A handbook of medical jurisprudence and toxicology : for the use of students and practitioners / by William A. Brend.

A HANDBOOK OF MEDICAL JURISPRUDENCE AND TOXICOLOGY

WILLIAM A. BREND

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MEDICAL JURISPRUDENCE

AND TOXICOLOGY.

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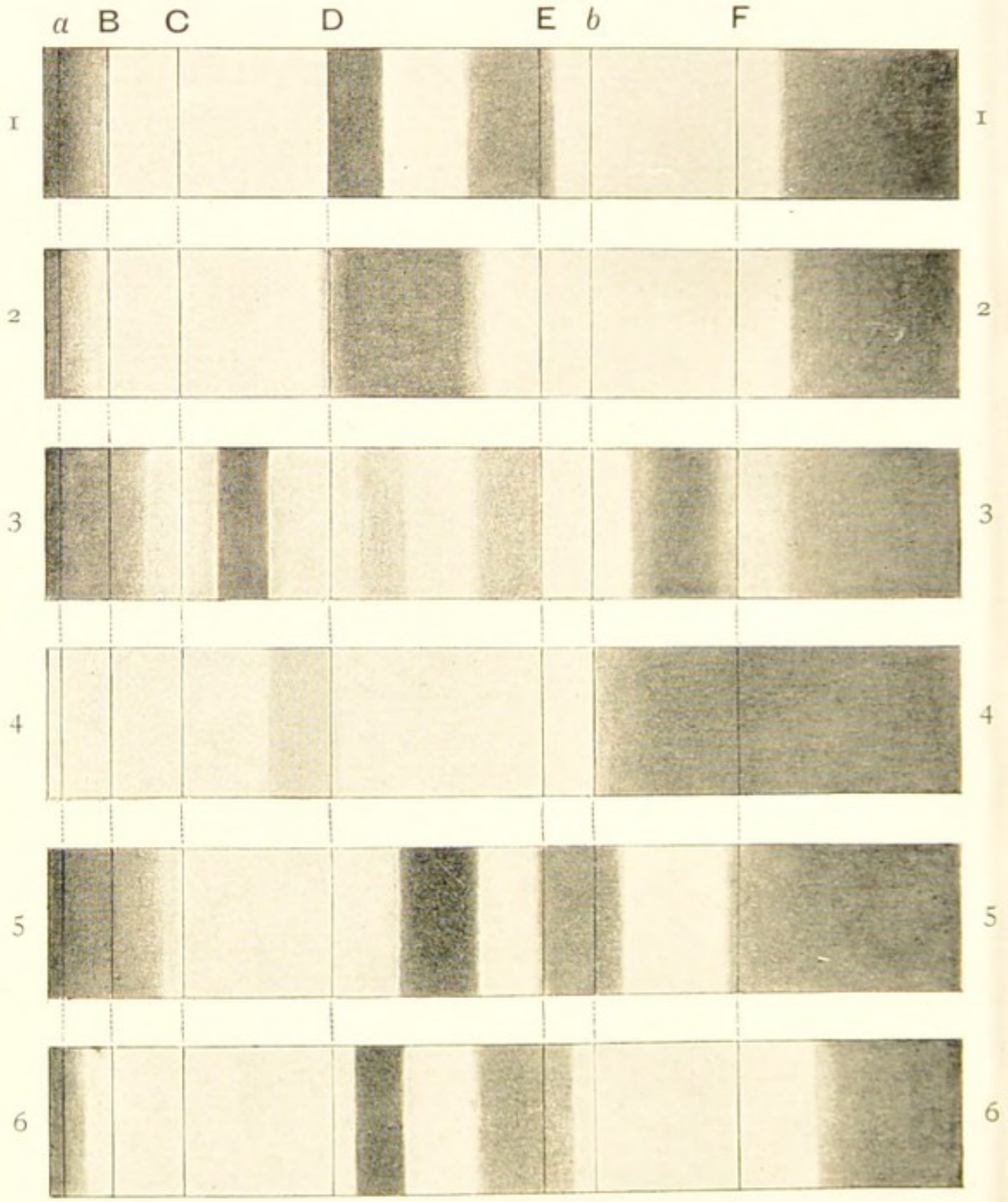

BLOOD SPECTRA.

1. Oxyhæmoglobin.
2. Hæmoglobin.
3. Methæmoglobin.
4. Alkaline hæmatin.
5. Hæmocromogen (reduced alkaline hæmatin).
6. Carbon monoxide hæmoglobin.

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MEDICAL JURISPRUDENCE

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BY

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Barrister-at-Law.

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PREFACE.

THIS Handbook is intended primarily for the use of Medical Students, and, in scope, should be sufficient for the Examination in Forensic Medicine and Toxicology for the M.B. of the London University. Each branch of the subject has been dealt with in sufficient detail for ordinary purposes, but without overburdening it by the addition of numerous illustrative examples, reports of trials, &c. The latter, though interesting reading, and of great value to Medical Jurists in the Law Courts, are not, as a rule, required by Students. Those who wish for further information should read the text-books of Prof. Dixon Mann or Prof. Glaister, to both of which works the writer has to acknowledge his indebtedness.

It is hoped also that the book may be of value to the General Practitioner. To further that object, endeavour has been made to deal as practically as possible with those matters calling for the exercise of medico-legal skill and knowledge which are most likely to be met with in everyday clinical experience. In Chapter xvii., especially, the requirements of the law in so far as they affect Medical Practitioners, as such, are considered, and the proper lines of conduct to adopt under various difficult circumstances are discussed.

Dr. Stanley B. Atkinson has kindly revised the proofs, and has made numerous valuable suggestions.

W. A. B.

43 CAMPDEN HILL COURT,
KENSINGTON, *February, 1906.*

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A HANDBOOK OF
MEDICAL JURISPRUDENCE
AND TOXICOLOGY.

PART I.—MEDICAL JURISPRUDENCE.

CHAPTER I.

INTRODUCTION.

In the code of laws promulgated by Hammurabi, King of Babylon, B.C. 2285-2242, we read:—

"If the doctor has treated a gentleman for a severe wound with a lancet of bronze, and has caused the gentleman to die, or has opened an abscess of the eye for a gentleman with the bronze lancet, and has caused the loss of the gentleman's eye, one shall cut off his hands."

"If a doctor has treated the severe wound of a slave of a poor man with a bronze lancet, and has caused his death, he shall render slave for slave."*

These laws against *malapraxis* are the earliest instances that can be found of interference on the part of the State with medical affairs, and may be regarded as the birth of medical jurisprudence. From that early period, down to the Midwives' Act of yesterday, the relations between the State and medical science have been continually widening and increasing. In the one direction, the State has framed laws for the general community based upon medical knowledge, and has made use of medical science for the elucidation of matters both civil and criminal; in the other, it has made special laws for medical men, regulating their practice and procedure. These relationships in their entirety constitute the science known as State-Medicine, which is now, for the sake of convenience, separated into two divisions, Hygiene or the science of Public Health, and Medical Jurisprudence.

Medical Jurisprudence, or Forensic Medicine, may be defined as the application of medical knowledge to legal purposes other than

* *The Oldest Code of Laws*, by C. H. W. Johns, M.A.

those directly concerned with the prevention and spread of disease. Toxicology, or the science of poisons, must be regarded as, to some extent, a separate subject. In so far as it is concerned with the criminal administration of poison, it is a branch of medical jurisprudence, but the question of treatment in cases of poisoning really belongs to the domain of therapeutics. However, it would be very inconvenient to consider these matters separately. Both medical jurisprudence and toxicology are subjects which frequently call to their assistance other branches of science. Besides medicine, surgery, and obstetrics, the medical jurist requires a knowledge of chemistry to aid him in the detection of poisons, anatomy in the identification of animal remains, physics in the use of the spectroscope, botany in the recognition of poisonous plants, and so forth.

A few words may be said with regard to medical jurisprudence from the points of view of the student of medicine, and of the general practitioner respectively. By the former, the subject is, in most cases, looked upon as tedious and uninteresting, and merely to be crammed up for the purpose of passing examinations. It is probable that this view arises from the necessity the student is under of learning forensic medicine almost entirely from books and lectures. In medicine and in surgery his most important work is done at the bedside, in the operating-theatre, and in the laboratory; but in medical jurisprudence it is, from the very nature of the subject, impossible to provide practical demonstrations, except perhaps in such matters as testing for blood and for the presence of poisons. There is, however, one course which the student may take if he is really anxious to miss no opportunity of acquiring a practical knowledge of the subject, and that is to attend frequently at the Coroners' Courts. The writer, when a student, did this, and invariably found the London Coroners ready to afford every facility for hearing the cases.

With regard to the general practitioner, it must be admitted that, as a rule, he is not so familiar with medical jurisprudence as he is with other branches of his professional work. Nevertheless, the subject is one of great importance to him, for he may at any moment be called upon to act in accordance with its teachings, under very diversified circumstances. The confidence, which is placed in the family doctor, makes him the recipient of many a confession, and the freedom of access, which he has to his patient at all times, enables him to detect crime, or attempts at crime, or the exercise of undue influence, which would otherwise pass unnoticed. In cases of death from violence, the medical man is often the first person trained in habits of observation upon the scene, and he may accordingly be the most important witness in any enquiry which follows. In cases of rapidly approaching death, the practitioner may have duties connected with dying declarations, will-making, and other matters quite outside the region of pure therapeutics. A knowledge of medical jurisprudence enables the medical man to take the right course under all these circumstances, and

thereby not only promote the interests of justice, but possibly save himself from actions-at-law, and from the rebukes which not infrequently fall from the lips of coroners and magistrates upon those who have committed some error in this branch of their professional work.

The subjects which medical jurisprudence treats of are of too diversified a character to permit of a scientific scheme in the order of their consideration. In this book the order usually adopted has been followed, with the exception that it has been thought more natural to deal with appearance in court and legal procedure after considering the various circumstances which lead to such appearance.

CHAPTER II.

IDENTIFICATION OF THE LIVING.

CONTENTS.—Circumstances under which identification is required—Anthropometry—Identification by finger-prints—Method in use in England—The Beck case—Scars—Personal markings—Tattooing—Methods of dyeing the hair—Estimation of age in the living; when required for legal purposes.

Circumstances under which Identification is required.—Identification of the living may be necessary in either civil or criminal courts when a plea of mistaken identity is set up, or when a claim is put forward for the possession of estates, &c. The identification of the habitual criminal is now effected by systems of measurement, supplemented by the use of finger-prints, and is in the hands of a special department of the police. The medical jurist is apt to be consulted in such matters as the production and removal of deformities, the age and possibility of disappearance of scars, tattooing and other marks; or changes in the colour of the hair.

Anthropometry.—Systems, having for their bases measurements of the human frame, are now employed in most civilised countries for the purpose of criminal detection. The earliest was invented by M. Alphonse Bertillon of the Paris Préfecture de Police, and was first employed in the French penal settlements in 1882. The length of the head is first determined, and according to the measurement—short, medium, or long—the prisoner is placed in one of three primary classes. Each class is again subdivided into three according to the width of the head. The lengths of the left middle finger, the left foot, and the left forearm are successively employed for further subdivision. By means of other measurements, and the colour of the eyes, the criminal is eventually assigned to a group containing from three or four to twenty descriptions, each of which is accompanied by a photograph and a record of any scars or markings. From these, the description of the individual under examination can be easily picked out.

Identification by Finger-prints.—A second method of identification, which is largely used in India, depends upon the fact that the patterns made by the fine lines on the tips of the fingers and thumb are constant throughout life, and are different in every individual. It is to Mr. Francis Galton and, later, to Mr. Henry that the credit is due of elaborating, from these impressions, a practical system of identification. The impressions of the fingers and thumbs are taken in printer's ink in a definite order. Certain distinct types of markings are recognised—viz., arches, whorls, loops, and composites—and from these a formula is constructed for

each individual, by means of which he can subsequently be readily identified.

Apart, however, from an official record, a mere chance impression may be of great value in bringing home a crime. This was illustrated during the trial for murder of the brothers Stratton in 1904, in which an impression on a cash-box found in the room where the crime was committed, formed an important link in the chain of evidence.

Method in use in England.—At the present time the system employed is a combination of anthropometry and the finger-print method, devised by Dr. Garson when adviser on identification to the Home Office. The same authority has also recently described an ingenious method of developing invisible finger-prints, which the student may readily test for himself. If a piece of white paper be gently pressed with the fingers, and then a little finely-divided dark powder, such as graphite, be scattered over it, the impressions, after the superfluous powder has been shaken off, often stand out with astonishing clearness. On a dark surface, such as the top of a mahogany table, a white powder produces a similar result.

The Beck Case.—Confidence in official methods of identification has been rudely shaken of late by the recent Beck case. It is, however, fair to point out that the error which was made was due to a combination of unfortunate circumstances, and does not throw any discredit upon the method of identification at present employed. Briefly, the story is as follows:—In 1877, a certain John Smith was convicted of obtaining jewellery, &c., from women by fraud, and was sentenced to five years' penal servitude. While in prison he asserted that he was a Jew, and, on examination, was found to have been circumcised. This fact, however, was not recorded among his distinctive marks when he was liberated, although it was noted in the prison papers.

In 1896, Adolf Beck was charged with exactly similar offences. Ten of the women who had been defrauded identified him as the man who had deceived them, and an expert in handwriting gave his opinion that the writing on bogus cheques which had been given to the women was the same as that admittedly Beck's. The prisoner was anxious to show that the character and details of the frauds proved that they had been perpetrated by the same person who was convicted in 1877, and as he (Beck) had a satisfactory *alibi* showing that he was in Peru from 1875 to 1882, he could not be the guilty party. The judge, influenced by a sound principle established in the interests of criminals themselves that previous convictions shall not be referred to until the verdict in the case on trial has been given, ruled that such evidence could not be heard, and thus this line of defence was barred. Beck was convicted, and sentenced to seven years' penal servitude, the judge remarking that the evidence against him was "overwhelming." In prison he was at first dressed as one who had been previously convicted, but, in 1898, the Home Office, learning from the prison papers that Beck was not circumcised, while Smith was, referred the case for reconsideration to the judge, who expressed his continued belief in the prisoner's guilt. Accordingly nothing further was done than removing the marks indicative of a previous conviction.

The unfortunate man was liberated on ticket-of-leave in 1901, only to

be re-arrested in 1904 for frauds of precisely the same character as those committed in 1877 and 1896. He was again convicted, but sentence was postponed, and, while he was waiting to learn his fate, the real John Smith was caught in the very act of defrauding women, and some of the jewellery stolen was found in his possession. Beck was then granted a free "pardon" for each offence, and subsequently received £5,000 compensation.

The committee appointed to investigate this miscarriage of justice, among a number of other comments, disapproved of the ruling of the judge in 1896 that evidence relating to the conviction of John Smith in 1877 was inadmissible. But it must be remembered that the mistake in identifying Beck with Smith was not responsible for the belief entertained by the authorities in the former's guilt, for, after this mistake was realised in 1898, the case was revised, and Beck was still detained in prison. The really responsible and unfortunate mistakes made in identification were those made by the ten women who identified Beck with the man who had defrauded them, in spite of the fact that the resemblance between the two was quite superficial. Their statements, combined with the expert testimony as to the handwriting, constituted the "overwhelming" evidence against the prisoner. Besides showing the unsatisfactory character of evidence derived from handwriting, the case is of importance as an illustration of the comparative worthlessness of identification by persons animated by feelings of anger, and anxious to see the supposed author of their injuries punished.

Scars.—Some of the most important and difficult questions in identification turn upon the production, age, and possibility of disappearance or artificial removal of scars. A scar consists of fibrous tissue which has developed in order to repair a solution of continuity of the skin. Whether a scar will follow any given injury or not, depends upon the character and extent of that injury. If the true skin has been severed, it is probable that in every case a scar will result, but in the case of a small linear incision which has healed by first intention the scar may eventually be so faint as to be indistinguishable unless searched for with a lens. When, however, there has been actual loss or destruction of tissue, a distinct scar is bound to remain. If suppuration occur, the resulting scar will be still more marked.

Shape of a Scar.—This depends upon the character, position, and manner of healing of the original wound. An incised wound usually leaves a linear cicatrix, but if made across the direction of the muscle fibres it is apt to gape widely, and an oval scar then results. Lacerated or septic wounds produce irregular cicatrices. In course of time the fibrous tissue of which the scar is composed contracts, and the skin in the neighbourhood becomes puckered and distorted. Thus, eventually, the shape of a scar may come to differ very considerably from that of the wound which gave rise to it. Scars made during infancy frequently enlarge as growth proceeds. The cicatrices which follow burns, syphilis, lupus, or tuberculosis have more or less characteristic appearances.

Age of a Scar.—This is a matter upon which a medical witness may be asked to express an opinion. Speaking generally, a scar

is red and vascular during its early stages. In course of time the minute vessels are obliterated by the contraction of the fibrous tissue, and the cicatrix then becomes white and glistening. Previous to this there may be a stage during which the scar shows a brown or coppery appearance. These changes, however, occur at very irregular intervals. After a lapse of twenty years a scar may still look red and angry; on the other hand, the white appearance may be present at the end of a few months. Only a very guarded opinion can be expressed in any given case.

Disappearance and Removal of Scars.—It may be definitely stated that a cicatrix of any depth or size, although it may fade very considerably in the course of time, will never disappear completely. Even the marks produced by such slight operations as cupping or venesection have been recognisable after a lapse of fifty years. On the other hand, small linear scars may eventually become so faint as to be practically indistinguishable. Sometimes a scar may be rendered more distinct by rubbing or striking the part, the greater vascularity of the surrounding tissue causing it to become redder than the white fibrous tissue of the cicatrix.

