to murder, or by a rash or negligent act not amounting to culpable homicide, the Coroner shall bind by recognizance any person knowing or declining anything material touching such murder, homicide, or act, to appear at the next criminal sessions at which the trial is to be, then and there to prosecute or give evidence against the party charged.

28. *Warrant for burial.*—When the proceedings are closed, or before, if it be necessary to adjourn the inquest, the Coroner shall give his warrant for the burial of the body on which the inquest has been taken.

SEC. 176. INQUIRY BY MAGISTRATE INTO CAUSE OF DEATH.—(1) When any person dies while in the custody of the police, the nearest Magistrate empowered to hold inquests shall, and, in any other case mentioned in section 174, clauses (*a*), (*b*) and (*c*) of sub-section (1), any Magistrate so empowered may, hold an inquiry in to the cause of death, either instead of, or in addition to, the investigat n held by the police-officer ; and, if he does

so, he shall have all the powers in conducting it which he would have in holding an inquiry into an offence. The Magistrate holding such an inquiry shall record the evidence taken by him in connection therewith in any of the manners hereinafter prescribed according to the circumstances of the case.

(2) *Power to disinter corpses.*—Whenever such Magistrate considers it expedient to make an examination of the dead body of any person who has already been interred, in order to discover the cause of his death, the Magistrate may cause the body to be disinterred and examined.

SEC. 267. TRIALS BEFORE HIGH COURT TO BE BY JURY.—All trials under this Chapter before a High Court shall be by jury ; and, notwithstanding any thing herein contained, in all criminal cases transferred to a High Court under this Code or under the Letters Patent of any High Court established under the Indian High Court Act, 1861, the trial may, if the High Court so directs, be by jury.

SEC. 268. TRIALS BEFORE COURTS OF SESSION TO BE BY JURY OR WITH ASSESSORS.—All trials before a Court of Session shall be either by jury, or with the aid of assessors.

SEC. 269. LOCAL GOVERNMENT MAY ORDER TRIALS BEFORE COURT OF SESSION TO BE BY JURY.——(1) The local Government may, with the previous sanction of the Governor-General-in-Council, by the order of the official Gazette, direct that the trial of all offences, or of any particular class of offences, before any Court of Session, shall be by jury in any district and may, with like sanction, revoke or alter such order.

(2) *The Local Government, by like order may also declare that, in the case of any district in which the trial of any offence is to be by jury, the trial of such offences shall, if the Judge, on application made to him or of his own motion, so directs, be by jurors summoned from a special jury list, and may revoke or alter such order.*

(3) When the accused is charged at the same trial with several offences of which some are and some are not triable by jury, he shall be tried by jury, and by the Court of Session, with the aid of the jurors as assessors, for such of them as are not triable by jury.

SEC. 274. NUMBER OF JURY.—In trials before the High Court the jury shall consist of nine persons.

(1) In trials by jury before the Court of Session the jury shall consist of such uneven number, not being less than three, or more than nine, as the Local Government, by order applicable to any particular district or to any particular class of offences in that district, may direct.

SEC. 276. JURORS TO BE CHOSEN BY LOT.—The jurors shall be chosen

by lot from the persons summoned to act as such, in such manner as the High Court may from time to time by rule direct.

Provided that—

First, pending the issue under this section of rules for any Court, the practice now prevailing in such Court in respect of choosing of jurors shall be followed;

Secondly, in case of a deficiency of persons summoned, the number of jurors required may, with the leave of the Court, be chosen from such other persons as may be present;

Thirdly, in the presidency-towns (a) if the accused person is charged with having committed an offence punishable with death, or

(b) if in any other case a Judge of the High Court so directs, the jurors shall be chosen from the special jury list hereinafter prescribed; and

Fourthly, in any district for which the Local Government has declared that the trial of certain offences may be by special jury, the jurors shall in any case in which the Judge so directs be chosen from the special jury list prescribed in section 325.

SEC. 280. FOREMAN OF JURY.—(1) When the jurors have been chosen, they shall appoint one of their number to be foreman.

(2) The foreman shall preside in the debates of the jury, deliver the verdict of the jury, and ask any information from the Court that is required by the jury or any of the jurors.

(3) If a majority of the jury do not, within such time as the Judge thinks reasonable, agree in the appointment of a foreman, he shall be appointed by the Court.

SEC. 284. ASSESSORS HOW CHOSEN.—When the trial is to be held with the aid of assessors, two or more shall be chosen, as the Judge thinks fit, from the persons summoned to act as such.

SEC. 305. VERDICT IN HIGH COURT WHEN TO PREVAIL.—(1) When in a case tried before a High Court, the jury are unanimous in their opinion, or when as many as six are of one opinion and the Judge agrees with them the Judge shall give judgment in accordance with such opinion.

(2) When in any such case the jury are satisfied that they will not be unanimous, but six of them are of one opinion, the foreman shall so inform the Judge.

(3) If the Judge disagrees with the majority, he shall at once discharge the jury.

(4) If there are not so many as six who agree in opinion, the Judge shall, after the lapse of such time as he thinks reasonable, discharge the jury.

SEC. 306. VERDICT IN COURT OF SESSION.—(1) When in a case tried before the Court of Session the Judge does not think it necessary to express disagreement with the verdict of the jurors or of a majority of jurors, he shall give judgment accordingly.

(2) If the accused is acquitted, the Judge shall record judgment of acquittal. If the accused is convicted, the Judge shall pass sentence on him according to law.

SEC. 307. PROCEDURE WHERE SESSIONS JUDGE DISAGREES WITH VERDICT.—(1) If in any such case the Judge disagrees with the verdict of the jurors, or of a majority of the jurors, on all or any of the charges on which the accused has been tried, *and is clearly of opinion that it is* necessary for the ends of justice to submit to the High Court, he shall submit the case accordingly, recording the grounds of his opinion, and when the verdict is one of acquittal, stating the offence which he considers to have been committed.

(2) Whenever the Judge submits a case under this section, he shall not record judgment of acquittal or of conviction on any of the charges on which the accused has been tried, but he may either remand the accused to custody or admit him to bail.

(3) In dealing with the case so submitted the High Court may exercise any of the powers which it may exercise on an appeal, and subject thereto it shall after considering the entire evidence and after giving due weight to the opinions of the Sessions Judge and the jury, acquit or convict the accused of any offence of which the jury could have convicted him upon the charge framed and placed before it, and, if it convicts him, may pass such sentence as might have been passed by the Court of Session.

SEC. 309. DELIVERY OF OPINIONS OF ASSESSORS.——(1) When, in a case tried with the aid of assessors, the case for the defence and the prosecutors reply (if any) are concluded, the Court may sum up the evidence for the prosecution and defence, and shall then require each of the assessors to state his opinion orally, and shall record such opinion.

(2) The Judge shall then give judgment, but in doing so shall not be bound to conform to the opinions of the assessors.

(3) If the accused is convicted, the Judge shall pass sentence on him according to law.

SEC. 312. NUMBER OF SPECIAL JURORS.—The names of not more than four hundred persons shall at any one time be entered in the special juror's list.

SEC. 320 EXEMPTIONS—The following persons are exempt from liability to serve as jurors or assessors, namely :—

(*a*) officers in civil employ superior in rank to a District Magistrate;

(*b*) *salaried* Judges;

(*c*) Commissioners and Collectors of revenue or customs;

(*d*) *police-officers* and persons engaged in the Preventive Service in the Customs Department;

(*e*) persons engaged in the collection of the revenue whom the Collector thinks fit to exempt on the ground of official duty;

(*f*) persons actually officiating as priests or ministers of their respective religions;

(*g*) persons in His Majesty's Army, except when, by any law in force for the time being, they are specially made liable to serve as jurors or assessors;

(*h*) surgeons and others who openly and constantly practise the medical profession;

(*i*) *legal practitioners* (*as defined by the Legal Practitioner's Act, 1879*), in actual practice;

(*j*) persons employed in the Post-Office and Telegraph Departments;

(*k*) persons exempted from personal appearance in Court under the provision of Civil Procedure, sections 640 and 641;

(*l*) other persons exempted by the Local Government from liability to serve as jurors or assessors.

SEC. 345. COMPOUNDING OFFENCES.—(1) The offences punishable under the sections of the Indian Penal Code such as 323, 334 are compoundable by the person to whom the hurt is caused.

(2) The offences of causing hurt and grievous hurt, punishable under section 324, section 325, section 335, section 337, or section 338 of the Indian Penal Code, may, with the permission of the Court before which any prosecution for such offence is pending, be compounded by the person to whom the hurt has been caused.

(3) When any offence is compoundable under this section, the abetment of such offence or an attempt to commit such offence (when such attempt is itself an offence) may be compounded in like manner.

(4) When the person who would otherwise be competent to compound an offence under the section is a minor, an idiot or a lunatic, any person competent to contract on his behalf may compound such offence.

(5) When the accused has been committed for trial or when he has been convicted and an appeal is pending, no composition for the offence shall be allowed without the leave of the Court to which he is committed, or, as the case may be, before which the appeal is to be heard.

(6) The composition of an offence under this section shall have the effect of an acquittal of the accused.

SEC. 374. SENTENCE OF DEATH TO BE SUBMITTED BY COURT OF SESSION.—When the Court of Session passes sentence of death, the proceedings shall be submitted to the High Court, and the sentence shall not be executed unless it is confirmed by the High Court.

SEC. 382. POSTPONEMENT OF CAPITAL SENTENCE ON PREGNANT WOMEN.—If a woman sentenced to death is found to be pregnant, the High Court shall order the execution of the sentence to be postponed, and may, *if it thinks fit*, commute the sentence to transportation for life.

SEC. 390. EXECUTION OF SENTENCE OF WHIPPING ONLY.—When the accused is sentenced to whipping only, the sentence shall be executed at such place and time as the Court may direct.