It is obvious, from what has been said, that a scar cannot be removed artificially, although it is possible to change its appearance. An irregular puckered cicatrix may be dissected out, and a less conspicuous linear scar substituted for it. On the other hand, a scar of known shape or character may be obliterated by producing a larger and deeper mark in its place.

Personal Markings, &c.—These include moles, nævi, keloid, &c. Congenital birth-marks usually persist throughout life. Small superficial nævi may, however, be present at birth, and disappear completely during early years. Occasionally both moles and nævi suddenly increase in size, and change in shape, during later life. Keloid may be an overgrowth of ordinary scar tissue, or may develop apparently spontaneously, in which case it probably originates from a minute lesion which has escaped notice. The latter form, after persisting for a longer or shorter period, sometimes disappears completely. A bodily marking may be removed by surgical means, but in that case a scar will be visible on the site.

Congenital dislocations, hare-lip, cleft palate, circumcision, and other physical features may be of value in identification. If modified by operation, indications of such treatment will remain.

Tattooing.—This is a process by which pigments are introduced beneath the skin in the form of fanciful designs, names, dates, figures, &c. The practice is most frequent among soldiers, sailors, and the criminal classes. The permanency of such marking depends upon the nature of the pigment employed, and the depth to which it is inserted. Superficial tattooing, in which merely the epithelium is stained, wears off in course of time as fresh epithelium grows. If, however, the colouring matter has been introduced into the true skin beneath the epidermis, the markings are much more durable. As regards the resisting power of the pigments employed, charcoal, gunpowder, coal-dust, and Indian ink have the greatest durability,

cinnabar and ordinary ink the least. If skilfully performed with one of the more lasting pigments, tattooing may be said to be practically indelible. In cases in which the markings have disappeared, the pigment is apt to be found after death in the nearest lymphatic glands. Artificial removal, as a rule, can only be effected by complete excision, or the application of caustics, in which case a scar will remain on the site. Quite superficial markings may, however, be picked out with a needle, leaving very little trace of their former presence.

In drawing deductions from the presence of tattooing, it must be remembered that professional tattooers may reproduce the same designs in the same positions on the bodies of a number of persons.

Methods of Dyeing the Hair.—The colour of the hair is sometimes changed in order to conceal identity. Dark hair may be lightened by washing it with chlorine water, dilute nitric acid, or hydrogen peroxide. The tint produced, as a rule, is not uniform, and the hair is stiffer and more brittle than normal. To darken the hair, it is first treated with a solution of a bismuth, lead, or silver salt, and this is then reduced to the sulphide by washing with sulphuretted hydrogen water, or rubbing with the yolk of an egg. Naquet's hair dye consists of a solution of bismuth hyposulphate in ammonia. When applied to the hair, the ammonia evaporates, and the sulphide is deposited.

The use of mineral dyes may be detected by cutting off a lock of the hair, steeping it in dilute nitric acid, and applying the appropriate chemical tests. Usually, also, the epidermis between the hairs will be found to be stained. If any doubt exists, the hair should be allowed to grow for a few days, and again observed. The natural colour will now be seen at the roots. Comparison of the hair of the head with that on other parts of the body is not reliable, since the colour and texture often differ naturally to a considerable extent.

Estimation of Age in the Living.—A medical man may be asked his opinion as to the probable age of a person for purposes either civil or criminal. This is a matter which can only be approximately determined by means of the general appearance and degree of bodily development. The epiphyses may be examined by means of X-rays. In children, some help may be derived from the state of the teeth (*v.* Chap. iii.), but the dates of eruption vary within considerable limits.

We may here briefly summarise the various circumstances under which the law takes cognisance of age.

By 24 and 25 Vict. c. 100, s. 27, unlawfully abandoning or exposing a child under two years old so that its life is endangered or its health is (or is likely to be) permanently injured is a misdemeanour punishable by three years' penal servitude.

Under the Infant Life Protection Act, 1897, various regulations, depending upon the age of the infant, are made for the nursing and maintenance of an infant away from its parents.

A child under the age of seven years cannot be convicted of crime;

he is presumed by the law to be *doli incapax*, and the presumption cannot be rebutted. Between seven and fourteen the presumption still holds, but may (except in a charge of rape) be rebutted by evidence that the child possessed sufficient discretion to know that he was doing wrong. After fourteen a person is liable for all his crimes.

A boy under fourteen is held to be incapable of rape, even if his physical capacity to commit the crime could be proved.

Unlawful carnal knowledge of a girl under thirteen—even with consent—is a felony punishable with penal servitude for life. The attempt is a misdemeanour, and can be punished with two years' imprisonment. In the case of a girl over thirteen, but under sixteen, unlawful carnal knowledge, under circumstances not amounting to rape, is a misdemeanour; but it is a defence to show that the accused had reasonable cause to believe that the girl was sixteen.

In cases of abduction or procuration of females, or charges against the owner or occupier of premises who has permitted the defilement of a young girl thereon, the nature and gravity of the offence varies with the age of the female.

Various restrictions as to age are also made by the Prevention of Cruelty to Children Act, 1894, the Children's Dangerous Performances Acts, 1879 and 1897, Factory and Workshop Acts, Public Health Acts, Shop Assistants Act, &c.

The legal age for marriage is fourteen years for a male, and twelve for a female.

At twenty-one a person assumes full civil rights and responsibilities.

CHAPTER III.

IDENTIFICATION AND EXAMINATION OF THE DEAD.

CONTENTS.—Means of identification of the dead—Estimation of age—Determination of sex—Post-mortem examination for medico-legal purposes—Exhumation.

Means of Identification of the Dead.—The personal identity of a body found dead is usually established by the recognition of friends or relatives of the deceased. But expert assistance may be required to identify a body more or less decomposed, or to determine the sex, approximate age, or stature of an individual from a collection of mutilated fragments, charred remains, or bones. Sometimes, also, it is necessary to determine whether bones found are those of an animal or a human being.

External markings on the dead body possess the same value and importance as those on the living. Hence the exact position and extent of all moles, nævi, tattooings, &c., should be carefully observed and noted. The stature, colour of the hair, presence or absence of beard or moustache, and any bodily deformities or peculiarities have likewise to be recorded.

Internally, every deviation from the normal is to be noted, and search must be made for any distinctive features known to have been present in the body of the person whom the deceased is believed to be. The value of any abnormality, as evidence of identification, depends upon the particular circumstances which accompany each case. For instance, the body of Livingstone was identified by an ununited fracture of the humerus, which was known to have followed mauling by a lion. In 1814 the coffin of Charles I. in Westminster Abbey was opened. The body had been embalmed, and the coffin, which was of lead, hermetically sealed, hence the remains were well preserved. Identification was effected by means of the short pointed beard, and by the fact that the fourth cervical vertebra had been cleanly severed.

The teeth have, on several occasions, furnished valuable aid in determining the identity of remains. It may happen that a cast of the jaws of a person has been taken by a dentist for the purpose of preparing a plate to hold artificial teeth. Such a cast may be found to fit the jaws of the individual whose identity is in question. Evidence of this character was forthcoming at the trial of Dr. Webster, lecturer on chemistry in Boston, for the murder of his colleague, Dr. Parkman, in 1849. The latter was missed, and suspicion fell upon the former, who was known to owe him a considerable sum of money. On searching the laboratory and premises of Webster a human trunk, exhibiting a wound on the left side of the chest, and portions of the legs and thighs were discovered. In

the ashes of the laboratory furnace were found numerous fragments of bone, the greater part of the right half of the lower jaw, artificial indentures, and a quantity of gold. The portion of the jaw was found to fit exactly a cast which had been taken by a dentist shortly before, and the gold on assaying proved to be of the same quality as that used by the dentist for settings. Webster was arrested and condemned. He confessed his crime before execution.

A more recent instance is furnished by the case of the Duchesse d'Alençon, who perished in the fire of the charity bazaar in Paris, in 1897. The remains were charred beyond recognition, but a dentist was able to recognise his work on the teeth.

The identification of the body of Miss Holland, who was murdered by Samuel Dougal at the Moat Farm in Essex, in 1903, was assisted by an examination of the teeth. The missing woman was known to have had several stoppings performed by different dentists, but otherwise had excellently preserved teeth for her age. In the skull of the remains, which were found in a ditch, where it was proved they had been buried for four years, not a single tooth was missing, and three different sorts of stoppings had been employed.

When only bones are forthcoming, an approximate estimation of the height of the individual may be made by placing the bones in their anatomical relation to each other, measuring the length of the figure, and then adding 1½ inches for the soft parts. Tables have also been constructed for determining the stature when only some or one of the long bones is present. For instance, the femur is about 25 per cent. of the height, and the humerus about 18 per cent.

Estimation of Age in the Dead.—Various indications are available at different periods of life. In the fœtus (*v.* Chap. xii.) we are guided by the degree of bodily development; in childhood and youth, by the teeth, presence or absence of ossific points, and the condition of the epiphyses. The question becomes more difficult in adult life and old age, but certain changes, which the progress of time induces in the skeleton, will, in most cases, afford some indication of the age.

The teeth are of value in estimating age, owing to the fact that they erupt in a fairly definite order, and at more or less constant intervals of time. Considerable divergencies, however, occur in individual cases. It must be remembered that rickets generally delays dentition, and that in congenital syphilis the teeth appear earlier than usual, and display characteristic features. The following table shows the average order and dates of eruption :—

Milk Teeth.

Lower central incisors	from 6th to 7th month.
Upper central incisors	,, 7th ,, 8th ,,
Upper lateral incisors	,, 7th ,, 9th ,,
Lower lateral incisors	,, 10th ,, 12th ,,
First molars	,, 12th ,, 15th ,,
Canines	,, 15th ,, 20th ,,
Second molars	,, 20th ,, 30th ,,

Permanent Teeth.

First molars	from 6th to 7th year.
Central incisors	,, 7th ,, 8th ,,
Lateral incisors	,, 8th ,, 9th ,,
Anterior bicuspids	,, 9th ,, 10th ,,
Posterior bicuspids	,, 10th ,, 12th ,,
Canines	,, 11th ,, 13th ,,
Second molars	,, 13th ,, 15th ,,
Third molars,	,, 18th ,, 28th ,,

The following is an abridged list of the times at which the centres of ossification appear, and the component portions of the bones unite. Fuller details will be found in Quain's *Osteology*, by Thane:—

1st year,	Centres of ossification appear in the head of the humerus, the coracoid process of the scapula, the os magnum, the head of the femur, and the external cuneiform of the tarsus.
2nd year,	Centres appear in the lower extremities of the radius, tibia, and fibula. Frontal suture unites.
3rd year,	Centres appear in the great tuberosity and the lower extremity of the humerus, the pyramidal bone, the patella, and the internal cuneiform of the tarsus.
4th year,	Centres appear in the great trochanter, and the middle cuneiform of the tarsus.
5th to 6th year,	Centres appear in the internal condyle of the humerus, the trapezium, the semilunar, the head of the radius, and scaphoid of the tarsus. The head and the great tuberosity of the humerus unite.
7th to 8th year,	Centres appear in the scaphoid of the carpus, and the trapezoid.
10th to 12th year,	Centres appear in the trochlea of the humerus, and the pisiform. The Y cartilage of the acetabulum commences to ossify.
13th to 14th year,	Centres appear in the small trochanter and the external condyle of the humerus.
14th to 16th year,	A centre appears in the acromion.
16th to 17th year,	The lower epiphysis of the humerus unites with the shaft.
17th to 18th year,	The upper epiphysis of the radius unites with the shaft, and the internal condyle joins the shaft of the humerus.
18th to 19th year,	The lower epiphysis of the tibia joins, and the head of the femur unites with the shaft.
20th year,	The lower epiphyses of the radius, ulna, and femur, and the upper epiphysis of the humerus unite with their respective shafts.
21st to 22nd year,	The upper epiphysis of the tibia and lower epiphysis of the fibula unite with the shafts.
24th year,	The upper epiphysis of the fibula unites with the shaft.
22nd to 25th year,	The acromion and spine of the scapula unite, and the bodies of the first and second sacral vertebræ join.

After full development has been attained, the indications from which age can be inferred become very uncertain. But little reliance can be placed upon such changes as the arcus senilis, thickening of the arteries, wrinkling of the skin, and greyness of the hair. Some characteristic features are, however, exhibited by the skeleton in old age. With the progress of time, the bones become lighter and thinner; and the cartilages, particularly those of the ribs and larynx, tend to ossify. But even in a young person, who has been the subject of emphysema, the costal cartilages may be extensively ossified. Another change is seen in the angle which the neck of the femur makes with the shaft of that bone. In adult life this is obtuse, but, as age advances, it approaches more and more to a right angle. Perhaps the most reliable indications of old age are presented by the lower jaw. In middle life the body and ramus meet at nearly a right angle, but in the senile jaw the angle is obtuse, the mandible thus showing a tendency to revert to the infantile type. The teeth are lost, the alveolar margin becomes absorbed, and the mental foramen is situated near the upper border instead of, as in middle life, about the centre of the bone.

Determination of Sex in the Dead.—This is an easy matter if the soft parts are remaining, except in cases of so-called hermaphrodism, which will be considered later. Even when decomposition is well advanced, identification of the sex is generally possible, as the uterus is one of the last organs of the body to decay, and may be found months after death when the other viscera are practically unrecognisable.

When only bones are forthcoming, it is often difficult to identify the sex with certainty. This is especially the case in young individuals, as, before puberty, there is very little difference between the male and female skeletons. In adults, speaking generally, the bones of the female are smaller, lighter, and show muscular impressions less strongly marked than those of the male. The female skull is smaller, smoother, and of less cranial capacity; the superciliary ridges, frontal sinuses, and mastoid process less developed; the zygomatic arches thinner; and the jaws and teeth smaller than in the male.

More striking differences are, however, seen in the pelvis. In the adult female this is shallower and wider than in the male; the brim of the true pelvis is larger and more circular owing to the lesser projection of the sacral promontory; and the outlet is more expanded. The ilia are more vertical; the sacrum less curved and broader in proportion to its length; the depth of the pubic symphysis less; and the obturator foramen more triangular. All the internal measurements of the true pelvis are greater in the female than in the male.

The angle between the shaft and neck of the femur is, as a rule, smaller in women than in men.

Post-Mortem Examination for Medico-Legal Purposes.—In the examination of a body which is the subject of legal enquiry, many points, both positive and negative, which do not

arise in the course of an ordinary pathological investigation, require to be noticed. Besides ascertaining the cause of death, and particularly whether such cause was accidental or otherwise, the examiner must be ready to reply to various subsidiary questions on the state of nutrition, degree of decomposition, probable age of the individual, length of time which has elapsed since death, &c. When possible, it is desirable to obtain a history of the circumstances attending the death, before commencing the examination, for then special attention may be directed towards the organs likely to be concerned. The examiner should allow no persons to be present other than those specially authorised. A note should be made of the time and date of the examination.

The examination of the **clothing** of a dead person is usually performed by the police. Sometimes, however, this duty falls to the lot of the medical man, and the latter may be called upon to identify stains or fabrics. The points to notice are whether the body is fully clothed or not, and whether the clothes are properly worn, or are unbuttoned, wrongly buttoned, ill adjusted, or torn. Markings on the underlinen, or stains on the outer garments from which the occupation can be inferred, are to be observed. The position of rents must be compared with wounds on the underlying surface of the body. Blood-stains are to be described, and portions of the cloth removed for further examination. If rape is suspected, the underlinen of the woman must be searched for stains of semen, blood, or mud. Fabrics are identified subsequently by teasing out a few threads and examining them under the microscope. The student is advised to mount and examine for himself slides of linen, wool, and silk.

External Examination.—This may commence with a general survey of the body. Is it well-nourished or emaciated; clean or dirty; blood-stained or otherwise? Has rigor mortis commenced or passed off? Has decomposition set in? If so, what is its character, and how far has it advanced? What is the apparent age? If the body has not been properly and fully identified, a note must be made of the position and character of all external markings and other data for identification mentioned in the previous chapter. The situation of hypostases should be noticed, as they may afford evidence as to the position in which the body has lain, or show that it has been moved since death (*v.* p. 32). Bruises and abrasions must be accurately described, with reference to their appearance, extent, and position, and any evidence pointing to the manner in which they were received, or time of infliction, noted. All wounds should be measured, their edges, &c., examined, and their depth and direction ascertained. In cases of drowning, the nails should be examined for collections of mud or fragments of aquatic plants beneath them.

Attention may now be turned to the orifices of the body. Has there been any hæmorrhage from the ears, nostrils, or mouth? Is there froth at the mouth or nose? Are the teeth clenched? Have the lips or tongue been bitten, or are they stained or charred with

corrosives? Is there any foreign body in the mouth or pharynx? In the case of a female, the vagina and condition of the hymen demand examination; and the presence or absence of bruises or other marks of violence about the external genitalia must be noted. The pubic hair should be examined, and if any of the hairs are matted together, they should be cut off and examined later under the microscope for spermatozoa. In a male, the penis should be examined for seminal emission. In the body of a newly-born infant, the condition of the remnant of the umbilical cord should be observed.

Internal Examination.—It is most important that this should be complete. The examiner must not desist when he has found one cause of death, but must go on and investigate the condition of every vital organ. If this is not done, the defence, in a charge of murder or manslaughter, may assert that death was due to natural organic disease, and the medical witness will be unable to express an opinion on the point. On the other hand, it may be found that, although death was actually caused by violence, disease or malformation of some organ has materially contributed to bring about the fatal result. Authorities differ as to which of the cavities of the body should be examined first. Perhaps the best plan is to commence by opening the abdomen, and noting the relative positions of the viscera without further disturbing them. Next, the costal cartilages are cut through, the sternum removed, and the pericardium opened, the heart and large vessels being left intact. The examiner may now dissect back the scalp, and saw through the cranium, *the use of a hammer and chisel being avoided*, owing to the possibility of producing a fracture, or increasing one already present. If this course be adopted, it is possible to form an accurate estimation of the relative amounts of blood present in the brain, heart, lungs, and abdominal viscera. The organs may now be examined individually. The condition of the brain and meninges is investigated, and then the membranes are completely stripped off the base of the cranium in order to determine the presence or absence of fractures. The larynx is opened and searched for foreign bodies. All the thoracic and abdominal viscera are examined in turn, including the thymus gland in young children. Penetrating wounds are followed up, and their depth and direction ascertained. In women, the uterus must be examined for signs of pregnancy, recent delivery, or abortion. The general appearance of the blood, whether unusually fluid, or exceptionally dark or light coloured, should be observed. Finally the ribs, spinal column, and limbs are examined for fractures or dislocations. In some cases it is necessary to remove the vertebral laminæ, and ascertain the condition of the spinal cord.

In a case of suspected poisoning, a double ligature is placed round the lower end of the œsophagus and another at the commencement of the duodenum. The stomach, with its contents, is then removed entire, and placed in a clean jar for further examination. The œsophagus and pharynx are dissected out and placed in another vessel, and the whole of the large and small intestines, with their

contents, is preserved in a third. The liver, spleen, kidneys, and urine are also kept in separate receptacles. Preservatives should not be added. The jars are sealed and labelled, and must be kept by the examiner until they are handed over to the analyst, or some person authorised to receive them.

The following table shows the average weights of the various organs in the adult :—

	Male.	Female.
Brain,	49½ ozs.	44 ozs.
Heart,	10-12 ,,	8-10 ,,
Right lung,	24 ,,	17 ,,
Left ,,	21 ,,	15 ,,
Liver,	50-60 ,,	45-55 ,,
Pancreas,	3 ,,	2¾ ,,
Spleen,	5-7 ,,	4½-6½ ,,
Kidney,	4½ ,,	4¼ ,,
Uterus (virgin),	...	1¼ ,,

In conducting a post-mortem examination upon the body of an infant, attention should be paid to the signs of maturity, evidence pointing to live or dead birth, the nature of any food in the stomach, and the state of nutrition (*v.* p. 126).

The following table from the report of the British Anthropometric Committee shows the average weights for each month up to one year :—

Birth,	6·8 lbs.	Five months,	11·8 lbs.	Nine months,	15·8 lbs.
One month,	7·4 ,,	Six ,,	12·4 ,,	Ten ,,	16·8 ,,
Two months,	8·4 ,,	Seven ,,	13·4 ,,	Eleven ,,	17·8 ,,
Three ,,	9·6 ,,	Eight ,,	14·4 ,,	Twelve ,,	18·8 ,,
Four ,,	10·8 ,,				

Exhumation.—This may be necessary when suspicion of foul play (usually poisoning) arises after interment. An order for exhumation may be given by a coroner or by the Home Secretary. The medical man who is to perform the examination, and also some person who can identify the body, should be present when the coffin is opened. The investigation should be conducted in the open air. After the lid of the coffin has been removed, an interval should be allowed to elapse for the gases generated by putrefaction to dissipate. Disinfectants should be freely used, and, if rubber gloves are not worn, the hands should be frequently washed during the progress of the examination. In cases of suspected poisoning, the viscera should be removed and placed in sealed jars without preservatives for further investigation. A note should be made of the extent to which putrefaction has advanced. If a wooden coffin has been employed, a sample of the earth adhering to it should be taken for chemical examination, since, if poison is found in the viscera, the defence may assert that it was introduced from the surrounding soil.

CHAPTER IV.

THE MEDICO-LEGAL RELATIONS OF DEATH.

CONTENTS.—The modes of dying: syncope, asphyxia, and coma—Sudden death—Classification of the causes of death for legal purposes—Natural and violent deaths—Deaths by accident, suicide, and homicide.

Modes of Dying.—Bichat considered that, whatever the primary pathological lesion, all forms of death might be regarded as resulting from one or other of three proximate causes, viz.:—

Syncope, or failure of circulation.

Asphyxia, or death due to failure of respiration.

Coma, or death due to arrest of the functions of the central nervous system.

This classification is convenient rather than scientifically accurate. Death from coma is really in the end due to failure of respiration or circulation, owing to interference with the centres governing these functions in the brain. Death from syncope, when due to such causes as fright or a sudden blow on the abdomen, is really brought about by the shock to the central nervous system, and could be justifiably considered as death beginning at the brain. Clinical experience teaches us that in some cases it is quite possible to say whether respiration or circulation failed first, but in other instances the two functions appear to be arrested simultaneously.

Syncope.—This may be due to—

a. **Lesions of the Heart**—*e.g.*, disease of the valves, especially aortic incompetency; disease of the walls of the heart, fatty or fibrous myocarditis, or changes due to the exhaustion accompanying long-continued illness or fever; rupture of the heart from violent exertion, usually occurring in an organ already the seat of disease; disease of the coronary arteries, or sudden blocking by an embolus; or penetrating wounds of the heart.

b. **Excessive Hæmorrhage**, which may be *internal*, as in the case of rupture of an aneurism or perforation of the splenic artery from a gastric ulcer; or *external*, following wounds of large vessels, rupture of varicose veins, uterine hæmorrhages, &c.

c. **Inhibition of the Cardiac Centres in the Brain.**—This may follow sudden mental shock, as, for instance, great grief, or fright; or bodily shock, such as a blow over a sensitive nerve area; or it may be caused by certain poisons—for instance, chloroform and chloral.

Signs and Symptoms of Syncope.—In the period before consciousness is lost, the person is observed to turn pale and stagger. The pulse becomes weak, frequent, and sometimes irregular. The individual experiences sensations of "sinking," giddiness, and

nausea, and, if the syncope is due to excessive hæmorrhage, he may be restless and agitated. Vision becomes indistinct, and sounds appear to come from a distance. Unconsciousness follows, and the patient falls to the ground, the muscles being completely relaxed. The skin is pallid, cold, and clammy. The pulse becomes fluttering, and towards the end almost imperceptible. Respiration is weak, sighing, and irregular. General convulsions, especially when the syncope is due to loss of blood, may precede death.

In transient attacks of syncope or fainting the pulse and respiration may become alarmingly weak, yet recovery occurs.

Shock is a condition which is closely allied to, and frequently causes death from, syncope. The chief difference is that in shock consciousness is retained. The condition is produced by sudden or severe emotion, or by violent stimulation of some of the peripheral nerves. The impression may be conveyed through the sympathetic system, as in the case of a blow on the epigastrium, or through the sensory system after the receipt of a painful injury on any part of the body. The stimulus acts in two ways upon the circulatory system—(1) reflexly through the vagus tending to inhibit the action of the heart, and (2) reflexly through the vaso-motor system producing a great dilatation of the peripheral vessels. The result is that the blood is all collected in the peripheral arteries and veins, especially those of the splanchnic area, and the individual, so to speak, "bleeds to death into his own vessels." In addition to its action on the circulatory system, the violent stimulation produces a general depression of the nervous system.

Post-mortem Appearances.—These vary with the cause of the syncope. When death has been due to disease of the heart, the cavities of that organ usually contain the normal amount of blood, and no characteristic features are found in the other viscera. After death from hæmorrhage, the body may be nearly drained of blood, the organs are pale and exsanguined, and the heart contracted and nearly empty. When death has been due to syncope following shock, the heart is found to contain only a small amount of blood, while the abdominal vessels and viscera are in a state of engorgement.

Asphyxia.—**Natural causes** of death from asphyxia include diseases of the lungs, pleurisy with effusion, embolism of the pulmonary artery, œdema of the glottis, occlusion of the air passages by tumours, &c., paralysis of the muscles of respiration, and affections involving the respiratory centre in the medulla.

Violent causes of death from asphyxia are drowning, hanging, suffocation, strangulation, throttling, penetrating wounds of the thorax leading to pneumo-thorax, inhalation of non-respirable gases, such as coal-gas and CO_2, and poisoning. Poisons act in one of two ways—narcotics, such as opium, paralyse the respiratory centre in the medulla; strychnine, on the other hand, produces asphyxia by fixing the muscles of respiration. After drowning, the cause responsible for the greatest number of deaths from asphyxia is the overlying of infants in bed by their mothers.

Signs and Symptoms of Asphyxia.—Three stages are recognised in the phenomena of asphyxia. In the first stage, the breathing becomes deeper and more rapid; the muscles of extraordinary respiration are soon called into action, and first inspiratory and then expiratory efforts become violent and prolonged. The lips are blue, the eyes starting, and the expression intensely anxious. In the second stage, the violent respiratory efforts become convulsive, and are succeeded by general convulsions. The final stage is that of exhaustion. The sufferer becomes unconscious, the conjunctivæ are insensible, the pupils dilated, and all the muscles of the body relaxed. The blood-pressure falls, and the pulse is scarcely felt. Feeble, sighing respirations occur at longer and longer intervals, and at length death supervenes. Cessation of respiration, at least as far as it can be observed, does not, however, necessarily indicate death. Persons apparently drowned have been resuscitated after all external signs of breathing have ceased to be perceptible, and, it is said, that there is always a chance of saving life if the heart-beat can still be detected. Undoubtedly, however, the heart may continue to beat for an appreciable time after death. Under ordinary circumstances this cannot, as a rule, be observed, for it is impossible to fix the exact moment of death, but the occurrence has been proved by observations on the bodies of executed criminals. Brouardel records the case of a man whose heart continued to beat for an hour after he was guillotined.

Post-mortem Appearances—External.—The face may show lividity, especially about the ears and lips, but sometimes it is normal in appearance. The eyes may be prominent, and the conjunctivæ injected. Blood-stained froth is occasionally found about the mouth and nostrils, and the tongue may be partially protruded. Lividity of the finger- and toe-nails is common, especially in young children, and there may be large, livid patches about the body. These are distinguished from hypostases by the fact that they are not confined to the dependent parts of the body. They are more marked after rapid than after slow asphyxia. The onset of rigor mortis is frequently delayed.

Internal.—The lungs may be engorged with blood, particularly in cases of slow asphyxia; on the other hand, if death has been rapid, they may be pale and anæmic. The mucous membrane of the trachea is often injected, and of a cinnabar colour. The right side of the heart, the pulmonary artery, and large veins are engorged with dark, fluid or slightly-clotted blood, while the left ventricle is contracted and empty, or nearly so. This appearance is to some extent due to post-mortem contraction or rigor mortis of the heart. It has been shown that if an animal be rapidly asphyxiated, and the heart immediately examined, the left ventricle contains on the average about half as much blood as the right. At the end of twenty-four hours, contraction of the left ventricle has expelled much of the blood from it. Minute, punctiform ecchymoses beneath the serous membranes, sometimes known as "Tardieu's spots," are very characteristic of death from asphyxia. They are most com-

monly found beneath the pleura and pericardium, but may be present elsewhere, and are due to rupture of capillaries by the high blood-pressure. The abdominal viscera, particularly the kidneys, are often congested. The meninges are usually normal in appearance, but sometimes they are congested and sometimes anæmic. The blood, owing to the large amount of CO_2 present, is dark in colour, and unusually fluid.

Coma.—Death from coma is primarily due to interference with the vital centres in the brain. The immediate cause is usually asphyxia, sometimes syncope. The causes of coma are :—

a. **Gross lesions of the brain**, such as tumour, hæmorrhage, abscess, meningitis, depressed fracture, &c.

b. **Auto-intoxication**, or poisoning by substances generated within the body, as in uræmia, diabetes, and, probably, epilepsy.

c. **Poisoning from external sources**, alcohol, opium, &c.

Death from coma is preceded by a period during which more or less profound unconsciousness prevails, the muscles are relaxed, and the reflexes diminished or absent. The symptoms vary somewhat with the cause of the condition, but a certain diagnosis is often difficult to make. Unfortunate mistakes are made from time to time even by experienced practitioners. A person who is found in a state of unconsciousness in the streets is taken to the police station, and thought to be suffering from drunkenness; subsequent developments show that the condition is really due to apoplexy, or some other organic lesion.

The following are the symptoms of the most frequently occurring states of unconsciousness :—

Apoplexy. — This usually occurs in elderly persons, more frequently men than women. The onset is usually sudden, the individual often dropping as if shot; but sometimes unconsciousness does not develop until a few minutes after he has fallen, or paralysis has become manifest. The face may be flushed or pale, and the head and eyes may show conjugate deviation. The pupils vary; they are usually dilated, and are often unequal, but may be contracted if the lesion is in the pons. The pulse is generally full, slow, and of increased tension; and the radial artery is frequently atheromatous. Respiration is slow and stertorous. The temperature is normal or subnormal, but may be high after hæmorrhage into the pons. The fæces and urine are generally passed involuntarily, and the latter may contain albumen. Unilateral paralysis of the face and limbs is often present. The reflexes are abolished.

Embolism of the Cerebral Arteries may occur at any age. The onset is abrupt. Unconsciousness is at first not so profound as in apoplexy, but may gradually deepen. The individuals are often the subjects of endocarditis, and cardiac bruits may be detected. Hemiplegia, more frequent on the right side than on the left, may be present.

Epileptic Coma.—The condition is more frequent in the young than in the old. Diagnosis is assisted by the history of convulsions preceding the coma. The face and tongue often show scars, and

teeth may have been knocked out by falls during previous attacks. The lips and face are cyanosed or congested, and there is often blood-stained froth about the mouth. The pupils are usually dilated. The breathing is noisy, and sometimes even stertorous. The muscles are relaxed, and unconsciousness is often profound. Escape of the urine and fæces is frequently found to have occurred. After an attack, the reflexes are sometimes lost; more frequently they are increased, and ankle-clonus is present.

Uræmic Coma generally occurs in elderly persons. The attack is often preceded by headache. Unconsciousness may develop after a convulsive seizure or without any warning; at first it is not so deep as in apoplexy, and the patient may be momentarily aroused. The pupils vary, but most frequently they are contracted. The tongue is usually furred, and the breath has the characteristic uræmic odour. Signs of nephritis, such as œdema of the eyelids or feet, cardiac hypertrophy, arterio-sclerosis, and albuminuria assist the diagnosis.

Diabetic Coma.—This occurs most frequently in individuals under forty years of age. In most cases the attack begins, more or less suddenly, with headache, gastric disturbance, delirium, or a form of dyspnœa known as "air-hunger," in which the breathing is deeper but not more frequent than usual. Drowsiness, gradually passing into profound coma, follows. The pulse is quick and small, the tongue dry, and the temperature usually subnormal. The diagnosis is established by the presence of sugar in the urine.

Alcohol Poisoning.—After a period of excitement accompanied by giddiness, tottering gait, &c., the individual passes into the state of coma known as "dead-drunk." The face is most frequently pale, but is sometimes flushed or cyanosed. The condition of the pupils is variously stated by different authors. The following rule, first indicated by Macewen, is given by Prof. Glaister, who has applied it during a police practice of some eighteen years, and considers it to be absolutely reliable in cases of pure alcoholic coma, provided the iris is not fixed by adhesions:—"If an alcoholic person, completely unconscious, be allowed to lie unmolested for half-an-hour, and his pupils be then examined, they will be found *contracted*, but if any external stimulation be applied to the body, such as moving the person, pulling the hair of his face, or slapping him, the pupils will be seen to gradually dilate, while he remains all the time completely comatose; then if he be allowed to lie quiet again for ten, fifteen, twenty, or thirty minutes—for the time differs in different cases—the pupils will be found to have returned to their originally contracted condition. It is this contraction and dilatation which is the characteristic pupillary condition of alcoholic cases, and, moreover, it is one which differs so much from those states of unconsciousness in which the pupils are contracted and fixed, or dilated and fixed, that it becomes a most valuable factor in diagnosis."* The breathing is regular and deep, but not usually stertorous. The temperature is nearly always subnormal, and may be as low as 94° F.

* *Medical Jurisprudence, Toxicology, and Public Health*, p. 347.

In determining the cause of a condition of coma, not too much importance must be attached to a smell of alcohol about the mouth, as brandy or other stimulant may have been given from kindly motives when the unconsciousness supervened. Moreover, in a drunken individual, the coma may still be wholly or partially due to another cause. The person may have fallen and fractured his skull, or had an attack of apoplexy or epilepsy.

Opium Poisoning.—A condition of drowsiness gradually passes into profound coma, from which no stimulus will arouse the patient. The face is pale, the lips cyanosed, and the pupils extremely contracted. The temperature may be subnormal. The pulse is usually weak and slow, but in some cases is very frequent. The breathing is slow, gasping, and stertorous; before death it may assume the Cheyne-Stokes type. Other poisons, notably carbolic acid, chloral, and belladonna produce states of unconsciousness before death. The symptoms observed are described in Part II.

Injuries to the Head.—If there are external signs of fracture, the diagnosis is readily made, but the condition of unconsciousness known as concussion of the brain or stunning, may supervene after a blow or fall on the head which has not produced any gross organic lesion. In severe cases the coma is profound, the muscles are relaxed, and the conjunctivæ insensitive. The pupils vary, but are equal; in bad cases they may be dilated. The breathing is slow and shallow, the pulse weak, the temperature subnormal, and the sphincters often relaxed. The diagnosis of coma due to internal hæmorrhage, depressed fracture, &c., will be found in works on surgery.