SEC. 391. EXECUTION OF SENTENCE OF WHIPPING, IN ADDITION TO IMPRISONMENT.—(1) When the accused is sentenced to whipping in addition to imprisonment in a case which is subject to appeal the whipping shall not be inflicted until fifteen days from the date of the sentence, or, if an appeal is made within that time until the sentence is confirmed by the Appelate Court, but the whipping shall be inflicted as soon as practicable after the expiry of the fifteen days, or, in case of an appeal, as soon as practicable after the receipt of the order of the Appellate Court confirming the sentence.

(2) The whipping shall be inflicted in the presence of the officer in the charge of the jail, unless the Judge or Magistrate orders it to be inflicted in his own presence.

(3) *No accused person shall be sentenced to whipping in addition to imprisonment when the term of imprisonment to which he is sentenced is less than three months.*

SEC. 392. MODE OF INFLICTING PUNISHMENT.—(1) In the case of a person of, or, over sixteen years of age, whipping shall be inflicted with a light ratan not less than half an inch in diameter, in such mode, and on such part of the person as the Local Government directs; and in the case of a person under sixteen years of age, it shall be *inflicted in such mode, and on such part of the person, and with such instrument, as the Local Government directs.*

(2) In no case shall such punishment exceed thirty stripes.

Paragraph 924 (VI-judicial (criminal) department) of the Manual of Government Orders provides that (1) all judicial whippings shall in future be inflicted in private, either at a jail or in an enclosure near the court house.

(2) Wherever it is possible to do so Magistrates shall secure the presence of a medical officer at the whipping.

Note.—The presence of a superior medical officer is not necessary at whipping. It will be sufficient if a competent sub-assistant Surgeon is present; but in any doubtful case the man to be whipped should be sent beforehand to the Civil Surgeon for inspection.

(3) The practice shall invariably be adopted of spreading a thin cloth soaked in some antiseptic cloth over the prisoner's buttocks during the operation.

(4) The cane employed shall never exceed the legal minimum of half inch in diameter in the case of persons over sixteen years of age; and in the case of juvenile offenders a still lighter cane shall be employed.

SEC. 393. NOT TO BE EXECUTED BY INSTALMENTS AND EXEMPTIONS.—No sentence of whipping shall be executed by instalments: and none of the following persons shall be punishable with whipping namely:—

(*a*) Females.

(*b*) Males sentenced to death, or to transportation or to penal servitude, or to imprisonment for more than five years.

(*c*) Males whom the Court considers to be more than forty-five years of age.

SEC. 394. WHIPPING NOT TO BE INFLICTED IF OFFENDER NOT IN A FIT STATE OF HEALTH.—(1) The punishment of whipping shall not be inflicted unless a medical officer, if present, certifies, or if there is not a medical officer present, unless it appears to the Magistrate or officer present, that the offender is in a fit state of health to undergo such punishment. (2) If, during the execution of a sentence of whipping, a medical officer certifies or it appears to the Magistrate or officer present, that the offender is not in a fit state of health to undergo the remainder of the sentence, the whipping shall be finally stopped.

SEC. 395. PROCEDURE IF PUNISHMENT CANNOT BE INFLICTED UNDER SECTION 394.—(1) In any case in which under section 394, a sentence of whipping is, wholly or partially, prevented from being executed, the offender shall be kept in custody till the Court which passed the sentence can revise it; and the said Court may, at its discretion, either remit such sentence or sentence the offender, in lieu of whipping, or in lieu of so much of the sentence of whipping as was not executed, to imprisonment for any term not exceeding twelve months, which may be in addition to any other punishment to which he may have been sentenced for the same offence. (2) Nothing in this section shall be deemed to authorize any Court to

inflict imprisonment for a term exceeding that to which the accused is liable by law, or that which the said Court is competent to inflict.

SEC. 399. CONFINEMENT OF YOUTHFUL OFFENDERS IN REFORMATORIES.—(1) When any person under the age of *fifteen* years is sentenced by any Criminal Court to imprisonment for any offence, the Court may direct that such person, instead of being imprisoned in a criminal jail, shall be confined in any reformatory established by the Local Government as a fit place for confinement, in which there are means of suitable discipline and of training in some branch of useful industry, or which is kept by a person willing to obey such rules as the Local Government prescribes with regard to the discipline and training of persons confined therein.

(2) All persons confined under this section shall be subject to the rules so prescribed

(3) *This section shall not apply to any place in which the Reformatory Schools Act, 1897, is for the time being in force.*

LUNATICS.

SEC. 464. PROCEDURE IN CASE OF ACCUSED BEING LUNATIC.—(1) When a Magistrate holding an inquiry or trial has reason to believe that the accused is of unsound mind and consequently incapable of making his defence, the Magistrate shall inquire into the fact of such unsoundness, and shall cause such person to be examined by the Civil Surgeon of the district or such other medical officer as the Local Government directs, and thereupon shall examine such surgeon or other officer as a witness, and shall reduce the examination to writing.

(2) If such Magistrate is of opinion that the accused is of unsound mind and consequently incapable of making his defence, he shall postpone further proceedings in the case.

SEC. 465. PROCEDURE IN CASE OF PERSON COMMITTED BEFORE COURT OF SESSION OR OF HIGH COURT BEING LUNATIC.—(1) If any person committed for trial before a Court of Session or a High Court, appears to the Court at his trial to be of unsound mind and consequently incapable of making his defence, the jury or the Court with the aid of assessors, shall, in the first instance, try the fact of such unsoundness and incapacity, and, if satisfied of the fact, shall pass judgment accordingly, and thereupon the trial shall be postponed.

(2) The trial of the fact of unsoundness of mind and incapacity of the accused shall be deemed to be part of his trial before the Court.

SEC 466. RELEASE OF LUNATIC PENDING INVESTIGATION OR TRIAL.—

(1) Whenever an accused person is found to be of unsound mind and incapable of making his defence, the Magistrate or Court, as the case may be, if the case is one in which bail may be taken, may release him on sufficient security being given that he shall be properly taken care of and shall be prevented from doing injury to himself or to any other person, and for his appearance when required before the Magistrate or Court or such officer as the Magistrate or Court appoints in this behalf.

(2) If the case is one in which bail may not be taken, or if sufficient security is not given, the Magistrate or Court shall report the case to the Local Government *remanding the accused to custody pending orders*, and the Local Government may order the accused to be confined in a lunatic asylum, jail or other suitable place of safe custody, and the Magistrate or Court shall give effect to such order.

SEC. 467. RESUMPTION OF INQUIRY OR TRIAL.—(1) Whenever an inquiry or trial is postponed under section 464 or section 465, the Magistrate or Court, as the case may be, may at any time resume the inquiry or trial, and require the accused to appear or be brought before such Magistrate or Court.

(2) When the accused has been released under section 466, and the sureties for his appearance produce him to the officer whom the Magistrate or Court appoints in this behalf, the certificate of such officer that the accused is capable of making his defence shall be receivable in evidence.

SEC. 468. PROCEDURE ON ACCUSED APPEARING BEFORE MAGISTRATE, OR COURT.—(1) If, when the accused appears or is again brought before the Magistrate or the Court, as the case may be, the Magistrate or Court considers him capable of making his defence, the inquiry or trial shall proceed.

(2) If the Magistrate or Court considers the accused person to be still incapable of making his defence, the Magistrate or Court shall again act according to the provisions of section 464 or section 465, as the case may be.

SEC. 469. WHEN ACCUSED APPEARS TO HAVE BEEN INSANE.—When the accused appears to be of sound mind at the time of inquiry or trial, and the Magistrate is satisfied from the evidence given before him that there is reason to believe that the accused committed an act which, if he had been of sound mind, would have been an offence, and that he was, at the time when the act was committed, by reason of unsoundness of mind, incapable of knowing the nature of the act, or that it was wrong or contrary to law, the Magistrate shall proceed with the case, and, if the accused ought to be committed to the Court of Session or High Court, send him

for trial before the Court of Session or High Court, as the case may be.

SEC. 470. JUDGMENT OF ACQUITTAL ON GROUND OF LUNACY.—Whenever any person is acquitted upon the ground that, at the time at which he is alleged to have committed an offence, he was, by reason of unsoundness of mind, incapable of knowing the nature of the act alleged as constituting the offence, or that it was wrong or contrary to law, the finding shall state specifically whether he committed the act or not.

SEC. 471. PERSON ACQUITTED ON SUCH GROUND TO BE KEPT IN SAFE CUSTODY.—(1) Whenever such judgment states that the accused person committed the act alleged, the Magistrate or Court, before whom or which the trial has been held shall, if such act would, but for the incapacity found, have constituted an offence, order such person to be kept in safe custody in such place and manner as the Magistrate or Court thinks fit, and shall report the case for the orders of the Local Government.

(2) The Local Government may order such person to be confined in a lunatic asylum, jail or other suitable place of safe custody.

(3) The Governor-General-in-Council may, *by general or special order*, direct that any person whom the Local Government has ordered to be confined in a lunatic asylum, jail or other place of safe custody, shall be removed from the place where he is confined, to any lunatic asylum, jail, or other place of safe custody in Brstish India.

(4) The Local Government may empower the officer in charge of the jail in which a person is confined under the provisions of section 466 or *this* section, to discharge all or any of the functions of the Inspector-General of Prisons under sections 472, section 473, or section 474.

SEC. 472. LUNATIC PRISONERS TO BE VISITED BY INSPECTOR-GENERAL.—When any person is confined under the provisions of section 466 or section 471, the Inspector-General of Prisons, if such person is confined in a jail, or the visitors of the lunatic asylum, or any two of them, if he is confined in a lunatic asylum, may visit him in order to ascertain his state of mind ; and he shall be visited once at least in every six months by such Inspector-General or by two such visitors as aforesaid ; and such Inspector-General or visitors shall make a special report to the Local Government as to the state of mind of such person.