Meningitis, abscess, or tumours of the brain may give rise to coma. The differential diagnosis of these conditions belongs to clinical medicine.

Syncope.—This condition has already been described.

Sun- and Heat-stroke.—The attendant circumstances will usually indicate the cause of the condition. In most cases the individual has either been doing hard physical work under a strong sun, or has been employed in the hot, moist atmosphere of an engine-room. Soldiers on the march and stokers on steamers are the most frequently affected. The symptoms are described in Chapter vii.

Post-mortem Appearances in Death from Coma.—These are not very characteristic. Usually the signs of asphyxia are more or less distinct. The brain and meninges may be hyperæmic.

Sudden Death from Natural Causes.—Death occurring suddenly and unexpectedly is so often the subject of enquiry in the coroner's court that it is important to be familiar with the causes, other than violence, which may produce it.

Cardiac lesions constitute the commonest natural causes of sudden death. They comprise valvular disease, especially aortic incompetence, fatty degeneration and other forms of myocarditis, angina pectoris, and rupture of the heart wall or valves, an event which very rarely occurs unless the organ is already the seat of disease.

Bodily exertion, fright, or emotion is often the precipitating cause.

Diseases of the blood-vessels, leading to apoplexy, aneurism, thrombosis, &c., come next in frequency.

Sudden death from asphyxia may be caused by pulmonary embolism, hæmorrhage from phthisical cavities, pleurisy with effusion, pneumo-thorax, &c. Obstruction of the air-passages may be the result of pressure of an aneurism or tumour, œdema of the glottis, diphtheritic membrane, or spasm of the larynx which may follow the lodging of a small particle of food upon the vocal cords. Laryngismus stridulus is occasionally fatal in children.

Other causes of sudden death are severe hæmorrhage from perforation of the splenic artery by a gastric ulcer, or from vulvo-vaginal varices, or varicose veins in the leg, rupture of a viscus or visceral abscess, or the sac of an ectopic gestation, sunstroke, a sting on the face or tongue by a bee or wasp (*v.* Chap. xxv.), and, in children, convulsions and abscess of the thymus gland.

Exceptionally, diseases which, as a rule, are attended by symptoms of some duration cause death without previous warning. Such are uræmia, diabetes, ambulatory typhoid, latent pneumonia, cardiac paralysis after an unnoticed attack of diphtheria, cerebral abscess especially of the frontal lobes, acute intestinal obstruction, strangulated hernia, and gallstone colic.

Certain affections of the nervous system which may cause sudden death are of great importance, for the reason that they produce no anatomical change which can be recognised on post-mortem examination. Epilepsy, for instance, is sometimes fatal in the acute stage, and if no one has seen the fit, the cyanosed face, injected conjunctivæ, blood-stained lips from the bitten tongue, and froth-covered mouth of the deceased may well give rise to suspicion of violence. If death occurs in the tonic stage, the muscular rigidity may pass continuously into rigor mortis. In another class of cases, death is due to inhibition of the action of the heart by stimulation of a peripheral nerve. A violent blow on the abdomen, or over the heart, for instance, may be followed by immediate death; and cases are recorded of like effects from violence to the testicle or larynx. But sometimes a comparatively small stimulus produces the untoward result, particularly in persons of neurotic temperament, or in a great state of apprehension. Sudden death, for example, has followed the passage of a catheter into the bladder, or of a sound into the uterus, or even a simple vaginal examination. Prof. Dixon Mann quotes several instances of the effect of extreme terror. In one case, a man who had been pounced upon by a panther, but had only received a few slight scratches on the shoulder, died from the shock the following day. In another, a man was aroused from sleep by a lizard creeping up his naked legs. Believing it to be a cobra, of which he had an intense dread, he became profoundly collapsed, and died in six hours. A boy upon whom Dupuytren was going to perform lithotomy fell back dead, when the surgeon drew his finger-nail across the perineum to indicate the line of incision to some students.

A purely mental stimulus, such as sudden great joy or sorrow, may be fatal. Brouardel relates the case of a girl, aged 7, who returned from school one day in a state of great excitement, crying out, "Mother, I have passed the examination," and was found dead shortly afterwards.

Classification of the Causes of Death for Legal Purposes.—So far we have been dealing with the causation of death from the point of view of the pathologist, but the lawyer is concerned with the responsibility of the cause of death. For legal purposes, therefore, deaths are classified as follows:—

- Natural Deaths.
- Violent Deaths.
  - Accident.
  - Suicide.
  - Homicide.
    - Murder.
    - Manslaughter.
    - Justifiable and excusable homicide.

The medical jurist is chiefly concerned with death by violence, each form of which requires consideration.

Accidental Death.—During the year 1903, 10,799 males and 4,665 females died from accident and negligence in England and Wales. Among the males, vehicular accidents were responsible for the greatest number of deaths, 2,139; drowning caused almost as many; and then, in the following order, falls; suffocation (mostly cases of overlying); and burns and scalds. Among the females, burns and scalds held the first place; then falls, suffocation, drowning, and vehicle accidents.

In the coroner's court, a verdict of "accidental death" is often equivalent only to an expression of opinion that the violence precedent to death was of a non-criminal nature.

In the law courts, the question as to whether a death is to be regarded as accidental or natural may be the point at issue in claims under accident or death insurance policies, actions for damages, and claims under the Workmen's Compensation Acts and other statutes. Disputes arise under various circumstances. Liability may be disclaimed on the grounds that the post-mortem examination has revealed organic disease, but for the presence of which the accident would not have proved fatal; or that the initial accident was of too trifling a character to be considered the cause of death; or that the individual was himself responsible in consequence of improper or foolish behaviour. Much information on the subject, together with lists of decided cases, will be found in an article by Dr. Stanley B. Atkinson in the *Law Magazine and Review*, Aug. 1905. With regard to claims under definite policies, no general principles can be laid down, for the decision in each case will depend largely upon the terms of the policy itself. But, of an accident *within the meaning of statutes*, Lord Macnaghten, in the House of Lords, in 1903, enunciated the following definition:—

"The expression 'accident' is used in the popular and ordinary sense of the word, as denoting an unlooked-for mishap or an untoward event which is not expected or designed." As illustrations of accidents and non-accidents within the meaning of statutes, we may quote the following from the article referred to above, with the dates of the decisions:—

A. Where the workman has predisposing bodily infirmity.

Accidents.

1899.—Gout aggravated by unexpected violence of fellow-workman.
1905.—Epileptic stevedore falls into a hold.

Not Accidents.

1900.—Hernia of womb while straining.
1901.—Internal strain and injury to spinal muscles.

B. Where the workman is blameless.

Accidents.

1901.—Spinal muscles rupture while lifting beam.
1904.—Lightning-stroke while exposed, working near building.
1905.—Woolsorters infected with *B. anthracis*.

C. Where the workman is probably negligent.

Accidents.

1902.—Crushed toe; cellulitis in fifteen days; death ten days later.
1903.—Scratch becomes septic.

Not Accidents.

1898, 1905.—Ingravescent industrial lead colic.
1900.—Red lead and oil poison blistered finger.

Suicide.—During the year 1903, 3,511 persons committed suicide. The distribution according to sex and method adopted is shown by the following table:—

Males.		Females.	
Hanging,	792	Drowning,	285
Drowning,	502	Poisons,	229
Knives, &c.,	481	Hanging,	150
Gun-shot wounds,	305	Knives, &c.,	121
Poisons,	300	Jumping from a height,	34
Railways,	122	Railways,	19
Jumping from a height,	48	Gun-shot wounds,	5
Burns, scalds, and explosions,	3	Burns, scalds, and explosions,	5
Otherwise, or not stated,	87	Otherwise, or not stated,	23
Total,	2,640	Total,	871

The relative frequency with which the different poisons are employed is given in Chapter xix.

It will be noticed that women seldom resort to fire-arms, while, on the other hand, poisoning is relatively much more frequent among them than among men. Six of the males and four of the females were between the ages of ten and fifteen, but suicide has been recorded in children less than ten years of age. Suicide in either sex is committed most frequently between the ages of forty-five and fifty-five.

The death-rate from suicide has shown a marked increase during recent years. In 1874 it was 67 per million persons living in England and Wales; in 1884 it was 76 per million; in 1894, 91; and in 1903 this death-rate was 105, the highest yet recorded.

Self-destruction by a person of sound mind is a felony. The attempt to commit suicide is a misdemeanour. A person who persuades, or aids and abets, another to commit suicide is guilty of murder, and when two persons agree to commit suicide together, and one only dies, the survivor is guilty of murder. Suicide is also committed, in law, when a person occasions his own death while feloniously attempting to kill another, as, for instance, by the bursting of his gun while shooting at another. A woman who dies in consequence of her own attempt to procure abortion has, in law, committed *felo de se*.

Suicidal impulses are strong in various forms of insanity, particularly melancholia, and some persons have held that the act of self-destruction alone is sufficient evidence for regarding the individual as insane. Undoubtedly, however, suicide may be the outcome of calm and deliberate reasoning by a person, in full possession of his faculties, who has come to the conclusion that it affords the best means of escape from his difficulties. Out of 3,480* inquests on suicides held in 1903, 3,441 verdicts of suicide while "of unsound mind" were returned. Probably the number of persons who were actually insane at the time was not nearly so great as this, but juries are generally anxious to find a verdict which saves the reputation of the individual.

Murder and Manslaughter.—According to Coke, the crime of murder is committed "when a person of sound memory and discretion unlawfully killeth any reasonable creature in being and under the king's peace with malice aforethought, either express or implied."

Manslaughter is the unlawful killing of another without malice either express or implied.

It is neither murder nor manslaughter unless death takes place within a year and a day after the injury.

It will be seen from the definitions that the essential distinction between the two crimes is the presence or absence of "malice." This term has, in law, a much wider significance than its ordinary meaning of personal hatred or ill-will, and has been defined as a

* These figures, from *Criminal Judicial Statistics*, 1903, differ slightly from the Registrar-General's returns.

deliberate intention to do a wrongful act without just cause or excuse. It is unnecessary here to describe the various circumstances from which the law will presume malice; but there are two occasions upon which the medical evidence is of great importance in determining the question of responsibility. These are (1) the discovery at the post-mortem examination of organic disease or abnormal development in the individual, and (2) evidence that the medical treatment of the injury was unskilled.

Many instances may be given of disease or abnormality contributing to cause death, or without which death would probably not have occurred. A blow on the head, not sufficient to have injured a person of ordinary development, may fracture the skull of an individual whose bones are abnormally thin. A box on the ear may cause death from the bursting of a pre-existing cerebral abscess; or a slight knock on the head may be followed by cerebral hæmorrhage in a person whose arteries are atheromatous. An aneurism may be ruptured by the application of force which would not otherwise have caused harm. A person suffering from heart-disease may drop dead as the result of a push, or even threatened violence. In lunatics, and persons suffering from nervous diseases, the bones, in consequence of trophic changes in them, are often extremely fragile, and very little violence may be sufficient, perhaps, to break half a dozen ribs.

Legally, it is no defence to a charge of murder or manslaughter to show the existence of contributory causes of death, or to prove that the victim was suffering from a mortal disease from which he was likely soon to die. The law regards a man as responsible for the natural and probable consequences of his act; in a person suffering from heart-disease, death after a blow which might not have been fatal to one in good health, is a natural and probable consequence.

The great importance of showing contributory causes of death arises from the fact that light may be thereby thrown upon the state of mind of the assailant at the time he committed the violence. A blow on the head, which was followed by death, was presumably inflicted with great force and with the intention to kill, or at least do grievous bodily harm—*i.e.*, with malice. When the post-mortem examination shows that death has been really due to the bursting of a cerebral abscess, the statement of the accused that the blow was of a trifling character, or was merited chastisement, becomes credible. Under such circumstances, a criminal charge may be dropped altogether, or one of murder reduced to manslaughter. In any case, the punishment is likely to be considerably mitigated.

With regard to the question of the medical treatment of the injury, it is no defence to a charge of murder to show that the immediate cause of death was the neglect or refusal of the injured person to submit to an operation. Nor is it any defence to show that death was due to the subsequent treatment of the wound or injury, even in cases in which the post-mortem examination has shown that the

treatment was based upon an erroneous diagnosis, and was unnecessary or wrong, provided that such treatment was applied in good faith and with reasonable skill and care. It is, however, a good defence to prove that the injury was not in itself of a dangerous character, and that death was due to treatment negligently or unskilfully applied. Death due to a *bona fide* mistake in treatment will be regarded as a natural and probable consequence of the act of the assailant; but unskilled treatment was not to be anticipated, and therefore forms a good defence. What constitutes reasonable skill and care will be determined by the attendant circumstances in each case (*v.* Malapraxis, Chap. xvii.).

Justifiable homicide is judicial execution, the killing, by a peace officer, of a person resisting lawful arrest, or, by a gaoler, of a felon trying to escape, &c.

Excusable homicide is killing by accident, or in self-defence upon a sudden affray.

CHAPTER V.

THE SIGNS OF DEATH.

CONTENTS.—Molecular and somatic death—Early signs of death; cessation of respiration and circulation; inconclusive signs—Signs of death appreciable only after an interval; post-mortem cooling; hypostases; rigor mortis; instantaneous rigidity; putrefaction—Putrefaction in water—Exceptional forms of decomposition; saponification; mummification—How long dead?—Conditions resembling death, syncope, trance, partial asphyxia—Premature burial—Cremation.

Molecular and Somatic Death.—The changes which occur in the body after death are important for two purposes—first, as a means of ascertaining that life is actually extinct, and, secondly, for determining the interval of time which has elapsed since death.

The signs of death can be grouped into two classes—those which are present immediately after death, and those which cannot be observed until an appreciable time has elapsed. The existence of these two classes is due, for the most part, to the fact that the death of the tissues or *molecular death* does not occur simultaneously with the death of the individual or *somatic death*. Every student of physiology is familiar with the fact that the heart of a pithed frog will continue to beat, and a muscle-nerve preparation show signs of vitality, for a considerable time after the frog has been killed; he has probably also observed contraction in the muscles of an amputated limb. All these signs of vitality are evidence that molecular death of the tissues has not yet occurred. A gangrenous toe, on the other hand, affords an instance of molecular without somatic death. We shall see later that these facts have important bearings in determining whether wounds or burns were received ante- or post-mortem.

Early Signs of Death—Permanent Cessation of Circulation and Respiration.—Conclusive evidence of death is afforded if the arrest of both these functions can be established with certainty. It is not sufficient that respiration alone should have apparently ceased, for it is well known that the apparently drowned may be resuscitated after respiration has stopped, or at all events has been reduced to so low a point as to be imperceptible by ordinary methods of observation. On the other hand, beating of the heart alone is not a conclusive sign of life, though, under ordinary circumstances, no one would pronounce the individual in whom this can be observed as dead. That, however, the heart may beat solely in virtue of the molecular life of its tissues is shown by the case of the guillotined criminal previously referred to. With regard to the means of ascertaining that the circulation has actually ceased, the physician, after carefully auscultating the heart, will rarely have any

difficulty in coming to a decision. A test which may be applied in doubtful cases is to tie a ligature around a finger, and observe whether the tip becomes blue. Icard's test consists in injecting a solution of fluorescin (resorcin-phthalein and sodium bicarbonate). If circulation continues, the skin assumes a yellowish-green colour, and fluorescin may be detected in the blood drawn from a distant part by placing some white threads in it, and then boiling them with water in a test-tube, when a greenish solution results. For this test to be of practical value, the medical man must go to the death-bed with his solution ready prepared, a rather unlikely proceeding.

Tests for ascertaining the existence of very weak breathing are the placing of a feather on the lips and noting whether it is moved, and the holding of a bright cold mirror before the mouth and observing if it becomes dim.

Inconclusive Signs applicable at the Moment of Death.—The face becomes pale, and often assumes a peaceful expression in consequence of the effacement of lines and wrinkles by muscular relaxation. The pupils dilate at the moment of death, but subsequently return to the intermediate position. The eyes lose their lustre, mucus collects on the conjunctivæ, and the tension of the eyeballs is lessened. But a fixed and glassy appearance of the eyes may be present before death. General muscular relaxation occurs, and the lower jaw drops, but after death from strychnine poisoning or tetanus the jaw may retain its position. Reaction to mechanical stimuli applied to the skin, such as pricking or pinching, is lost, but this may also be the case in conditions of profound coma. If a muscle be laid bare, mechanical stimuli will produce a reaction for a short period of time after death. Irritability to electric stimuli remains for some hours, but ceases when molecular death occurs.

Signs of Death Appreciable only after an Interval —Post-mortem Cooling.—This, if continuous, is a sure sign of death. It must be remembered, however, that the temperature may be very considerably lowered before life is extinct. The surface of the body and extremities may be quite cold to the touch, and internal temperatures below 90° F. have been recorded before death in states of collapse from acute peritonitis, cholera, or poisoning. Lemcke observed a rectal temperature of 73·4° F. twenty-seven hours before death in a case of hæmorrhage into the medulla oblongata. Usually, cooling commences at once after death, but in some cases of smallpox, cholera, yellow fever, acute rheumatism, tetanus, strychnine poisoning, and injuries to the nervous system, a post-mortem rise of temperature of several degrees may be observed. This is due to the heat developed by bacterial activity, muscular contraction, or nervous influences. But when once the temperature has commenced to fall, it continues to do so without intermission. The rate of cooling is not uniform; roughly speaking, it is at any moment proportional to the elevation of the temperature above that of the surrounding medium. Under ordinary circumstances it may be said that a body loses about 2° or 3° F. per hour for the first few

hours, and thereafter about 1° F. per hour, but the last few degrees of heat are retained for a long period. Usually, while the surface is quite cold to the touch in from seven to ten hours after death, the viscera are perceptibly warm to the hand after twenty-four hours. The normal rate of cooling may, however, be much modified by various factors connected either with the body or with its environment. These are as follows :—

(*a*) **The Condition of the Body.**—Fat is a bad conductor of heat ; fat bodies, therefore, do not cool so quickly as thin ones. Any circumstances which tend to preserve the nutrition and tone of the tissues will delay the rate of cooling, hence the bodies of those who have died suddenly retain heat longer than those of persons who have perished from lingering disease. Obviously, also, a body will retain heat longer if its temperature at the time of death is high than if it is low, or if its temperature rises after death.

(*b*) **The Age of the Body.**—Infants lose heat quickly, because of their large surface area in proportion to the weight of the body. Old persons cool more rapidly than the young and middle-aged, owing to the absence of subcutaneous fat, and the feeble nourishment of the tissues.

(*c*) **The Surroundings of the Body.**—A body which is clothed, or is in bed, or in a warm room, retains heat longer than one naked, or exposed to the open air. A body cools more quickly in water than on land, and more rapidly in running than in shallow, stagnant water.

Post-mortem Hypostasis. — After an interval, which is usually about five or six hours, but may be as short as three, or as long as twelve hours after death, livid stains, known as hypostases or sugillations, make their appearance upon the more dependent parts of the body and viscera. The development of these stains is a constant post-mortem occurrence, even after death from hæmorrhage, though, in that case, they may appear late, and be only slightly marked. They are generally regarded as a conclusive sign of death, but Brouardel states that they may appear before death in cases of cholera, uræmia, and asphyxia. Hypostases vary in colour from a pale blue to a dark reddish or coppery blue, but each patch is nearly uniform in tint. The stained area has a sharp margin, and is not raised above the level of the surrounding skin.

Post-mortem stains are produced by the distention of the relaxed capillaries with fluid blood, and they naturally tend, therefore, under the influence of gravity, to appear on the most dependent parts of the body. If a corpse has been lying on the back on a smooth surface such as that of the post-mortem table since death, hypostases will be found about the lobes of the ears, the nape of the neck, the lateral parts of the back, and the under surfaces of the limbs. But where the skin is actually in contact with the surface on which the body is lying, pressure prevents the capillaries from filling, and stains are not, therefore, present in these parts. Large white patches will consequently be observed about the shoulders, buttocks, and heels. The effect of pressure is well seen when a body has been

lying on an irregular surface, such as a wrinkled cloth. The ridges of the cloth are marked on the skin as white lines, between which the surface is irregularly stained or mottled. Internally, hypostases are found on the posterior wall of the stomach, lower parts of the lungs, brain, and other viscera. These discolorations are permanent when once clotting of the blood has occurred, a process which probably begins about four hours after death. If, while the blood is still fluid, the body is turned from the back on to the face, hypostases already formed in the dorsal region will disappear, and fresh staining will be formed on the ventral surface. Hence, if a body is found with post-mortem lividities on the upper surface, the inference can be drawn that it has been turned over at least some hours after death.

It is of great importance not to mistake hypostases for bruises, or *vice versa*. When a body is found exhibiting livid markings, suspicion of violence is very likely to be aroused in the lay mind, and the medical man is sure to be interrogated as to the nature of the appearances. Fortunately, the distinction between bruises and hypostases is easily made. A bruise, in the early stages at least, is raised above the general level of the skin, and the cuticle over it is often broken or abraded. The colour of a bruise may be a deep blue in the centre, but it fades away gradually at the margins, which, after a day or two, exhibit a series of green and yellow tints. An hypostasis, on the other hand, is uniformly coloured and has an abrupt margin. The limitation of post-mortem staining to one surface of the body may be another point of distinction. The most important difference, however, is shown when an incision is made into the stained patch. In a bruise, it will be found that the blood has been extravasated into the tissues. In an hypostasis, on the other hand, the blood is still in the capillaries, and the tissues are unstained; only minute drops of blood will be seen exuding from the ends of the divided vessels. After a considerable interval of time, however, the colouring matter of the blood does pass through the walls of the capillaries, and the tissues become stained, but by that time decomposition will have commenced.

Internally, care must be taken not to mistake hypostases for the results of disease or poisoning. The accumulation of blood in the posterior portions of the lungs is very apt to be regarded as congestion, and the staining of the stomach and intestines as inflammation. In that latter case, if a portion of the bowel be held up to the light and stretched, the dark lines of the vessels, if due to hypostasis, will be broken up into separate bits, but if due to congestion, will remain intact.

Closely associated with this subject is the post-mortem coagulation of the blood. In the heart and other cavities of the body containing much blood, clotting takes place in the same manner as outside the body, but more slowly. The red corpuscles sink through the plasma more rapidly than the white, hence the clot when formed consists of a dark red stratum underneath, and an upper nearly colourless portion. From this appearance it may be

possible to determine the position in which a body lay for some hours after death.

Rigor Mortis or Cadaveric Rigidity.—This is the stiffening which is exhibited by the muscles, both voluntary and involuntary, at a variable period after death. As we have already seen, the muscles for a while, under ordinary circumstances, retain their vitality, and are, in consequence, flaccid and contractile to electric stimuli; sooner or later, however, molecular death begins to appear in the tissues, and the changes consequent thereon occur. Rigor mortis does not appear over the whole body at once, but affects various muscles, or groups of muscles, in a more or less definite order. Prof. Glaister states that the involuntary muscles are affected first, and that the rigidity of the heart may give rise to an appearance of cardiac hypertrophy. Stiffening in the neck, jaw, and face commences, usually, in about five or six hours after death; the upper part of the body is definitely affected in ten hours; and rigidity is present over the whole body in from twelve to eighteen hours. It passes off in the same order in which it appeared, and, in most cases, has completely gone in thirty-six hours. Exceptionally, however, rigor mortis appears very shortly after death, and when this is the case it usually passes off quickly. Brown-Séquard records an instance in which it was present three and a half minutes after death from typhoid fever, and passed off in a quarter of an hour. On the other hand, the onset may be delayed, and then the condition is likely to persist for a longer period than usual. Prof. Glaister mentions a case in which it was present twenty-one days after death. After rigor mortis has disappeared, the muscles are again flaccid, but they do not now exhibit contractility to stimuli.

The limbs stiffen practically in the attitudes in which they were at the moment of death, but a slight amount of contraction recurs in the muscles, and this may give rise to small changes of position. Thus, the flexors of the thumb being stronger than the extensors cause the thumb to become slightly flexed across the palm. The resistance of the stiffened muscles to extension is very considerable. When the body is lifted, the limbs remain rigid and do not hang down; and a strong effort is required to overcome the rigidity of a joint. When once a joint has been moved, however, it remains mobile. The reaction of muscles in a condition of rigor mortis is markedly acid, due chiefly to the formation of sarco-lactic acid; but when the condition has passed off, the reaction again becomes alkaline.

The development of rigor mortis is essentially due to coagulation of the myosin within the sarcolemmas of the muscle-fibres; but a subsidiary part is also played by certain nervous influences the nature of which is not fully understood. Bierfreund has shown that section of the nerves supplying a muscle delays the advent of rigor mortis in that muscle, and that after hemisection of the cord the limbs enervated from the cut side remain flaccid longer than those on the other side.

Conditions modifying the time of onset and duration of rigor mortis :—

(*a*) **The State of the Muscles.**—Any influence which tends to exhaust the muscles or lower their tone before death, hastens the advent of rigor mortis. Hence it appears rapidly in the bodies of animals hunted to death, or in soldiers killed at the end of a battle or after a fatiguing march. The exhaustion produced by prolonged convulsions or lingering illness has the same effect. Conversely, those who die suddenly in the midst of good health stiffen slowly. Good muscular development retards, and muscular weakness accelerates, the onset of rigor mortis.

(*b*) **The Age of the Individual.**—It is said that rigor mortis does not appear in the body of a fœtus of less than seven months ; this statement, however, is not universally accepted. Rigidity sets in early in young children and in aged persons.

(*c*) **The Temperature of the Environment.**—A warm temperature hastens rigor mortis, but if above 75° C. other albuminates besides the myosin coagulate, and the condition known as heat-stiffening is produced (*v.* p. 55). Freezing prevents rigor mortis, but, when the body is thawed, it comes on more quickly that it would otherwise have done.

(*d*) **Integrity, or otherwise, of the Nerves.**—(*Supra.*)

Instantaneous Rigidity or Cadaveric Spasm.—This is a condition in which the muscles are firmly contracted in the position they were in at the moment of death. It occurs in cases in which death was immediately preceded by a state of great nervous tension or excitement. Many instances are recorded of a suicide continuing to grasp in his hand the weapon with which he has destroyed himself. Soldiers killed in battle have been found still holding their rifles in the position for taking aim. The hand of a drowned person may be firmly clenched round land plants seized at the moment of falling into the water. The cause of instantaneous rigidity is not fully understood ; the condition is not rigor mortis, but appears to be a vital contraction at the moment of death, which is continued after death, and gradually passes into rigor mortis. It is undoubtedly due to nervous influences, and has been produced experimentally in animals by irritation of the medulla. In some of the cases which exhibited instantaneous rigidity, death was due to injury of the brain, or epilepsy, or poisoning by CO or CO_2; but the condition has also been observed after death from cut-throat.

Instantaneous rigidity is of great medico-legal importance, for the reason that the condition cannot be artificially induced, or successfully imitated. In consequence, when a person is found dead with the hand firmly grasping a pistol or razor, a very strong presumption of suicide arises. If a murderer were to place a weapon in the hand of his victim, the fingers would not close over it unless he held or bandaged them in that position for some hours until rigor mortis set in, and, in that case, the marks of his fingers or of the bandages would be visible on the hand of the deceased.

Other conditions simulating rigor mortis are, freezing of the body, catalepsy, and heat stiffening. Freezing is distinguished from rigor mortis by the crackling sounds produced in the joints when they are forcibly flexed. Catalepsy is eliminated by the fact that life is not extinct. Heat stiffening is described on p. 55.

Putrefaction.—This is the process by which the tissues of the body are finally broken down and disintegrated. Decomposition is effected chiefly by the agency of bacteria, but it has been found also that different species of insects are attracted to the body in a definite order as putrefaction advances. These have been arranged into groups, and by means of the fauna which is present on the body, it has been found possible to determine the stage which putrefaction has reached, and thus, approximately, the time which has elapsed since death. Details of the method will be found in Brouardel's *Death and Sudden Death*. A body in the sea may be attacked by crabs, and one on land by rats, the latter often dividing the skin in a straight line so as to produce the appearance of a cut with a knife.

Both the rate and character of decomposition vary within wide limits with the condition of the body at death, and the circumstances of the environment. The following table, modified from Casper, shows the progress of decomposition under ordinary circumstances in a body exposed to air :—

1 to 3 days, .	A bright green, greenish-yellow, or coppery discolouration appears about the centre of the abdomen. The eyeball becomes softened, and the cornea somewhat corrugated.
3 to 5 days, .	The colour becomes of a deeper tint, spreads over the whole surface of the abdomen, and appears in patches on the genitals and other parts of the body. Gases develop in the abdomen, and force a brownish frothy fluid from the mouth and nose. An offensive odour is exhaled.
8 to 10 days, .	The abdomen is greatly distended with gas. The veins in places appear like red cords upon the surface. The cornea have become concave.
14 to 20 days, .	The whole body is now greenish-brown in colour, and enormously distended. The skin is peeling off in large patches, and in some places bullæ have formed beneath it. The nails and hair are loose, and easily detached. The features are bloated and unrecognisable. Maggots are present in various parts of the body.

The subsequent changes cannot be divided into stages except by the entomological method. The thorax and abdomen burst, the tissues undergo colliquative putrefaction, the ligaments disappear, and finally only the bones are left.

It is important to notice that putrefaction does not appear so early, or advance so rapidly, in the limbs as in the trunk ; and is still further retarded if the limbs and trunk are separated at the time of death. This fact has given rise to error in cases of dismemberment,

when the various portions of the body have been found at different times and places. It is perhaps thought that the remains do not all belong to the same body, or, if the limbs are found before the trunk, that the crime has been committed more recently than was actually the case.

Internally, as putrefaction progresses, the viscera show changes of colour—green, brown, and purplish-black—and gradually become soft and pulpy before liquefying. Patches of reddish-brown colour in the stomach must not be mistaken for signs of irritant poisoning. Decomposition does not proceed at the same rate in all the organs; it is more rapid in the larynx and trachea owing to the freedom of access of air; and in the stomach and intestines owing to the presence within them of bacteria and decomposing food; it is delayed in organs composed chiefly of muscular tissue. Casper gives the following as the order in which the viscera undergo decomposition :—

Putrefy rapidly.	**Putrefy slowly.**
1. Larynx and trachea.	9. Heart.
2. Brain of infants.	10. Lungs.
3. Stomach.	11. Kidneys.
4. Intestines.	12. Bladder.
5. Spleen.	13. Œsophagus.
6. Omentum and mesentery.	14. Pancreas.
7. Liver.	15. Diaphragm.
8. Adult brain	16. Blood-vessels.
	17. Uterus.

The uterus resists putrefaction longer than any other organ of the body; it may therefore be possible to determine with certainty the sex of a body so decomposed that the other viscera have practically disappeared.

The pressure of the gases developed by putrefaction within the body is often very considerable. Several instances have been recorded in which it was sufficient to expel a fœtus from a pregnant uterus. Another effect of the pressure may be to drive the blood from the interior of the body, and start bleeding afresh from a wound. In superstitious times, this posthumous bleeding was looked upon as a sign that the individual had been murdered.

The rate of decomposition varies within wide limits, the following being the chief factors which influence it :—

Freedom of Access of Air.—Bodies freely exposed to air decompose more quickly than those protected from it. Clothing, air-tight coffins, deep burial, and burial in clayey soil all tend to retard putrefaction. Even slight protection from air exerts an influence, for the bodies of infants have been found remarkably well preserved after lying for a considerable time beneath the filth of privies and cess-pits. Chloride of lime placed round a body retards decomposition both by keeping off the air, and acting as a germicide.

Temperature of the Environment.—A low temperature retards decomposition; if frozen, a body will remain unchanged indefinitely.

Carcases of mammoths which have been dug out of the frozen sand of Siberia thousands of years after they had been engulfed, have been found still quite fresh, and used by the natives for feeding their dogs. Warmth, up to a certain point, promotes dissolution of the body, but when the temperature is above 100° F. microbic activity begins to be inhibited, and the tissues tend to undergo desiccation.

Presence of Moisture accelerates decomposition, though a body totally immersed in water putrefies less quickly than one on land. Here, however, the protection from air, and the usually lower temperature, are also factors tending to retard change. A body which has been immersed, and then taken out of the water, decomposes more rapidly than one which has been lying on land since death.

As regards external conditions, then, decomposition is most rapid when the body is freely exposed to a warm, moist atmosphere. The internal factors to be considered are :—

The Age of the Body.—The bodies of infants putrefy more rapidly than those of adults ; the brain breaks down early in consequence of the openness of the sutures and fontanelles. Decomposition is slow in aged persons whose tissues are dry and shrivelled before death.

The Condition of the Body.—Obesity promotes decomposition ; emaciation retards it. Parts of the body which are contused or lacerated putrefy rapidly.

The Cause of Death.—The bodies of those who have died with dropsical effusions decompose quickly owing to the large amount of moisture in the tissues. Putrefaction is also rapid after death from asphyxia, lightning, and diseases accompanied by excessive bacterial activity, such as septicæmia, typhoid, smallpox, &c. The injection of certain substances before death tends to retard decomposition. The bodies of those who have died from arsenic or antimony poisoning have been found remarkably well preserved when exhumed after a considerable interval. Chronic alcoholism also tends to preserve the tissues.

Putrefaction in Water.—This takes place, as a rule, more slowly than putrefaction on land, owing to the low temperature and want of access of air. It is slower in running than in stagnant water, and is accelerated by the presence of sewage. Peaty water exerts a preservative action upon the tissues owing, chiefly, to the tannic acid it contains. On the average, the changes which occur in a body in water are as follows :—In from four to five days the skin of the fingers, palms, and soles becomes sodden and bleached, and, a little later, the backs of the hands and face are bleached. Greenish or brown discolouration appears on the face or middle of the chest in from eight to fourteen days. After six to twelve weeks the skin is extensively discoloured a deep bluish-black or green, and is wrinkled and peeling off in patches. The hair is falling out, the nails are loose, and the abdomen is distended with gases. Adipocere is forming in the more fatty parts of the body. Eventually the soft parts separate, and the bones fall asunder.

Owing to the development of gases within it, the body of a drowned

person rises to the surface within from three to nine days, according to the rate of decomposition. If the gases are liberated, it will sink again, and may alternately float and sink several times.

Exceptional Forms of Decomposition.—Under certain circumstances, the changes in a body proceed along lines differing from those described above. These processes are saponification and mummification.

Saponification.—This occurs in bodies immersed in water or buried in damp soil. The decomposition of the fatty tissues gives rise to various organic acids, chiefly palmitic, stearic, and oleic, which unite with ammonia liberated from the nitrogenous tissues, or with soda, potash, or calcium contained in the surrounding water. The result is the formation of a soap to which the name **adipocere** is given. This substance is white or brownish in colour, and, when dried, will last for many years unchanged. It has a firm, unctuous feel, a rancid odour especially when warmed, and a specific gravity less than that of water, so that it floats. It burns with a bright yellow flame. Adipocere is formed most readily in those parts of the body in which a considerable amount of fat is present, such as the breasts or buttocks. It is rare for the whole body to become changed, but in digging the foundations of King's College Hospital, which is built on the site of an old monastery, a number of bodies completely saponified were disinterred.