SEC. 473. PROCEDURE WHERE LUNATIC PRISONER IS REPORTED CAPABLE OF MAKING HIS DEFENCE.—If such person is confined under the provisions of section 466, and such Inspector-General or visitors shall certify that, in his or their opinion, such person is capable of making his defence, he shall be taken before the Magistrate or Court, as the case may be, at

such time as the Magistrate or Court appoints, and the Magistrate or Court shall deal with such person under the provisions of section 468; and the certificate of such Inspector-General or visitors as aforesaid shall be receivable as evidence.

SEC. 474. PROCEDURE WHERE LUNATIC CONFINED UNDER SECTION 466 OR 471 IS DECLARED FIT TO BE DISCHARGED.—(1) If such person is confined under the provisions of section 466 or section 471, and such Inspector-General or visitors shall certify that, in his or their judgment, he may be discharged without danger of his doing injury to himself or to any other person the Local Government may there upon order him to be discharged, or to be detained in custody, or to be transferred to a public lunatic asylum if he has not been already sent to such an asylum; and in case it orders him to be transferred to an asylum, may appoint a Commission, consisting of a judicial and two medical officers.

(2) Such Commission shall make formal inquiry into the state of mind of such person, taking such evidence as is necessary, and shall report to the Local Government, which may order his discharge or detention as it thinks fit.

SEC. 475. DELIVERY OF LUNATIC TO CARE OF RELATIVE.—(1) Whenever any relative or friend of any person confined under the provisions of section 466 or section 471 desires that he shall be delivered over to his care and custody, the Local Government, upon the application of such relative or friend, and, on his giving security to the satisfaction of such Government that the person delivered shall be properly taken care of and shall be prevented from doing injury to himself or to any other person, may order such person to be delivered to such relative or friend.

(2) Whenever such person is so delivered, it shall be upon condition that he shall be produced for the inspection of such officer and at such times as the Local Government directs.

(3) The provisions of section 472 and 474 shall, *mutatis mutandis*, apply to persons delivered under the provisions of this section; and the certificate of the inspecting officer appointed under this section shall be receivable as evidence.

SEC. 509. DEPOSITION OF MEDICAL WITNESS.—(1) The deposition of a Civil Surgeon or other medical witness, taken and attested by a Magistrate in the presence of the accused, or taken on commission, may be given in evidence in any inquiry, trial or other proceeding under this Code, although the deponent is not called as a witness.

(2) The Court may, if it thinks fit, summon and examine such deponent as to the subject-matter of his deposition.

Note.—In order to ensure that the medical officer's deposition may, in all cases, be admissible under this section, the Magistrate must sign at the foot of it a certificate in the following form :—" The foregoing deposition was taken in the presence of the accused, who had an opportunity of cross-examining the witness. The deposition was explained to the accused, and was attested by me in his presence." This is, of course, necessary when the deposition is taken in an inquiry preparatory to the commitment to the Sessions. Where the attestation is wanting, the Sessions Judge should summon such witness to give his evidence.

SEC. 510. REPORT OF CHEMICAL EXAMINER.—Any document purporting to be a report under the hand of any Chemical Examiner or Assistant Chemical Examiner to Government, upon any matter or thing duly submitted to him for examination or analysis and report in the course of any proceeding under this Code, may be used as evidence in any inquiry, trial or other proceeding under this Code.

SEC 540. POWER TO SUMMON MATERIAL WITNESS, OR EXAMINE PERSON PRESENT.—Any Court may, at any stage of any inquiry, trial, or other proceeding under this Code, summon any person as a witness, or examine any person in attendance, though not summoned as a witness or recall and re-examine any person already examined, and the Court shall summon and examine or recall and re-examine any such person if his evidence appears to it essential to the just decision of the case.

SEC. 544. EXPENSES OF COMPLAINTS AND WITNESSES.—Subject to any rules made by the Local Government with the previous sanction of the Governor-General-in-Council, any Criminal Court may, *if it thinks fit*, order payment on the part of Government, of the reasonable expenses of any complainant or witness attending for the purpose of any inquiry, trial or proceeding before such Court under this Code

APPENDIX IX.

THE INDIAN PENAL CODE.

SECTION 32. *Words referring to acts include illegal omission.*—In every part of this code, except where a contrary intention appears from the context, words which refer to acts done extend also to illegal omissions. (An act includes illegal omissions, which must be intentional and conducive to bad or harmful result).

34. *Act done by several persons in furtherance of common intention.*—When a criminal act is done by several persons in furtherance of the common intention of all, each of such persons is liable for that act in the same manner, as if it were done by him alone.

44. *Injury.*—The word *injury* denotes any harm whatever illegally caused to any person in body, mind, reputation, or property.

51. *Oath.*—The word "oath" includes a solemn affirmation substituted by law for an oath, and any declaration required or authorized by law to be made before a public servant or to be used for the purpose of proof, whether in a Court of Justice or not.

52. *Good faith.*—Nothing is said to be done or believed in good faith which is done or believed without due care and attention.

53. *Punishments.*—The punishments to which offenders are liable under the provisions of this code are,—

First,—Death ;

Secondly,—Transportation ;

Thirdly,—Penal servitude ;

Fourthly,—Imprisonment, which is of two descriptions, namely :—

(1) Rigorous, that is, with hard labour.

(2) Simple.

Fifthly,—Forfeiture of property ;

Sixthly,—Fine.

Seventhly,—Whipping added by the Whipping Act as in the case of a "juvenile offender" who is under sixteen years.

80. *Accident in doing a lawful act.*—Nothing is an offence which is done by accident or misfortune, and without any criminal intention or knowledge in the doing of a lawful act in a lawful manner by lawful means and with proper care and caution.

81. Nothing is an offence merely by reason of its being done with the knowledge that it is likely to cause harm, if it be done without any criminal intention to cause harm, and in good faith for the purpose of preventing or avoiding other harm to person or property.

82. *Act of a child under seven years of age.*—Nothing is an offence which is done by a child under seven years of age.

83. *Act of a child above seven and under twelve, of immature understanding.*—Nothing is an offence which is done by a child above seven years of age and under twelve, who has not attained sufficient maturity of understanding to judge of the nature and consequences of his conduct on that occasion.

According to the English law 14 years is the limit instead of twelve; and it is left to the jury to decide whether the offence was committed by the prisoner and if so, whether at the time of the offence the prisoner had a guilty knowledge that he was doing wrong, if he was indicted for felony between 7 and 14 years of age. In cases of murder an infant may be convicted of the capital punishment, if it appeared to the court and jury and if it was proved that the infant could discern between good and evil.

84. *Act of a person of unsound mind.*—Nothing is an offence which is done by a person who, at the time of doing it, by reason of unsoundness of mind, is incapable of knowing the nature of the act, or that he is doing what is either wrong or contrary to law.

86. *Act of a person incapable of judgment by reason of intoxication caused against his will.*—Nothing is an offence which is done by a person who, at the time of doing it, is, by reason of intoxication, incapable of knowing the nature of the act, or that he is doing what is either wrong or contrary to law: provided that the thing which intoxicated him was administered to him without his knowledge or against his will.

87. *Act not intended and not known to be likely to cause death or grievous hurt done by consent.*—Nothing which is not intended to cause death, or grievous hurt, and which is not known by the doer to be likely to cause death, or grievous hurt, is an offence by reason of any harm which it may cause, or be intended by the doer to cause, to any person above eighteen years of age, who has given consent, whether express or implied, to suffer that harm; or by reason of any harm which it may be known by the doer to be likely to cause to any such person who has consented to take the risk of that harm.

88. *Act not intended to cause death, done by consent in good faith for person's benefit.*—Nothing which is not intended to cause death, is an offence by reason of any harm which it may cause, or be intended by the

doer to cause, or be known by the doer to be likely to cause, to any person for whose benefit it is done in good faith, and who has given a consent, whether express or implied, to suffer that harm, or to take the risk of that harm.

89. *Act done in good faith for the benefit of child or insane person, by or by consent of guardian.*—Nothing which is done in good faith for the benefit of a person under twelve years of age, or of unsound mind, by or by consent, either express or implied, of the guardian or other person having lawful charge of that person, is an offence by reason of any harm which it may cause, or be intended by the doer to cause, or be known by the doer to be likely to cause, to that person.

Provided—

First.—That this exception shall not extend to the intentional causing of death, or to the attempting to cause death ;

Secondly.—That this exception shall not extend to the doing of anything which the person doing it knows to be likely to cause death, for any purpose other than the preventing of death or grievous hurt, or the curing of any grievous disease or infirmity :

Thirdly.—That this exception shall not extend to the the abetment of any offence, to the committing of which offence it would not extend.

90. *Consent known to be given under fear or misconception.*—A consent is not such a consent as is intended by any section of this code, if the consent is given by a person under fear of injury, or under a misconception of fact, and if the person doing the act knows, or has reason to believe, that the consent was given in consequence of such fear or misconception ; if the consent is given by a person who from unsoundness of mind or intoxication, is unable to understand the nature and consequence of that to which he gives his consent, or, unless the contrary appears from the context, if the consent is given by a person who is under twelve years of age.

91. *Exclusion of acts which are offences independantly of harm caused.*—The exceptions in sections 87 and 88 and 89 do not extend to acts which are offences independantly of any harm which they may cause or be intended to cause, or be known to be likely to cause, to the person giving the consent, or on whose behalf the consent is given.

92. *Act done in good faith for the benefit of a person without consent.*—Nothing is an offence by reason of any harm which it may cause to a person for whose benefit, it is done in good faith, even without that person's consent, if the circumstances are such that it is impossible for that person to signify consent, or if that person is incapable of giving

consent, and has no guardian or other person in lawful charge of him from whom it is possible to obtain consent in time for the thing to be done with benefit : Provided—

First.—that this exception shall not extend to the intentional causing of death or the attempting to cause death ;

Secondly.—That this exception shall not extend to the doing of any thing which the person doing it knows to be likely to cause death, for any purpose other than the preventing of death or grievous hurt or the curing of any grievous disease or infirmity ;

Thirdly.—That this exception shall not extend to the voluntary causing of hurt, or to the attempting to cause hurt, for any purpose other than the preventing of death or hurt ;

Fourthly.—That this exception shall not extend to the abetment of any offence, to the committing of which offence it would not extend.

191. *Giving false evidence.*—Whoever being legally bound by an oath or by any express provision of law to state the truth, or being by law to make a declaration upon any subject, makes any statement which is false, and which he either knows or believes to be false, or does not believe to be true, is said to give false evidence.

192. *Fabricating false evidence.*—Whoever causes any circumstance to exist, or makes any false entry in any book or record, or makes any document containing a false statement, intending that such circumstance, false entry, or false statement may appear in evidence in a judicial proceeding, or in a proceeding taken by law before a public servant as such, or before an arbitrator, and that such circumstance, false entry, or false statement, so appearing in evidence, may cause any person who in such proceeding is to form an opinion upon the evidence, to entertain an erroneous opinion touching any point material to the result of such proceeding, is said to "fabricate false evidence".

284. *Negligent conduct with respect to poisonous substance.*—Whoever does, with any poisonous substance, any act in a manner so rash or negligent as to endanger human life, or to be likely to cause hurt or injury to any person or knowingly or negligently omits to take such order with any poisonous substance in his possession as is sufficient to guard against probable danger to human life from such poisonous substance, shall be punished with imprisonment of either description for a term which may extend to six months, or with fine which may extend to one thousand rupees or with both.

299. *Culpable Homicide.*—Whoever causes death by doing an act with the intention of causing death, or with the intention of causing such

bodily injury as is likely to cause death, or with the knowledge that he is likely by such act to cause death, commits the offence of culpable homicide.

300. *Murder.*—Except in cases hereinafter excepted, culpable homicide is murder, if the act by which the death is caused is done with the intention of causing death, or—

2ndly—If it is done with the intention of causing such bodily injury as the offender knows to be likely to cause the death of the person to whom the harm is caused, or—

3rdly.—If it is done with the intention of causing bodily injury to any person and the bodily injury intended to be inflicted is sufficient in the ordinary course of nature to cause death, or—

4thly.—If the person committing the act knows that it is so eminently dangerous that it must in all probability cause death, or such bodily injury as is likely to cause death, and commits such act without any excuse for incurring the risk of causing death or such injury as aforesaid.

Exception 1.—Culpable homicide is not murder if the offender, whilst deprived of the power of self control by grave and sudden provocation, causes the death of the person who gave the provocation, or causes the death of any other person by mistake or accident.

The above exception is subject to the following provisions :—

First.—That the provocation is not sought or voluntarily provoked by the offender as an excuse for killing or doing harm to any person.

Secondly.—That the provocation is not given by anything done in obedience to the law, or by a public servant in the lawful exercise of the powers of such public servant.

Thirdly.—That the provocation is not given by anything in the lawful exercise of the right of private defence.

Exception 2.—Culpable homicide is not murder if the offender, in the exercise in good faith of the right of private defence of person or property exceeds the power given to him by law and causes the death of the person against whom he is exercising such right of defence without premeditation, and without any intention of doing more harm than is for the purpose of such defence.

Exception 3.—Culpable homicide is not murder if the offender, being a public servant or aiding a public servant acting for the advancement of public justice, exceeds the powers given to him by law, and causes death by doing an act which he, in good faith, believes to be lawful

and necessary for the due discharge of his duty as such public servant and without ill-will towards the person whose death is caused.

Exception 4.—Culpable homicide is not murder if it is committed without premeditation in a sudden fight in the heat of passion upon a sudden quarrel and without the offender's having taken undue advantage or acted in a cruel or unusual manner.

Exception 5.—Culpable homicide is not murder when the person whose death is caused being above the age of eighteen years, suffers death or takes the risk of death with his own consent.

N. B. The law of British India, differing from the law of England, does not regard every case of homicide *as prima facie* murder ; it throws on the prosecution the burden of proving a certain intent or knowledge.

301. *Culpable homicide by causing death of person other than person whose death was intent.*—If a person, by doing anything which he intends or knows to be likely to cause death, commits culpable homicide by causing the death of any person, whose death he neither intends nor knows himself to be likely to cause, the culpable homicide committed by the offender is of the description of which it would have been if he had caused the death of the person whose death he intended or knew himself to be likely to cause.

302. *Punishment for murder.*—Whoever commits murder shall be punished with death, or transportation for life, and shall also be liable to fine.

303. *Punishment for murder for life-convict.*—Whoever, being under sentence of transportation for life, commits murder, shall be punished with death.

304. *Punishment for culpable homicide not amounting to murder.*—Whoever commits culpable homicide not amounting to murder, shall be punished with transportation for life, or imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine, if the act by which the death is caused is done with the intention of causing death, or of causing such bodily injury as is likely to cause death ; or with imprisonment with either description for a term which may extend to ten years, or with fine, or with both, if the act is done with the knowledge that it is likely to cause death, but without any intention to cause death or to cause such bodily injury as is likely to cause death.

304A. *Causing death by negligence.*—Whoever causes the death of any person by doing any rash or negligent act not amounting to culpable homicide shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both.

305. *Abetment of suicide of child or insane person.*—If any person under eighteen years of age, any insane person, any delirious person, any idiot, or any person in a state of intoxication commits suicide, whoever abets the commission of such suicide, shall be punished with death, or transportation for life, or imprisonment for a term not exceeding ten years, and shall also be liable to fine.

306. *Abetment of suicide.*—If any person commits suicide, whoever abets the commission of such suicide, shall be punished with imprisonment of either description for a term which may extend to ten years and also be liable to fine.

307. *Attempt to murder.*—Whoever does any act with such intention or knowledge and under such circumstances, that if he by that act caused death, he would be guilty of murder, shall be punished with imprisonment o either description for a term which may extend to ten years, and shall also be liable to fine; and if hurt is caused to any person by such act, the offender shall be liable either to transportation for life or to such imprisonment as is hereinbefore mentioned.

When any person offending under this section is under sentence of transportation for life, he may, if hurt is caused, be punished with death.

308. *Attempt to commit culpable murder.*—Whoever does any act with such intention or knowledge, and under such circumstances that, if he by that act caused death, he would be guilty of culpable homicide not amounting to murder. shall be punished with imprisonment of either description for a term which may extend to three years, or with fine, or with both; and if hurt is caused to any person by such act, shall be punished with imprisonment of either description for a term which may extend to seven years, or with fine, or with both.

309. *Attempt to commit suicide.*—Whoever attempts to commit suicide and does any act towards the commission of such offence, shall be punished with simple imprisonment for a term which may extend to one year, or with fine, or with both.

312. *Causing miscarriage.*—Whoever voluntarily causes a woman with child to miscarry, shall, if such miscarriage be not caused in good faith for the purpose of saving the life of the woman, be punished with imprisonment of either description for a term which may extend to three years, or with fine, or with both; and if the woman be quick with child, shall be punished with imprisonment of either description for a term which may extend to seven years, and shall also be liable to fine.

Explanation.—A woman who causes herself to miscarry is within the meaning of this section.

NOTE.—"*With child*" means pregnant, and it is not necessary to show that quickening, that is, perception by the mother of the movements of the fœtus has taken place, or that the embryo has assumed a fœtal form, the stage to which pregnancy has advanced and the form which the ovum or embryo may have assumed are immaterial.

Miscarriage means the premature expulsion of the child or fœtus from the mother's womb at any period of pregnancy, before the term of gestation is completed.

Quick with child.—when the woman has felt the child move within her.

313. *Causing miscarriage without woman's consent.*—Whoever commits the offence defined in the last preceding section without the consent of the woman, whether the woman is quick with child or not, shall be punished with transportation for life, or with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

314. *Death caused by act done with intent to cause miscarriage.*—Whoever with intent to cause the miscarriage of a woman with child, does any act which causes the death of such woman, shall be punished with imprisonment of either description for a term which may extend to ten years, and also be liable to fine, and if the act is done without the consent of the woman, shall be punished either with transportation of life, or with the punishment above mentioned :

Explanation.—It is not essential to this offence that the offender should know that the act is likely to cause death.

Even though the woman is not pregnant, yet if the death is caused by administering a drug under the belief that she was so, the offence will probably come under this section.

315. *Act done with intent to prevent child being born alive or to cause it to die after birth.*—Whoever before the birth of any child does any act with the intention of thereby preventing that child from being born alive or causing it to die after its birth, and does by such act prevent that child from being born alive, or causes it to die after its birth, shall, if such act be not caused in good faith for the purpose of saving the life of the mother, be punished with imprisonment of either description for a term which may extend to ten years, or with fine, or with both.

Cf. English law. If a person intending to procure abortion does an act which causes a child to be born so much earlier than the natural time, that it is born in a state much less capable of living, and afterwards dies in consequence of its exposure to the external world ; the person who by

this misconduct so brings the child into the world and puts it thereby in a situation in which it cannot live is guilty of murder; and the mere existence of a possibility that something might have been done to prevent the death will not render it less murder.

316. *Causing death of quick unborn child by act amounting to culpable homicide.*—Whoever does any act under such circumstances, that if he thereby caused death he would be guilty of culpable homicide, and does by such act cause the death of a quick unborn child, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

317. *Exposure and abandonment of child under twelve years, by parent or person having care of it.*—Whoever being the father or mother of a child under the age of twelve years, or having the care of such child, shall expose or leave such child in any place with the intention of wholly abandoning such child, shall be punished with imprisonment of either description for a term which may extend to seven years, or with fine, or with both.

Explanation.—This section is not intended to prevent the trial of the offender for murder or culpable homicide, as the case may be if the child die in consequence of the exposure.

318. *Concealment of birth by secret disposal of dead body.*—Whoever by secretly burying or otherwise disposing of the dead body of a child, whether such child die before or after or during its birth, intentionally conceals or endeavours to conceal the birth of such child, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine, or with both.