The formation of adipocere, in this country, is a slow process. Prof. Dixon Mann states that it does not appear in a body buried in moist earth before from eight to twelve months, but years must elapse before the soft parts are completely saponified. In water, partial saponification may occur within three or four months, and it has been observed after a little more than five weeks. In hot climates, extensive formation of adipocere has occurred after the lapse of a few days.

Mummification.—When a body is surrounded by a hot, dry atmosphere, the soft parts become desiccated, and the skin looks like parchment tightly stretched over the shrunken tissues and bony framework. Instances are not infrequently met with in warm countries where bodies have been placed in dry catacombs, or buried in hot, sandy soils. In this country mummification occurs only under exceptional circumstances. It has been observed in the bodies of infants hidden behind fireplaces, or in other dry localities.

How long has the Body been Dead?—This is a question which it is impossible to answer precisely. Devergie has divided the changes which occur after death into four periods as follows :—

A Few Minutes to Twenty Hours.—The body still retains warmth, and rigor mortis is only partial. The muscles contract to electric stimuli. Usually a body feels cold to the touch in from seven to twelve hours after death.

Ten Hours to Three Days.—The body is quite cold, and rigor mortis is well marked. Contractility of the muscles is lost.

Three to Eight Days.—Rigor mortis has completely passed off.

Six to Twelve Days.—Putrefaction is occurring.

Nevertheless the rate of post-mortem changes varies so largely with the condition of the body and the circumstances of the environment, that the above table can only be looked upon as a very rough approximation. Days in winter may correspond to hours in summer. Extensive decomposition has been noticed in as short a period as sixteen hours after death. The medical man in the witness-box must never be dogmatic, therefore, when giving his opinion on this question.

Conditions resembling Death.—Three states of suspended animation, which are liable to be mistaken (by the layman, rarely by the medical man) for death, are described. These are syncope, trance, and partial asphyxia. In rare instances also error has been made in cases of cerebral concussion, poisoning, and drunkenness.

Syncope (*v.* p. 17).—In the vast majority of severe fainting attacks some indication of circulation or respiration can be observed.

Trance.—This condition may be met with in young neurotic females. In deep trance there is usually complete unconsciousness, and the conjunctival and other reflexes are frequently lost. The face is pale, and the pulse may be imperceptible, though weak heart-sounds are still audible. Gowers states that the breathing may be so feeble that movement of the thoracic walls cannot be observed, a respiratory murmur is not audible over the lungs, and a mirror held before the mouth remains undimmed. In such cases of "death-trance" he gives as indications for recognising the presence of life (1) the absence of any sign of decomposition; (2) the normal appearance of the fundus oculi as seen with the ophthalmoscope; and (3) the persistence of excitability of the muscles by electricity. When so high an authority considers it necessary to wait for such signs of death as decomposition or loss of contractility, it must be admitted that there is a real danger, though in extremely rare cases, of mistaking the condition for death.

Catalepsy is an allied state which is accompanied by muscular rigidity.

Partial Asphyxia is the condition of suspended animation most likely to be met with. It is observed chiefly in persons rescued from drowning; those who have inhaled non-respirable gases; and newly-born infants, particularly after prolonged or difficult labour. In such cases no time should be wasted in applying delicate tests for the presence of life, but artificial respiration should be at once resorted to, and persisted in for at least an hour. If, during that time, the smallest sign of life is evinced, the efforts should be continued for several hours longer.

Premature Burial.—The subject of apparent death is of importance, in view of the risk of premature burial, a morbid fear of which exists in the minds of a good many persons. In countries, such as England, where an interval of several days is allowed to elapse between death and burial, the danger of such an occurrence is practically non-existent. In Germany, mortuary-chambers in which the dead are placed, have been established for many years. An attendant visits the mortuary at intervals, and a bell-rope is placed in the hands of the corpse, but the bell has never yet been

rung. During times of epidemics, and in hot countries, where it is necessary to dispose of the body soon after death, a slightly greater risk of premature burial exists. A good many cases have been recorded, but the great majority of them are not authenticated, and in very few was the death verified by a physician. Brouardel relates the following instance, which occurred in Morlaix in 1866:—A young woman, aged twenty-six, after a short illness was believed to have died from cholera, which was at that time raging in the Morbihan. She was placed in a coffin, and buried sixteen hours after death. Subsequently sounds were heard by several persons, and the coffin was exhumed after three hours' interment. Dr. Roger, who examined the girl, found unmistakable evidence of life, but death undoubtedly occurred the following day. In this case it will be noticed that an epidemic was prevailing at the time, that the death was not verified by a physician, and that only sixteen hours elapsed between death and burial.

The details of a recent remarkable case, which illustrates the danger of permitting certificates to be given without verification of death, are recorded in the *Lancet* of January 28, 1905. A married woman, living near Accrington, was believed to be dead, and the body, clad only in a nightdress, was laid out in an icy-cold room in the usual manner. Six hours later, an undertaker, while measuring the supposed corpse for a coffin, noticed a twitching movement of the eyelids. He resorted to artificial respiration, with the result that the woman regained consciousness. There was no shadow of doubt that she had been regarded as dead, for funeral coaches had been ordered, an insurance company informed of the death, and a doctor's certificate obtained. The medical man had seen his patient on the previous day, and was not surprised to hear of her death, as she had been ill and confined to bed for several weeks. On two previous occasions the woman had passed into a cataleptic state, and she had also been subject to fits.

Cremation.—A discussion as to the hygienic value of this method of disposing of the dead as compared with burial, is not within the province of this book. The medico-legal importance of cremation arises from the possibility of evidence of death by violence being thereby destroyed. On the average, five exhumations are performed in England and Wales in a year, and, in rather less than a fifth of these, evidence of crime is found. Conclusive evidence of poisoning was found in the bodies of Chapman's victims after they had been interred, in one case for five years, and in another for one year. It is argued that the general adoption of cremation would prevent such cases from ever coming to light; on the other hand, the upholders of the system assert that the precautions taken to ascertain beyond doubt that death was due to natural causes before the body is burned would lead to the prompt detection of crime, and that the necessity for exhumations would be abolished. The London Cremation Company require a certificate from the deceased's ordinary medical attendant, and another from a medical man specially qualified for the purpose. These certificates must be satisfactory to the Company's medical referee.

CHAPTER VI.

DEATH FROM CAUSES USUALLY LEADING TO ASPHYXIA.

CONTENTS.—Death by drowning — Suffocation — Hanging— Strangulation.

Death by Drowning.—This, in strict language, is death from asphyxia owing to submersion of the mouth and nostrils beneath water or other fluid. It is, however, convenient to consider together all the forms of death in water.

Cause of Death.—In most cases, death following immersion in water is due to asphyxia, but, under certain circumstances, syncope, exhaustion, or other factors may play a large, if not the entire part in the causation of death.

When a person who is unable to swim, is suddenly immersed in water, he sinks, but, if not rendered unconscious by syncope or shock, soon rises to the surface again gasping and spluttering for breath. He swallows and inhales a mixture of air and water. In a vain endeavour to grasp something, he throws up his arms, and this sends his head under water a second time. He probably rises again, and even a third time, on each occasion gasping, struggling, and taking in more and more water. Eventually he becomes asphyxiated, and sinks slowly to the bottom. A strong swimmer, on the other hand, will probably make an effort to save himself, and will continue to swim until he is completely exhausted. When the death struggles begin, he has no reserve of strength left, and, accordingly, succumbs more quickly than the non-swimmer, death being due largely to exhaustion. On post-mortem examination in such a case, the signs of death from asphyxia are proportionately less marked.

Sometimes syncope or shock caused by fright, the sudden immersion in the cold medium, or violently striking the surface of the water combines with asphyxia in bringing about death. In such cases the person sinks at once, and does not rise again. Conditions of disease may accelerate death. A person the subject of cardiac lesions may fall into the water, and die from heart-disease, or an attack of apoplexy may be induced by the shock. In other cases syncope or an epileptic fit may be the cause of the fall into the water. Finally, death may be due to injuries received by striking rocks, or inflicted by blows from the paddle of a steamer. In nearly every case, however, some of the signs of asphyxia will be found on post-mortem examination, though the appearances characteristic of simple drowning may be considerably modified.

Post-mortem Appearances in Death by Drowning.—When death has been occasioned entirely or chiefly by asphyxia, the following appearances are found if the body be examined shortly after it is taken from the water :—

External.—The face is usually ashy pale, but, in some cases, is slightly livid with rosy patches about the cheeks. The expression is generally peaceful. One of the most characteristic signs of drowning is the presence of a fine froth, sometimes tinged with blood, about the mouth and nostrils. Its absence, however, is no evidence against death by drowning, for it may have been wiped or washed off, and it disappears naturally in from one to three days. A somewhat similar froth is seen in those who have been asphyxiated by coal-gas or carbon monoxide. Professor Glaister states, however, that in such cases the bubbles are very much larger, and the difference quite appreciable to the experienced eye. Mud and fragments of aquatic plants may be found within the mouth and nostrils. The surface of the body generally shows the appearance known as *cutis anserina* or goose-skin, due to the contraction of the arrectores pilorum. This feature is seen also in death from cold or fright, so that it possesses little diagnostic significance. Moreover, it may occur after death, during the period that the skin still possesses vitality. Rigor mortis occurs early, and the instantaneous rigidity described in Chapter V. is occasionally observed in the bodies of the drowned. The hands may be seen to be firmly clenched around reeds, portions of plants growing on the banks, or other objects. Sand or mud may be found beneath the nails. These appearances are almost conclusive evidence that death had not occurred when the individual entered the water. If the body has been immersed for some days, the skin on the hands and feet will present a bleached and sodden appearance. When decomposition is fairly advanced, the characteristic signs of death by drowning can no longer be distinguished.

Internal.—The **lungs** are voluminous and distended, and, when the thorax is opened, they bulge forward owing to the removal of pressure, a phenomenon to which the term "ballooning" has been applied. They pit on pressure, and, when cut into, exude a frothy, blood-stained fluid. Minute, punctiform ecchymoses may be observed beneath the pleura.

The presence of a similar froth, clear or blood-stained, in the **bronchi**, **larynx**, and **trachea** is a very characteristic sign of drowning. Mud or small portions of water plants may be found in the air passages.

The **heart** exhibits the appearances usually found in death from asphyxia, the right chambers and venæ cavæ being engorged, while the left are comparatively empty.

A valuable sign is the presence of water in the **stomach**, particularly if it contains pond weeds, &c. Numerous experiments have shown that if a body already dead be immersed, water finds its way into the stomach only under very exceptional circumstances. A source of fallacy, in rare cases, is the possibility of water having been drunk immediately before death. On the other hand, water is

not necessarily present in an undoubted instance of drowning, particularly if death was hastened by syncope or shock in consequence of which the individual did not struggle and swallow water.

The **intestines** sometimes contain water which has been passed on by peristaltic action from the stomach.

The **blood** is dark in colour, and unusually fluid.

The typical signs of drowning may be very much modified in cases in which syncope, shock, or concussion has been the chief or a large factor in bringing about death; and their diagnostic value is diminished by the progress of decomposition.

When a body is found in water, the following questions present themselves for determination:—Was death due to drowning; and, if so, have we to deal with a case of accident, suicide, or homicide? Was the body thrown into water after death? How long has the body been immersed?

Was Death Due to Drowning?—When the signs enumerated above, particularly those exhibited by the lungs, air-passages, and stomach, are present, the presumption of death from drowning amounts to a practical certainty. If, however, the post-mortem examination affords only doubtful or inconclusive evidence of drowning, very careful search must be made for wounds, injuries, and other possible causes of death. When the contents of the stomach are still in a condition to be examined, search should be made for the presence of poisons. In cases in which the signs of drowning are not marked, and no other cause of death can be found, the inference must be drawn that death was due to syncope or shock.

Was the Drowning Accidental, Suicidal, or Homicidal?—This question may present very great difficulties, and is often impossible of determination. In the absence of indications to the contrary, a presumption of accident, especially where the body is that of a male, arises. The Registrar-General's figures show that, during the year 1903, 3,317 deaths were caused by drowning in England and Wales. These were distributed as follows:—

	Accident and Negligence.	Suicide.	Murder.
Males, ...	2,109	502	5
Females, . . .	407	285	8
Totals, . .	2,516	787	13

There was also 1 case of manslaughter. Of the murdered persons, 10 were infants under one year of age.

The examination of the body may afford some indications. Injuries must be examined according to the principles laid down in the chapter on wounds. In a body which has been immersed, it is often a difficult matter to determine whether the injuries found were inflicted before or after death, for the water washes away the blood,

and modifies the appearance of the wounds. Bruises, however, are not altered by immersion. Marks of violence, if received ante-mortem, give rise to a suspicion of foul play, and strong presumption of murder is created when the injuries are of a character likely to have proved fatal, and the signs of death from drowning are indistinct or absent. Ante-mortem wounds, however, may be received during the fall if the individual strike the piers of a bridge, steps of a landing stage, &c.; or he may be dashed against rocks while still struggling for life in the water. Occasionally suicides inflict severe injuries upon themselves before taking the fatal plunge. Post-mortem wounds are received if the body is dashed by the waves against hard objects, or struck by the screw of a steamer. Murder is usually indicated when a body is found gagged, or with a cord round the neck, or with the limbs tied together; but a determined suicide, who has failed to achieve his object by stuffing things into his mouth, or endeavouring to strangle himself, may finally resort to drowning, and may even tie his hands and feet together before jumping into the water.

Clothing on the body is compatible with any of the three explanations of death, but a presumption of accident arises when a naked body is found. A murderer pushes his victim into the water as he is, or, if he has previously killed him, does not delay to strip the body of clothes. A suicide usually throws himself in fully dressed. When a body is found weighted, or with the pockets of the clothes filled with stones, suicide or murder is an equally possible explanation.

Signs of a struggle on the bank are very suggestive of homicide, and if land plants are found clenched in the hands of the deceased, the probability that foul play has occurred is greatly increased. Murdered bodies are most frequently thrown into deep water. Very shallow water usually indicates accident. Drunken persons and epileptics have been drowned by falling face downwards in a puddle on a muddy road. Babies, however, are not infrequently drowned in cisterns, tubs, or water-closets.

How long has the Body been in Water?—This can only be estimated by the extent to which decomposition has advanced.

Death by Suffocation.—This is defined as death from asphyxia caused otherwise than by drowning or external compression of the neck—*i.e.*, hanging or strangulation. 1,973 deaths in England and Wales from suffocation (excluding inhalation of coal-gas, &c.), during 1903, were distributed as follows:—

	Accident and Negligence.	Suicide.	Murder.
Males, ...	1,022	2	5
Females, . . .	936	1	7
Totals, . .	1,958	3	12

Of the accidental deaths 1,796 were of children under one year of age, and of these 1,622 occurred in bed.

Post-mortem Appearances.—These are essentially those of asphyxia (*v.* p. 18). It must be noticed, however, that the post-mortem signs of suffocation vary within wide limits, and that in some cases—particularly infants—the indications of asphyxia are conspicuously absent. Occasionally the external signs, lividity and congestion, are present, while the internal organs show nothing abnormal. Subpleural, punctiform ecchymoses, or "Tardieu's spots," are present in most cases. They were believed by that writer to be absolutely diagnostic of suffocation, but are now known to occur in other forms of asphyxia.

Accidental Suffocation may be due to the following causes:—

Numerous pathological conditions—e.g., œdema of the glottis, laryngismus stridulus, obstruction of the air-passages by tumours or aneurism, pulmonary embolism, &c.

Obstruction of the larynx by foreign bodies, such as false teeth, food, coins, buttons, &c. Vomited material may be drawn into the larynx, particularly in persons who are drunk or unconscious. A small particle of material, insufficient in itself to block the larynx, may nevertheless cause death by setting up a laryngeal spasm if it lodges on or between the vocal cords.

Pressure on the chest by falls of earth on those working in tunnels, sand-pits, &c., or in panic-stricken crowds.

Falling face downwards upon feather beds, mud, or other soft substances. This may happen to infants, drunkards, paralytics, and other helpless persons.

Breathing non-respirable gases, such as the foul air of mines and sewers, coal-gas, fumes from coke or charcoal burners, gases evolved in manufactories, &c. In many of these cases the gas exerts a direct toxic action upon the system as well.

Overlying of infants in bed.—This is the most frequent cause of accidental death by suffocation, and must be considered in detail. Dr. Wynn Westcott, in a valuable paper* on the subject, states that the proportion of deaths of infants from overlying in England exceeds that of any other European country. On the average, over 1,500 deaths in England and Wales are annually attributed to this cause. In London alone, 500 to 600 infants are overlain every year. In addition, many deaths of infants in bed with their parents are certified as due to convulsions, but there is no doubt that some of these are really cases of overlying. The risk is greatest during early life, over 75 per cent. of the cases occurring during the first three months of life. As the child gets older, it is able to struggle, and thus arouse the sleeping parent before suffocation takes place.