319. *Hurt.*—Whoever causes bodily pain, disease, or infirmity to any person is said to cause hurt.

320. *Grievous hurt.*—The following kinds of hurt only are designated as "grievous."—

First.—Emasculation.

Secondly.—Permanent privation of the sight of either eye.

Thirdly.—Permanent privation of the hearing of either ear.

Fourthly.—Privation of any member or joint.

Fifthly.—Destruction or permanent impairing of the powers of any member, or joint.

Sixthly.—Permanent disfiguration of the head or face.

Seventhly.—Fracture or dislocation of a bone or tooth.

Eighthly.—Any hurt which endangers, life or which causes the sufferer

to be, during the space of twenty days, in severe bodily pain, or unable to follow his ordinary pursuits.

321. *Voluntarily causing hurt.*—Whoever does any act with the intention of thereby causing hurt to any person, or with the knowledge that he is likely thereby to cause hurt to any person, and does thereby cause hurt to any person, is said "voluntarily to cause hurt."

322. *Voluntarily causing grievous hurt.*—Whoever voluntarily causes hurt, if the hurt which he intends to causes or knows himself to be likely to cause is grievous hurt, and if the hurt which he causes is grievous hurt is said to "voluntarily cause grievous hurt."

323. *Punishment for voluntarily causing hurt.*—Whoever except in the case provided for by section 334, voluntarily causes hurt, shall be punished with imprisonment of either description for a term which may extend to one year, or with fine which may extend to one thousand rupees or both.

324. *Voluntarily causing hurt, by dangerous weapons or means.*—Whoever except in the case provided for by section 334, voluntarily causes hurt by means of any instrument for shooting, stabbing, or cutting, or any instrument, which, used as a weapon of offence, is likely to cause death, or by means of fire or any heated substance, or by means of any poison or any corrosive substance, or by means of any explosive substance, or by means of any substance which it is deleterious to the human body to inhale, to swallow, or receive into the blood, or by means of any animal, shall be punished with imprisonment of either description for a term which may extend to three years, or with fine, or with both.

325. *Punishment for causing grievous hurt.*—Whoever except in the case provided by section 335 voluntarily causes grievous hurt, shall be punished with imprisonment of either description for a term which may extend to seven years, and shall also be liable to fine.

328. *Voluntarily causing grievous hurt by dangerous weapons or means.*—Whoever except in the case provided by section 335, voluntarily causes grievous hurt by means of any instrument for shooting, stabbing, or cutting or any instrument which, used as a weapon of offence, is likely to cause death, or by means of fire or any heated substance, or by means of any poison or any corrosive substance, or by means of any explosive substance, or by means of any substance which it is deleterious to the body to inhale, to swallow, or to receive into the blood, or by means of any animal, shall be punished with transportation for life, or with imprisonment of either description for a term which may extend to ten years and shall also be liable to fine.

327. *Voluntarily causing hurt to extort property, or to constrain to an illegal act.*—Whoever voluntarily causes hurt for the purpose of extorting from the sufferer, or from any person interested in the sufferer, any property or valuable security, or of constraining the sufferer or any person interested in such sufferer to do anything which is illegal or which may facilitate the commission of an offence, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

328. *Causing hurt by means of poison, etc., with intent to commit an offence.*—Whoever administers to or causes to be taken by any person any poison or any stupefying, intoxicating, or unwholesome drug, or other thing, with intent to cause hurt to such person or with intent to commit or to facilitate the commission of an offence, or knowing it to be likely that he will thereby cause hurt, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

329. *Voluntarily causing grievous hurt to extort property or to constrain an illegal act.*—Whoever voluntarily causes grievous hurt for the purpose of extorting from the sufferer or from any person interested in the sufferer, any property or valuable security, or of constraining the sufferer or any person interested in such sufferer to do anything that is illegal or which may facilitate the commission of an offence, shall be punished with transportation for life, or imprisonment of either description for a term which may extend to ten years and shall also be liable to fine.

330. *Voluntarily causing hurt to extort confession, or to compel restoration of property.*—Whoever voluntarily causes hurt for the purpose of extorting from the sufferer or any person interested in the sufferer any confession or any information which may lead to the detection of an offence or misconduct, or for the purpose of constraining the sufferer or any person interested in the sufferer to restore or to cause the restoration of any property or valuable security or to satisfy any claim or demand, or to give information which may lead to the restoration of any property or valuable security, shall be punished with imprisonment of either description for a term which may extend to seven years, and shall also be liable to fine.

331. *Voluntarily causing grievous hurt to extort confession, or to compel restoration of property.*—Whoever voluntarily causes grievous hurt for the purpose of extorting from the sufferer or any person interested in the sufferer any confession or any information which may lead to the detection of an offence or misconduct, or for the purpose of constrain-

ing the sufferer or any person interested in the sufferer to restore or to cause the restoration of any property or valuable security, or to satisfy any claim or demand or to give information which may lead to the restoration of any property or valuable security shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

332. *Voluntarily causing hurt to deter public servant from his duty.*—Whoever voluntarily causes hurt to any person being a public servant in the discharge of his duty as such public servant or with intent to prevent or deter that person or any other public servant or in consequence of anything done or attempted to be done by that person in the lawful discharge of his duty as such public servant, shall be punished with imprisonment of either description for a term which may extend to three years, or with fine, or with both.

333. *Voluntarily causing grievous hurt to deter public servant from his duty.*—Whoever voluntarily causes grievous hurt to any person being a public servant in the discharge of his duty as such public servant, or with intent to prevent or deter that person or any other public servant from discharging his duty as such public servant or in consequence of anything done or attempted to be done by that person in the lawful discharge of his duty as such public servant, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

334. *Voluntarily causing hurt on provocation.*—Whoever voluntarily causes hurt on grave and sudden provocation, if he neither intends or knows himself to be likely to cause hurt to any person other than the person who gave the provocation, shall be punished with imprisonment of either description for a term which may extend to one month, or with fine which may extend to five hundred rupees, or with both.

335. *Voluntarily causing grievous hurt on provocation.*—Whoever voluntarily causes grievous hurt on grave and sudden provocation, if he neither intends or knows himself to be likely to cause grievous hurt to any person other than the person who gave the provocation, shall be punished with imprisonment of either description for a term which may extend to four years, or with fine which may extend to two thousand rupees, or with both.

336. *Act endangering life or personal safety of others.*—Whoever does any act so rashly or negligently as to endanger human life or the personal safety of others, shall be punished with imprisonment of either description for a term which may extend to three months, or with fine which may extend to two hundred and fifty rupees, or with both.

337. *Causing hurt by endangering life or personal safety of others.*—Whoever causes hurt to any person by doing any act so rashly or negligently as to endanger human life, or the personal safety of others, shall be punished with imprisonment of either description for a term which may extend to six months or with fine which may extend to five hundred rupees, or with both.

338. *Causing grievous hurt by endangering life or personal safety of others.*—Whoever causes grievous hurt to any person by doing any act so rashly or negligently as to endanger human life, or the personal safety of others, shall be punished with imprisonment of either description for a term which may extend to two years, or with fine which may extend to one thousand rupees, or with both.

351. *Assault.*—Whoever makes any gesture, or any preparation, intending or knowing it to be likely that such gesture or preparation will cause any person present to apprehend that he who makes that gesture or preparation is about to use criminal force to that person, is said to commit an assault.

Cf. English law.—An assault consists in an attempt or offer by a person having present ability; with force to do any hurt or violence to the person of another. Battery means any least hurt or violence unlawfully and wilfully or culpably done to the person of another. Striking at another with a cane, stick, or fist although the blow misses, drawing a sword or bayonet, or throwing a bottle or glass with intent to wound or strike, presenting a loaded gun at a man within range, or any other act indicating an intention to use violence against the person of another, is an assault.

352. *Punishment for assault or criminal force otherwise than on grave provocation.*—Whoever assaults or uses criminal force to any person otherwise than a grave and sudden provocation given by that person shall be punished with inprisonment of either description for a term which may extend to three months, or with fine which may extend to five hundred rupees or with both.

359. *Kidnapping.*—Kidnapping is of two kinds: Kidnapping from British India, and kidnapping from lawful guardianship.

360. *Kidnapping from British India.*—Whoever conveys any person beyond the limits of British India without the consent of that person or of some person legally authorized to consent on behalf of that person, is said to kidnap that person from British India.

361. *Kidnapping from lawful guardianship.*—Whoever takes or entices any minor under fourteen years of age if a male, or under sixteen

years of age if a female, or any person of unsound mind, out of the keeping of the lawful guardian of such minor, or person of unsound mind without the consent of such guardian, is said to kidnap such minor or person from lawful guardainship.

Exception.—This section does not extend to the act of any person who in good faith believes himself to be the father of an illegitimate child, or who in good faith believes himself to be entitled to the lawful custody of such child, unless such act is committed for an immoral or unlawful purpose.

362. *Abduction.*—Whoever by force compels, or by any deceitful means induces, any person to go from any place, is said to abduct that person.

363. *Punishment for kidnapping.*—Whoever kidnaps any person from British India or from lawful guardianship shall be punished with imprisonment of either description for a term which may extend to seven years, and shall also be liable to fine.

364. *Kidnapping or abducting in order to murder.*—Whoever kidnaps or abducts any person in order that such person may be murdered or may be so disposed of as to be put in danger of being murdered, shall be punished with transportation for life, or rigorous imprisonment for a term which may extend to ten years, and shall also be liable to fine.

365. *Kidnapping or abducting with intent secretly and wrongfully to confine a person.*—Whoever kidnaps or abducts any person with intent to cause that person to be secretly and wrongfully confined, shall be punished with imprisonment of either description for a term which may extend to seven years and shall also be liable to fine.

366. *Kidnapping or abducting woman to compel her marriage, etc.*—Whoever kidnaps or abducts any woman with intent that she may be compelled, or knowing it to be likely that she will be compelled to marry any person against her will, or in order that she may be forced or seduced to illicit intercourse, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

367. *Kidnapping or abducting in order to subject person to grievous hurt, slavery, etc.*—Whoever kidnaps or abducts any person in order that such person may be subjected, or may be so disposed of as to be put in danger of being subjected to grievous hurt, or slavery, or to the unnatural lust of any person, or knowing it to be likely that such person will be so subjected or disposed of shall be punished with imprisonment of

either description for a term which may extend to ten years, and shall also be liable to fine.

368. *Wrongfully concealing or keeping in confinement, kidnapped or abducted person.*—Whoever, knowing that any person has been kidnapped or has been abducted, wrongfully conceals or confines such person shall be punished in the same manner as if he had kidnapped or abducted such person with the same intention or knowledge, or for the same purpose as that with or for which he conceals or detains such person in confinement.

369. *Kidnapping or abducting child under ten with intent to steal from its person.*—Whoever kidnaps or abducts any child under the age of ten years with the intention of taking dishonestly any movable property from the person of such child, shall be punished with imprisonment of either description for a term which may extend to seven years, and shall also be liable to fine.

372. *Selling minor for purposes of prostitution, etc.*—Whoever sells, lets to hire or otherwise disposes of any minor under the age of sixteen years with intent that such minor shall be employed or used for the purpose of prostitution or for any unlawful and immoral purpose, or knowing it to be likely that such minor will be employed or used for any such purpose, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

373. *Buying minor for purposes of prostitution, etc.*—Whoever buys, hires, or otherwise obtains possession of any minor under the age of sixteen years with intent that such minor shall be employed or used for the purpose of prostitution, or for any unlawful and immoral purpose, or knowing it to be likely that such minor will be employed, or used for any such purpose, shall be punished with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

375. *Rape.*—A man is said to commit "rape," who except in the case hereinafter excepted, has sexual intercourse with a woman under circumstances falling under any of the following descriptions :—

First.—Against her will.

Secondly.—Without her consent.

Thirdly.—With her consent, when her consent has been obtained by putting her in fear of death, or of hurt.

Fourthly.—With her consent, when the man knows that he is not her husband, and that her consent is given because she believes that he is another man to whom she is or believes herself to be lawfully married.

Fifthly.—With or without her consent, when she is under twelve years of age.

Exception.—Sexual intercourse by a man with his own wife, the wife not being under twelve years of age, is not rape.

376. *Punishment for rape.*—Whoever commits rape shall be punished with transportation for life, or with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

English law.—A boy under fourteen years of age cannot be convicted of rape, as at that age he is under a physical incapacity to commit the offence. In India, the potency of a person charged with the offence has to be proved by evidence in each case, as unlike the English law there is no limit of age laid down under which the law presumes a person physically incapable of committing rape.

377. *Unnatural offences.*—Whoever voluntarily has carnal intercourse against the order of nature with any man, woman, or animal shall be punished with transportation for life, or with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

According to the English law if the passive agent is under fourteen, it is not felony in him, but only in the active agent. If both be of the age of discretion, *i.e.*, above fourteen years, it is felony in both. A married woman who consents to her husband's committing an unnatural offence with her is an accomplice. It is doubtful whether the act of having connection with a woman in the mouth amounts to this offence.

394. *Voluntarily causing hurt in committing robbery.*—If any person in committing, or attempting to commit, robbery, voluntarily causes hurt, such person, and any other person jointly concerned in committing or attempting to commit, such robbery, shall be punished with transportation for life, or with rigorous imprisonment for a term which may extend to ten years, and shall also be liable to fine.

396. *Dacoity with murder.*—If any one of five or more persons, who are conjointly committing dacoity, commits murder in so committing dacoity, every one of those persons shall be punished with death, or transportation for life, or rigorous imprisonment for a term which may extend to ten years, and shall also be liable to fine.

397. *Robbery or dacoity with attempt to cause death or grievous hurt.*—If at the time of committing robbery or dacoity, the offender uses any deadly weapon, or causes grievous hurt to any person, or attempts to cause death or grievous hurt to any person, the imprisonment with which such offender shall be punished shall not be less than seven years.

459. *Grievous hurt caused whilst committing lurking house-trespass or house-breaking.*—Whoever while committing lurking house-trespass or

house-breaking, causes grievous hurt to any person or attempts to cause death or grievous hurt to any person, shall be punished with transportation for life, or imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

460. *All persons jointly concerned in lurking house-trespass or house-breaking by night, punishable where death or grievous hurt caused by one of them.*—If, at the time of the committing of lurking house-trespass by night, or house-breaking by night, any person guilty of such offence shall voluntarily cause, or attempt to cause, death or grievous hurt to any person, every person jointly concerned in committing such lurking house-trespass by night or house-breaking by night shall be punished with transportation for life or with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine.

499. *Defamation.*—Whoever, by words either spoken or intended to be read, or by signs or by visible representations, makes or publishes any imputation concerning any person intending to harm, or knowing, or having reason to believe that such imputation will harm the reputation of such person, is said, except in the cases hereinafter excepted, to defame that person.

Explanation.—It may amount to defamation to impute anything to a deceased person, if the imputation would harm the reputation of that person if living, and is intended to be hurtful to the feelings of his family or other near relatives.

Explanation 2.—It may amount to defamation to make an imputation concerning a company or an association or collection of persons as such.

Explanation 3.—An imputation in the form of an alternative or expressed ironically, may amount to defamation.

Explanation 4.—No imputation is said to harm a person's reputation, unless that imputation directly or indirectly in the estimation of others, lowers the moral or intellectual character of that person, in respect of his caste or of his calling or lowers the credit of that person, or causes it to be believed that the body of that person is in a loathsome state or in a state generally considered as disgraceful.

500. *Punishment for defamation.*—Whoever defames another shall be punished with simple imprisonment for a term which may extend to two years, or with fine, or with both.

511. *Punishment for attempting to commit offences punishable with transportation or imprisonment.*—Whoever attempts to commit an offence punishable by this code with transportation or imprisonment, or to cause such an offence to be committed, and in such attempt does any act

towards the commission of the offence, shall, where no express provision is made by this code for the punishment of such attempt, be punished with transportation or imprisonment of any description provided for the offence, for a term of transportation or imprisonment which may extend to one-half of the longest term provided for that offence, or with such fine as is provided for the offence, or with both.

APPENDIX X.

FORMS REQUIRED BY THE INDIAN LUNACY ACT, 1912.

FORM 1.

APPLICATION FOR RECEPTION ORDER.

In the matter of A. B., residing at , by occupation , son of ; a person alleged to be a lunatic.

To Presidency Magistrate, for [or District Magistrate of , or Subdivisional Magistrate of or Magistrate sepecially empowered under Act IV of 1912 for].

The Petition of C. D., residing at , by occupation , son of , in the town of [or sub-division of in the district of].

1. I am years of age.

2. I desire to obtain an order for the reception of A. B. as a lunatic in the asylum of situate at .

3. I last saw the A.B. at on the day of .

4. I am the of the said A. B.

[*Or if the petitioner is not a relative of the patient state as follows.*]

I am not a relative of the said A.B The reasons why this petition is not presented by a relative are as follows: (State them.)

5. The persons signing the medical certificates which accompany the petition are.

6. A statement of particulars relating to the said A B. accompanies this petition.

7. [*If that is the fact.*] An application for an inquiry into the mental capacity of the said A. B. was made to the on the and a certified copy of the order made on the same petition is annexed hereto. [*Or if that is the fact.*]

No application for an inquiry into the mental capacity of the said A. B has been made previous to this application.

The petitioner therefore prays that a reception order may be made in accordance with the foregoing statement.

(Sd.) C. D.

The statements contained or referred to in paragraphs are true to my knowledge; the other statements are true to my information and belief.
Dated. (Sd.) C. D.

STATEMENT OF PARTICULARS.

[If any of the particulars in this statement is not known, the fact to be so stated.]

The following is the statement of particulars relating to the said A. B.

Name of patient at length.

Sex and age.

Married or single or widowed.

Previous occupation.

Caste and religious belief as far as known.

Residence at or immediately previous to the date hereof.

Names of any near relatives to the patient who are alive.

Whether this is a first attack of lunacy.

Age (if known) on first attack.

When and where previously under care and treatment as a lunatic.

Duration of existing attack.

Supposed cause.

Whether the patient is subject to epilepsy.

Whether suicidal.

Whether the patient is known to be suffering from phthisis or any form of tubercular disease.

Whether dangerous to others, and in what way.

Whether any near relative (stating the relationship) has been afflicted with insanity.

Whether the patient is addicted to alcohol. or the use of opium, ganja, charas, bhang, cocaine or other intoxicant.

[The statements contained or referred to in paras are true to my knowledge. The other statements are true to my information and belief.]

[Signature by person making the statement.]

FORM 3.

MEDICAL CERTIFICATE.

In the matter of A. B. of in the town of [or the subdivision of in the district of] an alleged lunatic.

I, the undersigned C. D., do hereby certify as follows:

1. I am a gazetted medical officer [or a medical practitioner declared a holder of * [or declared by Local Government to by Government to be medical officer under Act IV of 1912] be a medical practitioner under Act IV of 1912] and I am in the actual practice of the medical profession.

2. On the day of 19 at in the town/village of [or subdivision of in the district of] [separately from any other practitioner], I personally examined the said A. B. and came to the conclusion that the said A. B. is a lunatic and a proper person to be taken charge of and detained under care and treatment.

3. I formed this conclusion on the following grounds, *viz* :—

(*a*) Facts indicating insanity observed by myself, *viz* :—

(*b*) Other facts (if any) indicating insanity communicated to me by others, *viz* :—Here state the information and from whom.

(Sd.) C. D.
Designation as above.

FORM 5.

Reception order in case of wandering or dangerous lunatics or lunatics not under proper control or cruelly treated sent to an asylum established by Government.

See section 14, 15 and 17.