The suffocation may be due to pressure on the chest as well as closure of the mouth and nostrils, the mother having hugged the child to her for the sake of warmth or for the purpose of suckling it. When gradual suffocation has occurred, there may be no external signs of injury; but, in other instances, there are distinct indications

* *Brit. Med. Journ.*, Nov. 7, 1903.

of pressure, flattening of the nose, for example, is frequently observed. Signs of asphyxia are present in most cases. The lips are bluish, the mouth and nostrils filled with a froth which is sometimes blood-stained, the tongue livid and protruded. Punctiform hæmorrhages may be present beneath the conjunctivæ. The nails of the fingers and toes are bluish, the limbs flexed, and the hands often clenched. Internally, the signs of death from asphyxia are generally well-marked; the lungs, air-passages, brain, and meninges are congested; the pleuræ exhibit minute ecchymoses; the right side of the heart is distended; and the blood is unusually fluid and dark.

There is no doubt that a certain number of deaths from overlying occur when the parent is in a state of drunkenness. Support of this assertion is afforded by the fact that more cases occur on Saturday nights than at any other time. Figures published by the Registrar-General show that of 1,000 fatalities 283 occur on Saturday night, the average for other nights of the week being 120. Dr. Wynn Westcott points out that if a drunken mother suckle her infant before going to sleep, the alcohol in the milk will partially stupefy the child, and render it more liable to suffocation than otherwise. While the great majority of cases are truly accidental, a certain number of infants are deliberately overlain in order that the parents may obtain insurance money; it is rarely possible, however, to bring home such a crime.

The excessive overcrowding which prevails in many of our large cities is undoubtedly the chief cause of the evil. At the same time, if separate cradles were always provided for young infants, many lives would be saved, and it has been urged that such a course should be obligatory. It is the general custom on the Continent, where, in consequence, deaths from overlying are comparatively infrequent.

Juries as a rule are unwilling to find a verdict of manslaughter in cases of overlying; but Dr. Wynn Westcott is of the opinion that the evil would be mitigated if magistrates were empowered to deal summarily with culpably careless cases, and inflict short terms of imprisonment.

Deaths from overlying are sometimes caused by one infant rolling on top of another; and several instances are recorded of cats smothering young children by going to sleep over their faces.

Suicidal Suffocation is rare; criminals and lunatics, however, occasionally cause death by stuffing pieces of cloth, &c., into the larynx. In France, suicide by inhaling the fumes from charcoal stoves is not uncommon. Death, in this case, is partially due to the toxicity of the gases generated, as well as to deprivation of oxygen.

Homicidal Suffocation is difficult to achieve without a struggle; it is, therefore, rarely resorted to by murderers except in the case of infants, aged persons, and those helpless from drink. The method most frequently adopted is to hold the bed-clothes or a pillow over the head of the victim until death ensues. Sometimes paper, rags, or a cork, are thrust into the larynx. Burke and Hare murdered

their victims by sitting on the body and keeping one hand forcibly under the chin, at the same time closing the mouth and nostrils with the other.

Death by Hanging.—This occurs when a noose is placed round the neck, and constricting force is exerted by the weight or momentum of the body.

Cause of Death.—This is not the same in every case. It varies with the tightness of the noose, the length of the drop, the weight of the individual, and other circumstances. The following are the modes in which death may be brought about :—

Injury to the Spinal Cord by fracture or dislocation of the upper cervical vertebræ. Death in this case is practically instantaneous. It occurs when the body is allowed to fall, and is then brought up suddenly against the noose. Endeavour is always made to bring about death in this manner in judicial hanging, a drop of from 6 to 10 feet being allowed, according to the weight of the individual.

Asphyxia is the mode of death when continuous compression instead of abrupt mechanical violence is exerted by the noose. It occurs when only a short drop is allowed, or when the body is only partially suspended. Suicides, for instance, are often found hanging with the toes in contact with the ground, and cases are recorded in which the end of the rope has been attached to an object so low as the handle of a door or leg of a table, the body half-resting on the floor. In the vast majority of cases the noose is placed, to start with, above the thyroid cartilage, or else slips up over it when the rope becomes tightened. The effect of this is to compress the base of the tongue against the posterior pharyngeal wall, and completely occlude the air-passages. It is probable, however, that asphyxia alone is seldom or never the sole cause of death, disturbance of the cerebral circulation, owing to compression of the vessels in the neck, always aiding to a greater or lesser degree. Comato-asphyxia is, therefore, more correctly to be regarded as the cause of death.

Arrest of the Cerebral Circulation.—Compression of the big vessels in the neck rapidly produces insensibility, followed, after an interval, by death. It operates, however, as the sole cause of death by hanging only in rare instances in which some exceptional circumstance has prevented complete occlusion of the air-passages. Reineboth records the case of a man, upon whom tracheotomy had been performed, who placed the noose of the rope above the canula, and hanged himself. The post-mortem examination showed congestion of the base of the brain, but no signs of asphyxia. Experiments on dogs in which the trachea was opened below the line of constriction showed that life might be prolonged for a considerable interval when interference with the cerebral circulation was the only factor operating. In the great majority of cases, however, compression of the cervical vessels, although not the cause of death, undoubtedly accelerates asphyxia.

Shock due to pressure on the vagi and phrenic nerves has been suggested as a possible cause of death in hanging. There is not much

evidence in support of this view, while the fact that in some cases the heart continues to beat for a considerable time after death, is opposed to it.

Post-mortem Appearances — External. — These are not constant. The face is usually pale, but in some cases is livid or congested; there may be small hæmorrhages beneath the skin and conjunctivæ. The pupils are nearly always dilated, and in some instances the eyes are prominent. The tongue is generally swollen, bluish in colour, and frequently protruded between, or pressed against, the teeth. Saliva sometimes dribbles from the mouth. Erection of the penis, with emission of semen, occurs in a few cases. Passage of the urine and fæces is not infrequent, but as this is also seen in death from other causes, both natural and violent, it is of little significance.

The mark on the neck is the most important external feature. Its situation depends upon the position of the noose. In front, as a rule, it traverses the neck just beneath the lower jaw, but in cases in which the suspension was incomplete it may be at a lower level. If the noose is at the back of the head, the mark passes obliquely upwards behind the ears, and is lost on the occipital region. When the noose is at the side, the mark may be present only on the opposite side of the neck. A running noose which has been drawn tight may cause a complete circular mark; and if two or more turns of the ligature have been passed round the neck, there may be a circular and an oblique mark. The character of the mark depends largely upon the nature of the material employed for suspension. It is indistinct (and possibly completely absent) when a broad soft ligature, such as a silk handkerchief, has been used, and well-marked if rope or other hard material has been employed. The strands of a rope may produce a pattern on the skin, and knots or other irregularities may modify the appearance of the neck beneath them. The mark is generally a shallow groove along which the epidermis may be abraded. It may be colourless, or pale with reddened edges, or purplish with more deeply-tinted margins, or yellowish-brown and parchment-like in appearance. Its character may vary in different parts of the neck.

Internal.—Since death in hanging may result actually from one or more of several causes, the post-mortem appearances of the internal organs are correspondingly inconstant, but, in most cases, the signs of death from asphyxia or comato-asphyxia are more or less distinctly present. The internal injuries in the region of the neck are proportionate to the amount of violence exerted, and this depends upon the length of the drop and the weight of the individual. When (as in judicial hanging) the noose is placed under the chin, and a long drop is allowed, the head is jerked violently backwards at the moment of arrest, and much damage is, in consequence, done to the structures. The lesions which may be produced are dislocation or fracture of the upper cervical vertebræ and consequent rupture or compression of the spinal cord, injuries to the muscles of the neck, fracture or dislocation of the hyoid bone or

laryngeal cartilages, and rupture of the inner or middle coats of the carotid arteries. Exceptionally, when too long a drop has been allowed, the tissues of the neck have been torn right through, and large gaping wounds produced; in rare cases the head has even been severed from the body. In suicidal hanging, when the suspension is incomplete, there may be little or no internal injury inflicted upon the neck.

The condition of the internal organs varies with the mode of death. If life has been suddenly arrested by injury to the medulla, nothing unusual is found. When death has occurred slowly, the signs of asphyxia are more or less pronounced. The larynx and trachea are generally injected. The lungs may be normal in appearance, paler than usual, or hyperæmic; punctiform hæmorrhages are frequently found beneath the pleura. The right side of the heart may be distended with dark fluid blood. Congestion of the abdominal viscera is occasionally observed. The condition of the brain and meninges is not characteristic; usually they are normal—sometimes congested.

Was the Hanging Suicidal, Homicidal, or Accidental?—As a matter of probability, suicide is by far the most likely explanation when a body is found hanged. The Registrar-General's returns for the period from 1894 to 1903 show that 7,922 deaths by hanging (6,561 males and 1,361 females) were suicidal, 6 homicidal, and none accidental. Moreover, hanging is one of the methods most frequently adopted by suicides to achieve their purpose. The elucidation of an obscure case calls, as a rule, for the exercise of detective skill rather than medico-legal knowledge. Signs of a struggle and scratches on the neck and face, or other indications that an attempt has been made to loosen the rope, do not necessarily indicate homicide. A suicidal maniac may have previously thrown the room into a state of disorder, and, when too late, may make frantic efforts to undo the rope and save himself. Sometimes a body is found hanging with the limbs tied together. A determined suicide may do this before committing the final deed. In one case a man bound his wrists together, and then succeeded in passing his legs between his arms, so that he was found suspended with his hands tied behind his back, a condition of affairs which would have strongly suggested homicide had not this explanation been negatived by concomitant circumstances.

Incomplete suspension is quite as likely to be suicidal as homicidal.

Homicidal Hanging.—The infrequency with which murderers resort to hanging is due to the difficulty of carrying out the process. A man, single-handed, could scarcely hang another, unless the latter were drunk or had been rendered insensible. Even then, he must have at least the muscular strength necessary to raise the body. The recorded cases of homicidal hanging, therefore, except where the victim has been an infant or young child, have been almost invariably the work of more than one individual. The hanging, for instance, of a negro in the Southern States of America, under "Lynch law," necessitates the co-operation of a number of persons.

A sensational murder by hanging occurred in Paris, in 1888, of a M. Gouffé while visiting his paramour, a girl named Bompard. The latter had previously made arrangements for the deed with an accomplice, Eyraud, who was concealed during the interview behind a curtain in an alcove. Bompard, while sitting on her victim's knee, playfully threw a noose over his head, and then passed the cord, which terminated in a loop, behind the curtain to Eyraud. The latter slipped the loop over a hook at the end of a rope which passed over a pulley fixed in the roof of the alcove. He then pulled the rope and hanged his victim. At the trial, Bompard, who confessed the crime, unsuccessfully pleaded in defence that she had acted under the influence of hypnotic suggestion.

Accidental Hanging is rare, but occasionally happens by a person slipping from a height and getting his clothing caught or becoming entangled in a rope. Prof. Glaister mentions the case of a boy who fell from a tree. His jacket, which was buttoned around his neck, caught in the branches and turned up and hanged him. Occasionally, too, boys have lost their lives while reproducing judicial executions in play.

The case of *R.* v. *Montague*, which was tried in Dublin in 1892, afforded a remarkable instance of accidental hanging. The prisoner, as a punishment, tied her child's arms with a stocking, which she then passed round the body so as to pinion the limbs to the sides. The stocking was tied to a cord the end of which was fixed to a ring in the wall of a dark cupboard. At the end of three hours the child was found dead. It was difficult to say with certainty what had happened, but a mark was found on the lower part of the trachea. The prisoner was convicted of manslaughter, and sentenced to twelve months' imprisonment.

Some of the cases of apparently suicidal hanging are really accidental. A prisoner, for instance, believing that he is being watched, or thinking that he can support himself with his toes, may make a feigned attempt to hang himself in order to create an impression of insanity. Owing to some miscarriage of his plans a fatal result ensues.

Was the Body Suspended after Death?—This course is sometimes taken by a murderer in order to suggest suicide. Suspicion of foul play is aroused when injuries or wounds of a character likely to have proved rapidly fatal are found on the body, particularly if on examination the signs of death from asphyxia are found to be wanting. Endeavour must be made to ascertain, from the character and position of the wounds, whether they have been self-inflicted or are the handiwork of another. In some cases an analysis of the contents of the stomach is necessary. It must be remembered, however, that a suicide may resort to hanging after he has attempted, and failed, to take his life by shooting or wounding himself. Dr. F. J. Smith mentions the case of a man who first took arsenic, then cut his throat, and finally hanged himself.

No positive information can be obtained from the mark round the neck, for it has been shown that all the appearances usually observed in hanging can be produced by suspension after death,

even when an interval of an hour or two has elapsed. This is due to the fact that the tissues still retain their vitality. The most difficult cases to detect are those in which death has been caused by some form of asphyxia, for then the internal post-mortem appearances are essentially those of hanging. But if the asphyxia has been caused by strangulation and the body has been subsequently hung, there may be two marks around the neck, a circular one produced by the ligature which destroyed life, and an oblique one left by the rope employed for suspension. Dr. Gosse records a case in which suspicion, which subsequently proved to be well-founded, of murder was first aroused by the presence of two marks round the neck; further examination showed that the rope was too short for the man to have been able to hang himself.* Similarly, the bruises left by the fingers and thumb after throttling may be distinguishable from the mark of suspension.

The dribbling of saliva from the mouth is strong, but not conclusive, evidence that life was present when suspension occurred.

Death by Strangulation.—This is death due to constriction of the neck by a force other than the weight of the body. **Throttling** is a term applied to strangulation effected by compression with the fingers.

The cause of death is either asphyxia alone, or asphyxia combined with cerebral congestion if the big veins of the neck have been included in the compression.

Post-mortem Appearances.—These are very much the same as those seen in death by hanging. *Externally*, the most important feature is the mark on the neck. As in hanging, the nature of the ligature affects the appearance of the mark it produces; the strands of a rope, for instance, may be clearly visible. Three important differences in strangulation, however, are: (1) that the mark tends to encircle the neck more completely; (2) that it is more horizontal in direction; and (3) that it is frequently below the level of the *pomum Adami*. In throttling, there may be a mark of the thumb on one side of the larynx or trachea, and marks of the fingers on the other. If both hands were employed, the marks may be most distinct at the back and front of the neck, or, more or less, encircle it. In some cases, the impression of each finger is recognisable; in others, there is only a confused patch of bruising. Little crescentic depressions, produced by the finger-nails, are sometimes seen.

The *internal* post-mortem appearances are those of asphyxia or comato-asphyxia.

Homicidal, Suicidal, and Accidental Strangulation.—Most books state that homicidal strangulation is the commonest form, and that accidental strangulation is very rare. Judging, however, from the Registrar-General's returns this is not the case; for, during the ten years ending 1903, 228 deaths (172 males and 56 females) were certified as due to strangulation by accident and negligence, only a small proportion of which could have been due to strangulation by the umbilical cord, as the number of infants under

* *Lancet*, vol. ii., 1889, p. 451.

one month of age was only 39. During the same period there were 146 murders by strangulation, of which 116 were of infants under one month. No instance of suicidal strangulation appears in the lists.

The frequency with which strangulation is resorted to by murderers, as compared with hanging, is due to the fact that it is much more easily accomplished. If seized from behind, the victim is in a bad position to defend himself, and the unconsciousness which rapidly supervenes when the neck is constricted, soon renders him incapable of offering resistance. "Garrotting" was at one time of frequent occurrence in London. The assailant seized his victim from behind, and robbed him as soon as he was insensible. It has been both asserted and strenuously denied that the practice was only put a stop to by sentencing those caught to so many lashes with the "cat."

Particular attention should be paid to the mark on the neck. Scratches in its neighbourhood indicate a struggle. Finger-marks, if they can be identified as such with certainty, afford conclusive evidence of homicide; for suicidal throttling is probably impossible of accomplishment. A man might produce a state of insensibility by deliberately compressing his throat with his hands, but as soon as this condition supervened, the pressure would relax, and recovery take place.

When the ligature is still around the neck, information is sometimes furnished by the manner in which it has been tightened or tied. Suicidal strangulation is usually effected by placing a loose ligature around the neck, and then twisting it tight by turning a poker or stick slipped through it. Self-strangulation, by passing a cord once around the neck and tying it tightly, is difficult of accomplishment; but if several turns are employed, the ligature may hold with only a loose knot, or even without any knot. When, therefore, the ligature is found to consist of a single turn, and to be tied firmly with a tight knot, or a series of super-imposed knots, particularly if at the back of the neck, homicidal strangulation is indicated. On the other hand, a ligature of several turns with a single, loosely-tied knot in front, points to suicide.

The amount of injury done to the neck should be noticed. As a general rule a murderer employs more violence than is necessary for his purpose. Fracture of the hyoid bone or laryngeal cartilages indicates a degree of force very unlikely to have been exerted by a suicide. Wounds and injuries on other parts of the body usually indicate homicide; but the possibility of a suicide having previously tried and failed to take his life by other means must not be lost sight of.

Strangulation of infants by the umbilical cord is usually accidental, but may be homicidal (*v.* Chap. xiii.).

Accidental strangulation occurs in a variety of ways, but usually the attendant circumstances clearly indicate what has happened. Frequently the victims are drunk, or otherwise helpless. An infant has been strangled by a cloak being tied too tightly round its neck; and, in another case, by the end of a muffler placed round its throat

becoming caught in the wheel of the perambulator, and being drawn tight. Children have been strangled while playing with blind-cords; a drunken woman by her bonnet-strings; and an epileptic by getting his head wedged between the seat and rail of a chair during a fit. In more than one instance, a person carrying a heavy weight on the back, by means of a strap passing round the front of the neck, has been strangled by the weight suddenly slipping off a support on which it was temporarily rested, and compressing the trachea.