I . . . . . Magistrate of . . . . . empowered by Government under Act IV. of 1912, having caused to be examined by Medical Officer under the Indian Lunacy Act, 1912 and being satisfied that . . . . . is a Lunatic who was wandering at large (or is a person dangerous by reason of lunacy) or is a lunatic not under proper care and control or is cruelly treated or neglected by the person having the care of charge of him and a proper person to be taken charge of and detained under care and treatment, hereby direct you to receive the . . . . . into your asylum.

Dated the.....192 .

Magistrate.

To

THE OFFICER IN CHARGE OF THE ASYLUM,

* The qualification must be registrable in the United Kingdom.

APPENDIX XI.

THE HIPPOCRATIC OATH AND THE VEDIC PRINCIPLES OF MEDICINE.

I. The Hippocratic (Unani) Oath, 400 B. C.

I swear by Apollo the Physician and Æsculapius and Hygeia and Panaces, while I take to witness all the Gods and Goddesses that I shall fulfil according to my ability and judgment this oath and this covenant.

That I shall esteem my teacher in this art as I do my parents, and contribute towards his subsistence, and share my goods with him if he is in need, and regard his offspring as my own brothers and teach them this art, without fee and covenant, should they wish to study it, and impart its general precepts and oral lessons and all the rest of the science to my sons, and those of my teachers and to students who have been registered and sworn according to the law of Medicine, but to none other.

I will follow the dietetic regimen for the benefit of the sick according to my ability and my judgment and will withhold that which would be for their injury and hurt.

I will not administer a deadly drug to any one though solicited thereto, nor will I suggest any such advice.

In like manner I will not administer abortive drugs to women.

Purely and holily will I live and practise my art.

Nor will I use the knife on those suffering from stone, but will leave them to specialists in this operation.

Into whatever house I enter I will go with the object of helping the sick, holding aloof from all voluntary and all other hurtful wrong doing and from licentious practices, whether with women or with men, free or bond, and regarding the things I see or hear, in the exercise of my art, or outside its exercise, in my intercourse with men, which ought not to be divulged I will keep silent regarding them as inviolable secrets.

If then I fulfil this oath without any violation, may I enjoy life and the fruits of my art held in honour by all men for evermore, but, if I transgress it and commit perjury may quite the contrary befall me.

II. The Vedic Principles of Medicine.

Thus said the illustrious son of Atri : If an intelligent man, impelled by proper reason, desires to become a Physician, the following should be

the qualifications of him that should be selected as preceptor. He should be :

One whose doubts have been all cleared in respect of Medical criptures – possessed of experience—clever in the practice of his profession—compassionate towards those who approach Him—clean in person and clothing—have a practised hand in Surgery—possessed of all the implements of his profession with his organs of sense perfect—conversant with nature—his knowledge of medical science supplemented with a knowledge of other branches of study—without malice—of a peaceful disposition—capable of bearing privations and pain—well affected towards disciples and disposed to teach them—capable of communicating his ideas—

Approaching such a preceptor, the pupil should attend on him with heedfulness like one revering one's sacrificial fire, or one's deity, or one's king, or one's father or one's patron.

The preceptor should examine his pupil who should be of a mild disposition—noble by nature—not mean in acts—with eyes, mouth and nasal line straight—Tongue thin red and not slimy—teeth and lips without deformity—voice of good tone—possessed of intelligence—free from pride—endowed with a large understanding—with a power of judgment and memory—having a liberal mind – belonging to a medical family—devoted to truth—without defect in his limbs having all his senses perfect—disposed to solitude—free from haughtiness – of thoughtful disposition—free from the faults of "Vyasana"—not prone to wrath – endowed with purity of behaviour and compassion for all devotedly attached to the study of medicine free from cupidity—without sloth – seeking the good of all creatures –prepared to obey all his preceptor's commands and attached to him.

Unto one adorned with such qualifications the preceptor should say—thou shouldst always regard me as the foremost of persons—holding thyself in subjection to me—bearing thyself in a way that is agreeable and beneficial to me—behaving as a son, as a slave, as a suppliant, towards me whilst being taught by me.

Thou shouldst be free from impatience and always attentive, doing everything with a mind concentrated upon thy work—behaving with humility and acting after reflection – never murmuring or finding fault with thy instructor but willingly carrying out my orders.

Thou shouldst with thy whole heart strive to bring about the cure of those that are ill—not even for thy life's sake extorting their substance. Thou shouldst not, even in imagination, know another man's

wife, and similarly thou shouldst not appropriate the possession of others.

Thou shouldst never administer medicines unto those that have incurred the displeasure of the king or those that are ill-disposed towards him or those that have incurred the displeasure of the great, or those bearing ill-will towards them. So also thou shouldst not administer medicines to those that are of exceedingly perverse or wicked disposition or those that are exceedingly poor, or those that never vindicate their character when it is aspersed, or those that are on the point of death or those that have not their masters near them, or those women that have not their husbands or other guardians near them.

Thou shouldst never gossip of the practices of a patient's house. Even if possessed of sufficient knowledge thou shouldst not boast of that knowledge.

There is no end in the science of medicine. Hence heedfully and carefully thou shouldst devote thyself to it conducting thyself as I direct and without feeling of humiliation acquiring practice in the art.

Unto men, possessed of intelligence the entire world acts as a preceptor. Unto men, destitute of intelligence, the entire world occupies the position of an enemy.

The preceptor saying these words the pupil should answer, "yes." If the pupil does as he is commanded then should he be taught. If he behaves otherwise he should be rejected as unworthy.

APPENDIX XII.

THE POISONS ACT (ACT NO. I.), 1904.

AND THE RULES IN THE UNITED PROVINCES OF AGRA AND OUDH.

Whereas it is expedient to make provision for regulating the possession and sale of all poisons in certain local areas, and the importation, possession and sale of white arsenic throughout the whole of British India ; It is hereby enacted as follows :—

1. (1) This Act may be called the Poisons Act, 1904 ; and

(2) It extends to the whole of British India.

2. (1) Subject to the control of the Governor-General in Council, the Local Government may, by rule, regulate within the limits of any municipality or cantonment the possession for sale and the sale, whether wholesale or by retail, of any specified poison.

(2) In particular, and without prejudice to the generality of the power conferred by sub-section (1), rules made there under may provide for, amongst other matters,

(*a*) the grant of licenses to possess any specified poison for sale, wholesale, or by retail, and the fixing of the fee (if any) to be charged for such licenses ;

(*b*) the classes of persons to whom alone such licenses may be granted ;

(*c*) the classes of persons to whom alone any such poison may be sold ;

(*d*) the maximum quantity of any such poison which may be sold to any one person ;

(*e*) the maintenance by vendors of any such poison of registers of sales, the particulars to be entered in such registers, and the inspection of the same ;

(*f*) the safe custody of such poisons and the labelling of the vessels, packages or coverings in which any such poison is sold or possessed for sale ; and

(*g*) the inspection and examination of any such poison when possessed for sale by any such vendor.

(3) Any substance specified as a poison in a rule made under this section shall be deemed to be a poison for the purposes of this Act.

3. The Governor-General in Council may, by notification in the Gazette of India, prohibit, except under and in accordance with the conditions of a license, the importation of white arsenic into British India, and may, by rule, regulate the grant of licenses and prescribe the conditions to be imposed thereby under this section.

4. (1) Subject to the control of the Governor-General in Council, the Local Government may, by rule, regulate within the whole or any part of the territories under its administration the possession for sale and the sale, whether wholesale or by retail, of white arsenic.

(2) In particular and without prejudice to the generality of the power conferred by sub-section (1), rules made thereunder may provide, amongst other matters, for all or any of the matters specified in Section 2, sub-section (2).

(3) Rules made under subsection (1) may further provide that no person shall sell any powdered white arsenic unless the same is, before the sale thereof, mixed with soot, indigo or Prussian blue in the proportion of half an ounce of soot, indigo or Prussian blue at least to one pound of the white arsenic, and so in proportion for any greater or less quantity.

Provided that, where such arsenic is stated by the purchaser to be required for some purpose for which such admixture would, according to the representation of the purchaser, render it unfit, such arsenic may be sold, without such admixture, in a quantity of not less than ten pounds at any one time.

5. (1) The Local Government, with the previous sanction of the Governor-General in Council may further, by rule, regulate the possession of white arsenic in any local area in which murder by poisoning with that drug or the offence of mischief by poisoning cattle therewith appears to it to be of such frequent occurrence as to render restrictions on the possession thereof desirable.

(2) In making any rule under sub-section (1) the Local Government may direct that any breach thereof shall be punishable with imprisonment for a term which may extend to one year, or with fine which may extend to one thousand rupees, or with both together with confiscation of the white arsenic in respect of which the breach has been committed, and of the vessels, packages or coverings in which the same is found.

6. (1) The Governor-General in Council may, by notification in the Gazette of India, apply to any specified poison other than white arsenic

all or any of the provisions of this Act relating exclusively to white arsenic.

(2) Any substance specified as a poison in a notification issued under subsection (1) shall be deemed to be a poison for the purposes of this Act.

7. (1) Whoever,—(*a*) commits a breach of any rule made under section 2 or section 4, or (*b*) imports into British India, without a license, white arsenic the importation of which is for the time being restricted under section 3, or (*c*) breaks any condition of a license for the importation of white arsenic granted to him under section 3, shall be punishable,—(i) on a first conviction, with imprisonment for a term which may extend to three months, or with fine which may extend to five hundred rupees, or with both, and (ii) on a second or subsequent conviction, with imprisonment for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

(2) Any poison in respect of which an offence has been committed under this section together with the vessels, packages or coverings in which the same is found, and, in the case of any offence mentioned in clause (*b*) or clause (*c*) of sub-section (1), any animals and conveyances used in carrying it, shall be liable to confiscation.

8. (1) The District Magistrate, the Sub-divisional Magistrate and, in a Presidency town, the Commissioner of Police, respectively, may issue a warrant for the search of any place in which he has reason to believe or suspect that any poison is possessed or sold in contravention of this Act or any rule thereunder or that any poison liable to confiscation under this Act is kept or concealed.

(2) The person to whom the warrant is directed may enter and search the place in accordance therewith, and the provisions of the Code of Criminal Procedure, 1898, relating to search-warrants shall, as far as may be, be deemed to apply to the execution of the warrant.

9. (*a*) In addition to any other power to make rules hereinbefore conferred, the Governor-General in Council, or, subject to the control of the Governor-General in Council, the Local Government, may make rules generally to carry out the purposes and objects of this Act.

(2) Every power to make rules conferred by this Act shall be subject to the condition of the rules being made after previous publication.

(3) All rules made by the Governor-General in Council or by the Local Government under this Act shall be published in the Gazette of

India or the Local Official Gazette, as the case may be, and on such publication shall have effect as if enacted in this Act.

10. (1) Nothing in this Act or in any license granted or rule made thereunder shall extend to or interfere with anything done in good faith in the exercise of his profession or business as such—

(*a*) by a medical or veterinary practitioner or

(*b*) by a chemist or druggist only qualified to act or such under the law for the time being in force in the United Kingdom, or

(*c*) by a chemist, druggist or compounder dispensing or compounding in compliance with the prescription of a medical or veterinary practitioner, or

(*d*) subject to any rules for the time being in force under section 5, by a tanner or hide-merchant.

(2) Notwithstanding anything herein before contained, the Local Government may, in its discretion, by general or special order, declare that all or any of the provisions of this Act shall not be deemed to apply to any article, or class of articles, of commerce specified in such order, or to any poison, or class of poisons, used for any purpose so specified, and may, from time to time, alter or vary any such declaration.

(3) The authority on which any power to make rules under this Act is conferred may, by general or special order, exempt any person or class of persons, either generally or in respect of any poison or poisons specified in the order, from the operation of any such rules.

11. From such date as the Local Government may, by notification in the Local Official Gazette, fix in this behalf, the following enactment, shall be repealed in the territories for the time being administered by the Governor of Bombay in Council and the Lieutenant-Governor of the United Provinces of Agra and Oudh respectively, namely :—

Bombay Act VIII of 1866 (an act to regulate and restrict the sale of poisons in the Bombay Presidency). The North-Western Provinces and Oudh Municipalities Act, 1900 (North-Western Provinces and Oudh Act I. of 1900), Section 128, clause (e).

THE RULES REGARDING POISONS IN THE UNITED PROVINCES OF AGRA AND OUDH.

A.—General.

All the provisions of the Poisons Act 1904, relating exclusively to white arsenic, have been applied to the following poisons :—

I.—Sulphides of arsenic,

(*a*) Red Sulphide, *mansil.*
(Realgar).
(*b*) Yellow Sulphide, *Hartal.*
(Orpiment).

II.—Impure Sulphides of arsenic.
(*c*) Black arsenic, *Kala sankhia.*
(*d*) Impure orpiments,
(1) White sulphuret, *Safed sankhia.*
(2) Pink sulphide, *Gulabi sankhia.*
(3) Brown sulphide, *Bhura sankhia.*

III.—Green arsenic,
(*e*) Arsenite of copper, *Hirwa.*
(Scheele's green).
(*f*) Aceto arsenite of copper, *Hirwa.*
(Schweinfurth's green).

IV.—Aconite, *Singhya or mitha telia.*

V.—Perchloride of mercury, *Raskapur,*
(Corrosive sublimate).

B.—Rules regarding white arsenic, aconite and certain other poisons.

The following substances are specified as poisons for the purposes of section 2, subsection (3), of the Poisons Act, 1904, namely :—

Aconite, nux vomica, perchloride of mercury (corrosive sublimate), cyanide of potash, and stramonium (*dhatura*).

The expressions "sell" and "sale" mean respectively "sell by retail" and "sale by retail."

No person shall (1) possess for sale by retail, or (2) sell by retail white arsenic or other poison except under a license granted in this behalf by the District Magistrate.

A license holder shall effect every sale of white arsenic or other poison in person.

A license holder shall not sell white arsenic or other poisons to any person.

(*a*) who is not personally known to him or identified to his satisfaction, or,

(*b*) who appears to him to be under the age of eighteen years, or,

(*c*) who does not appear to him to be in full possession of his faculties, or

(*d*) who is a wandering mendicant.

A license holder shall not sell white arsenic or other poison in any quantity exceeding an ounce at any one time and to any one person.

A license holder shall maintain a register in which he shall enter all sales of white arsenic or other poison with the following particulars :—

(*a*) serial number,
(*b*) name of poison,
(*c*) quantity sold,
(*d*) date of sale,
(*e*) name of purchaser,
(*f*) address of purchaser,
(*g*) purposes for which white arsenic or other poison is stated to be required,
(*h*) signature of purchase (or where the purchaser is illiterate, his thumb mark), and
(*i*) signature of vendor.

A license holder shall maintain in respect of white arsenic or other poison a stock register, which shall contain the following particulars:—

(*a*) serial number,
(*c*) amount received,
(*b*) date,
(*d*) name and address of person from whom received,
(*e*) amount sold,
(*f*) balance in stock, and
(*g*) remarks.

Any magistrate, any police officer of or above the rank of sub-inspector, any revenue officer of or above the rank of naib-tahsildar, or any medical officer of or above the rank of sub-assistant surgeon may at any time visit and inspect the premises of a license holder where white arsenic or other poisons are kept for sale and may inspect all such poisons found therein and the registers maintained under the rules.

(1) White arsenic or other poison shall be kept in securely closed receptacles of glass, tin or earthenware.

(2) All such receptacles shall be kept in a separate locked almirah or box and shall be marked in paint with the name of the poison contained therein.

(3) Every almirah or box, and each receptacle within such receptacle or box, shall have the word "poison" in English and vernacular painted upon it in red letters.

(1) When white arsenic or other poison is sold, it shall be securely packed in a packet.

(2) Every packet sold shall be labelled by the vendor with a red label bearing the name of the poison in the vernacular and the number and date of the entry in the register of sales.

When a license holder also deals with white arsenic or other poison

wholesale, the stock maintained for sale as defined in these rules shall be kept entirely distinct from any stock maintained for the purpose of wholesale transactions.

A license holder shall not sell powdered white arsenic to any person unless the same is, before the sale thereof, mixed with soot, indigo, or Prussian blue in the proportion of half an ounce of soot, indigo, or Prussian blue at least to one pound of the white arsenic, and so in proportion for any greater or less quantity.

C.—RULES REGARDING SULPHIDES OF ARSENIC AND OTHER POISONS.

No person shall—

(1) possess for sale by retail, or

(2) sell by retail

any of the following poisons except under a license granted in this behalf by the District Magistrate :—

I.—Sulphides of arsenic—

(*a*) Red sulphide, (*b*) yellow sulphide.

II.—Impure sulphides of arsenic—

(*c*) Black arsenic, (*d*) Impure orpiments.

1. White sulphuret, (2) Pink sulphide, (3) Brown sulphide.

III.—Green arsenic—

(*e*) Arsenite of copper, (Scheele's green). (*f*) Aceto-arsenite of copper, (Schweinfurth's green).

IV.—Aconite. V.—Perchloride of mercury, (Corrosive sublimate).

A license holder shall effect every sale of any of the said poisons in person.

A license holder shall not sell any of the said poisons to any person—

(*a*) who is not personally known to him or identified to his satisfaction, or

(*b*) who appears to him to be under the age of eighteen years, or

(*c*) who does not appear to him to be in full possession of his faculties; or

(*d*) who is a wandering mendicant.

A license holder shall not sell any of the said poisons in any quantity exceeding one ounce at any one time and to any one person

(1) A license holder shall maintain a register, in which he shall enter all sales of any of the said poisons.

(2) The following particulars shall be entered, in respect of each sale, in the register maintained under sub-rule (1) namely—

(*a*) a serial number, (*b*) name of poison, (*c*) quantity sold, (*d*) date of sale, (*e*) name of purchaser, (*f*) address of purchaser, (*g*) purpose for which the poison is stated to be required, (*h*) signature of purchaser (or where the purchaser is illiterate his thumb mark), and (*i*) signature of vendor.

A license holder shall maintain in respect of the said poisons a stock register, which shall contain the following particulars, namely:—

(*a*) a serial number, (*b*) date, (*c*) amount received, (*d*) name and address of persons from whom received, (*e*) amount sold, (*f*) balance in stock, and (*g*) remarks.

A separate page or pages shall be assigned to each poison stocked by the license holder.

Any magistrate, any police officer of or above the rank of sub-inspector, any revenue officer of or above the rank of naib-tahsildar, or any medical officer of or above the rank of sub-assistant Surgeon, may at any time, visit and inspect the premises of a license holder where any of the said poisons is kept for sale and may inspect the stock found therein and the registers.

(1) Each of the said poisons shall be kept in securely closed receptacles of glass, tin or earthenware.

(2) All such receptacles shall be kept in a separate locked almirah or box, and shall be marked in paint with the name of the poison contained therein.

(3) Every almirah or box, and each receptacle within such almirah or box, shall have the word "poison" in English and vernacular painted upon it in red letters.

When any of the said poisons is sold, it shall be securely packed in a packet.

(2) Every packet sold shall be labelled by the vendor with a red label bearing the name of the poison in the vernacular and the number and date of the entry in the register of sales.

A license holder shall not sell any of the said poisons except red and yellow sulphides of arsenic in the form of powder to any person unless the same is before the sale thereof mixed with soot, indigo or Prussian blue in the proportion of half an ounce of soot, indigo, or Prussian blue at least to one pound of the said poison and so in proportion for any greater or less quantity.

When a license holder also deals in any of the said poisons wholesale, the stock maintained for sale as defined in these rules shall be kept entirely distinct from any stock maintained for the purpose of wholesale transactions.

APPENDIX XIII.

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