Feigned attempts at strangulation are sometimes made in order to create an impression of insanity, or support a statement that the individual has been attacked and robbed. In such cases it is found that the ligature around the neck is not tight enough to do any serious harm.

CHAPTER VII.

DEATH BY BURNING, SUNSTROKE, AND ELECTRICITY.

CONTENTS.—Death by burning—Heat- and sun-stroke—Lightning—Mechanically-generated electricity.

Death by Burning.—Lesions caused by the action of dry heat or corrosive fluids are termed burns. Scalding is the word applied to the injuries produced by steam or hot fluids.

Six different degrees of burning are recognised by surgeons:—(1) Superficial scorching, producing redness and congestion of the skin, perhaps followed by desquamation, but causing no permanent injury. (2) Greater congestion and vesication (blistering), usually followed by complete recovery. (3) Destruction of the cuticle and part of the cutis vera, the deeper structures of the skin, hair follicles, sebaceous- and sweat-glands being left intact. Owing to exposure of the sensitive nerve terminals, this is the most painful degree of burning. The scar which results is usually slight and elastic. (4) The whole thickness of the skin, as well as part of the subcutaneous tissue, is destroyed. Serious scarring, often leading to deformity, follows. (5) The muscles are encroached upon. (6) The deep structures or organs are charred or destroyed.

If the individual live, inflammation and sloughing follow, according to the degree of injury which has been received. The wound may become infected, pus formed, and cellulitis developed.

Scalding by hot fluids or steam produces congestion of the skin and extensive vesication.

The lesions caused by corrosives are characterised by ulceration, absence of vesication, and, in most cases, staining of the surrounding skin (*v.* "Corrosive Poisons").

Cause of Death from Burning.—The constitutional effects of a burn depend more upon the extent and situation of the lesion than upon its depth. The greater the area of skin involved, the more likely are the results to be serious; if one-third of the total surface is affected, recovery is extremely improbable. Burns on the front of the abdomen or chest are more dangerous to life than those of a similar extent on the limbs or back. Death sometimes occurs from shock immediately the injury is received. In other cases it is delayed for an interval of from a few hours to two or three days. The explanation of this phenomenon is not quite clear. Shock undoubtedly plays a part in many instances, but such factors as cardiac paralysis from over-heating of the blood, accumulation of toxins in the system, and destruction of the red corpuscles, leading to thrombosis, have been regarded as contributory causes.

If the patient survive the first two or three days, a period of inflammatory fever commences, and lasts usually from four to fourteen days. During this stage death may occur from various complications. Suppuration of the burns may set up septicæmia or pyæmia; congestion of the stomach and intestines sometimes leads to ulceration or even peritonitis; congestion of the brain or lungs is not uncommon. A peculiar ulceration of the second part of the duodenum occasionally occurs towards the end of this period. It is probably due to elimination of toxic substances by the liver through the bile-duct.

At a still later period, if large sloughs have failed to separate, chronic suppuration may supervene. Amyloid changes may then develop in the viscera, and the patient eventually die from exhaustion.

Children and old persons succumb more readily to burns than do adults.

Post-mortem Appearances—External.—After a body has been exposed to a temperature higher than 75° C.—for instance, by falling into a vat of boiling oil—the phenomenon known as *heat-stiffening* is observed. Other albuminates besides the myosin of the muscles coagulate, and a condition of rigidity greater than that of rigor mortis is produced. The contraction of the more powerful flexor muscles overcomes the extensors, and a general state of flexion of the limbs is observed. The legs are drawn up, and the arms are bent at the elbows and folded across the chest. If death has occurred at once, the appearance of the burnt surface is that already described; if after an interval, there are more or less distinct indications of inflammatory reaction in the neighbourhood of the injuries.

Internal.—When a burnt body is recovered after a fire in a building, it does not necessarily follow that death was due to burning. It may have been caused by asphyxia from smoke, or injuries inflicted by falling débris, the burning of the body having occurred after death. Probably in most fires the victims are asphyxiated, or at least rendered unconscious, before the flames actually reach them, and it is some consolation to the relatives to learn that the deceased has perished by this comparatively painless form of death. The heart and lungs, therefore, generally exhibit signs of asphyxia, and particles of carbonised material, which have been inhaled, may be found in the air-passages. The blood frequently displays a cherry-red colour, due partially to an unusual brilliancy of the oxy-hæmoglobin, and partially to the presence of carbon monoxide, the existence of which in the blood can be detected by spectroscopic examination. Changes in the viscera are more marked if the individual has survived the burning for some time. The kidney may show signs of nephritis, and, on section, exhibit a reddish-brown colour, due to blood pigment in the tubules. Thrombosis of small vessels in the organs may be found. The mucous membrane of the stomach and intestines may be congested, and, in a few cases, the duodenal ulcer described above is present.

Were the Burns received before or after Death?—This is a question the medical witness may be called upon to answer, and, as a rule, it presents no difficulty. Burns received before death show evidence of vital reaction. The hyperæmia which characterises burns of the first degree and scalding is essentially a vital phenomenon, and cannot be produced after death. If vesication has occurred, the blisters formed during life contain serum, as shown by the presence of sodium chloride and albumen, and are surrounded by an inflammatory areola. The fluid should be withdrawn and tested for sodium chloride by adding a drop of silver nitrate, and for albumen by boiling. If the floor of the vesicle be exposed, the papillæ are found to be swollen and inflamed. When pus is present in the blisters, it follows that life had been maintained for at least thirty-six hours after the burning. On the other hand, experiments on the cadaver have shown that vesication cannot be produced at all readily on a body which has been dead some time. At the most, only a small bleb is raised, and this does not exhibit an inflammatory areola or an injected base, and contains watery vapour instead of serum. The only cases which may offer difficulty are those in which the burns have been received immediately after death—*i.e.*, while molecular life was still active in the tissues. Under these circumstances some signs of vital reaction may be present, but, according to Hofmann, an absolutely typical blister cannot be produced ten minutes after death.

Burns of a greater degree are more difficult to distinguish; but, if received during life, search with a lens at the margin of the lesion may reveal traces of inflammatory reaction. When the tissues are completely charred, there is no means of distinguishing between ante- and post-mortem burning.

Accidental Burning.—Accident is the commonest cause of death by burning. Apart from the annual loss of life in conflagrations, many fatalities are caused by the clothing catching fire. The upsetting of paraffin lamps, filled with cheap oil of a low flash-point, is responsible for numerous accidents. In the homes of the poor, where no fire-guard is in use, children are not infrequently burnt to death. The risk is greater if, as is too often the case, they are wearing clothing of flannellette, a cheap and inflammable material composed chiefly of cotton. The dangerous practice of dressing children in cotton-wool during Christmas fetes has led to much loss of life.

A remarkable case of accidental burning occurred in London in 1897. A lady was having her hair shampooed with a petroleum hair-wash, when suddenly the whole mass burst into flame. She was terribly burnt about the head and shoulders, and died shortly afterwards from the effects. The hairdresser was rubbing the hair at the time, and the evidence at the inquest tended to show that the ignition of the oil was caused by the heat or an electric spark generated by the friction.

Scalding to death is generally the result of a child pulling over a kettle of boiling water, or attempting to drink from the spout.

It is sometimes caused by escape of steam from a boiler in an engine-room.

Suicidal Burning is rare, but occasionally persons of unsound mind have been known to throw themselves into cauldrons of boiling fluid, blast-furnaces, &c., or to saturate their clothing with paraffin and then set light to it.

Homicidal Burning is also exceptional, but instances are not rare in which murderers, after killing their victims by some other means, have endeavoured to destroy the bodies by fire. The murder of Dr. Parkman, described on p. 10, is a case in point. When there are suspicious circumstances connected with the burning, careful search should be made for the presence of wounds or other marks of violence upon the body. In the case of Dr. Parkman, for example, a penetrating wound was found over the heart. An instance is on record in which the mark produced by strangulation was recognisable around the neck of a boy whose body was recovered from a burnt-out cottage. In such a case, the ligature tends to protect the skin immediately beneath it, while there may be extensive charring on the exposed area of the neck. The possibility of injuries found having been inflicted by falling débris during the progress of the fire must not be overlooked. Furthermore, exposure of a body to excessive heat sometimes produces a fissuring of the soft parts, which might be mistaken for incised wounds. Such cracks tend to occur upon the extensor aspects of the joints, and the vessels and nerves may be found running across them still intact.

Vitriol-throwing is a practice more frequently adopted on the Continent than in this country. It rarely causes death, but may lead to much disfigurement.

Spontaneous Combustion.—The only practical importance of this subject results from the fact that a medical witness may be asked by a coroner if it is a possible explanation in a case of burning, the cause of which is not quite clear. Spontaneous combustion of the body, in the sense that the layman attaches to the words, never occurs; but, very rarely, a state of the tissues exists, for which Prof. Dixon Mann suggests the term *præternatural combustibility*. The condition has been most frequently noticed in the bodies of fat, bloated individuals who have been excessive drinkers. Probably, in such cases, inflammable gases are generated in the body after death, and, if a light is near, become ignited, leading to a partial consumption of the soft tissues.

Heat- and Sun-stroke.—These terms are applied to certain states produced by prolonged exposure to artificial or solar heat. If the exposure is accompanied by severe physical exertion, the liability to attack is greatly increased. Soldiers marching in thick clothing, and oppressed by the weight of heavy accoutrements, are particularly liable to suffer from sunstroke. Others likely to be affected are workers in heated engine-rooms, stokers on ships, &c. Dry heat is not so dangerous as moist heat, for the reason that free evaporation from the surface of the skin occurs, and this tends to keep down the bodily temperature. Bakers and workers in glass

are often able to endure high temperatures for prolonged periods without sustaining any ill effects. Intemperate habits, and vitiated air such as that of badly-ventilated barracks, predispose towards attack.

The Cause of death seems to be, primarily, derangement of the central nervous system.

Three types of cases are recognised :—

(1) **Syncopal Form.**—The individual is suddenly struck down with symptoms of collapse. The pulse is rapid and feeble, the skin cold and clammy, the face pale, and the respiration sighing. In severe cases death occurs rapidly from heart-failure.

(2) **Asphyxial Form**—*Sunstroke Proper.*—Premonitory symptoms of weakness and oppression are rapidly followed by dyspnœa and coma. Death may ensue from failure of respiration and circulation. Sometimes there are no prodromata, and death occurs with great suddenness.

(3) **Hyper-pyrexial Form.**—Prodromal symptoms may occur for some hours, or even days, before the condition fully develops. They consist of pain in the head, sensations of flashes of light or coloured vision, dizziness, nausea or vomiting, profuse and frequent micturition, and diarrhœa. The temperature rapidly rises, in some cases to as high as 110° F. The pulse is usually full and strong, and the face deeply congested. Respiration is laboured and sometimes stertorous. Cheyne-Stokes breathing may be observed. Delirium, convulsions, and coma precede death.

After recovery from sunstroke permanent mental weakness may remain.

Post-mortem Appearances.—Rigor mortis sets in and passes off early. Putrefaction advances with great rapidity. The appearances presented by the internal organs are not very characteristic. When death has been due to shock, very few pathological changes may be found. There may be congestion of the abdominal viscera. In some cases signs of asphyxia are distinct. The lungs may be congested, and the large veins, right side of the heart, and pulmonary arteries filled with dark, fluid blood. Hyperæmia of the brain and meninges is sometimes observed.

Death by Lightning.—During the period from 1894 to 1903, 205 deaths were certified as due to lightning. Prominent objects form good conductors for the electric current, hence persons struck are generally found to have been standing near a tree or some other projection above the general level of the ground. But in an open space an erect person may himself constitute the best conductor in the neighbourhood. Moisture increases electrical conductivity, other things being equal; therefore, a person who has been drenched by a shower of rain during a thunderstorm is more likely to be struck by lightning than one who has kept dry.

Effects of Lightning.—The tricks which lightning plays with the clothing and articles about the person are most varied and bizarre. Objects of metal, owing to their high conductivity, are nearly always picked out by the current, and suffer severely.

Watches and chains are fused, buckles torn from belts, nails driven out of boots, and steel articles sometimes magnetised. The clothing may be burnt or torn, and even completely stripped from the body. Objects held in the hand are sometimes flung to a distance.

The details of a case recorded by Dr. Wilks in 1879 illustrate the effects produced by lightning. A farm labourer was struck whilst in the act of micturating beneath a tree, the bark of which was torn off by the flash. When found, his boots were still at the foot of the tree, but the man himself was a couple of yards away, and completely naked except for part of the left arm of his vest. The clothing, the remains of which are preserved in the museum of the Royal College of Surgeons, was much torn, and scattered around in all directions. The buckle of the belt was burnt out, the sole of the right boot rent, the bootlaces gone, and some of the eyelets burst. A hole was fused through the case of the watch, and the chain almost destroyed. The man stated that he felt himself being hurled through the air, but never lost consciousness. He sustained a compound fracture of the right tibia and comminution of the right os calcis. The hair of the face was scorched, and the skin of the chest, abdomen, and legs burnt. He eventually made a good recovery.

The cause of death by lightning is usually shock. Sometimes, however, injuries are inflicted which terminate fatally after a longer or shorter interval.

Post-mortem Appearances—External.—It was formerly stated that rigor mortis did not occur after death by lightning. This is now known to be incorrect. Sometimes, however, it supervenes early and passes off quickly, in which case it may fail to be observed. Putrefaction occurs rapidly. Exceptionally, there may be no lesions upon the surface of the body. Usually the skin exhibits patches of erythema, ecchymoses, and burns of various degree, size, and shape, especially in the neighbourhood of metal objects. A peculiar feature which has been noticed in a good many cases, is the presence of arborescent markings on various parts of the body, a phenomenon the cause of which is not fully understood. The hair is often singed. Lacerations and wounds are frequently produced. It is important to notice that the latter sometimes look as if they had been made by a sharp cutting instrument, or even by a bullet.

Internal.—The viscera do not exhibit any distinctive features. Fractures of the bones are sometimes observed.

Death by Mechanically-generated Electricity.—This occurs among persons working with dynamos or other electric plant. The fall of an overhead tramway wire conveying a strong current has also been responsible for loss of life. In America, judicial execution is accomplished by passing an electric current of high tension through the criminal.

As regards the strength of current likely to prove fatal, 240 volts have caused death. On the other hand, in a case at Southport, recovery occurred after the passage through the body of a current

of 2,150 volts. The regulations of the Board of Trade prohibit the introduction into dwelling-houses of currents of higher voltage than 250.

The cause of death has not been definitely ascertained. Some observers consider that electricity kills by arresting respiration, others believe that death is due to cardiac paralysis. Death may be instantaneous, or may be delayed for some hours, or may occur after several days from secondary complications.

In the *Lancet* for January 21, 1905, the case is described of a boy whose hand came in contact with a cable carrying a current of 10,000 volts. He was rendered rigid and apparently lifeless; no pulse could be felt; and the limbs were burnt, swollen, and stiff. Consciousness returned with artificial respiration, but all the limbs became gangrenous. The right arm was amputated at the shoulder-joint on the third day, and both legs on the sixth, but the patient died on the ninth day.

Post-mortem Appearances.—The face is generally pale and the pupils dilated. Burns and ecchymoses may be present, particularly on the hands or other parts of the body which have been actually in contact with the "live" wires. The internal organs may be congested, and signs of death from asphyxia are sometimes observed.

CHAPTER VIII.

DEATH FROM COLD AND DEATH FROM STARVATION.

CONTENTS.—Death from cold—Death from starvation.

DURING the year 1903, 103 deaths (86 males and 17 females) were certified as due to cold, and 28 to starvation. Probably, in many of these cases, both factors combined to bring about the result.

Death from Cold—Cause of Death.—This appears to be the following :—At low temperatures the capacity of the hæmoglobin to part with its oxygen to the tissues is decreased ; in consequence, the chemical processes necessary to maintain vitality become less active. A state of lethargy ensues, and finally death occurs from profound depression of the nervous system owing to the inadequate supply of oxygen. Any circumstance which tends to decrease the power of resistance, renders the effect of cold more likely to be fatal. Hence, infants, old persons, and those suffering from chronic disease readily succumb. Drunkenness is also a predisposing cause of death, for it often lowers the bodily temperature several degrees to start with, and the condition prevents the individual from making an effort to save himself.

Post-Mortem Appearances.—These are not very distinctive, as most of them can be produced after death if the body be exposed to cold.

External.—If the body has been frozen it is absolutely rigid. Such rigidity can be distinguished from ordinary rigor mortis by the fact that, if the joints be forcibly flexed, a crackling sound is produced. When the body is thawed, rigor mortis may be found to be still present ; or, if the freezing occurred before it had supervened, it appears after the thawing, in which case it passes off more quickly than usual. Decomposition tends to occur early, but if the body remains in a temperature below zero, putrefaction is arrested indefinitely.

The skin is pale and waxy-looking owing to comparative bloodlessness from contraction of the peripheral arterioles. About the face and other exposed parts of the body are patches of a bright, rosy-red colour produced by oxygenation of the blood through the skin, and retention of the hæmoglobin owing to the low temperature. These patches differ from hypostases by the fact that they are not confined to dependent parts of the body. When the temperature is raised, the oxy-hæmoglobin breaks up, and the stains assume the ordinary livid appearance. The production of these brightly-coloured

areas is a very characteristic effect of exposure to cold, but does not necessarily indicate death by cold; for the same appearances have been observed in bodies exposed to low temperatures after death. In poisoning by carbon monoxide similarly coloured patches are produced. They are equally marked, however, upon the covered and the exposed parts of the body, and are readily differentiated by spectroscopic examination.

Internal.—In consequence of the expulsion of blood from the skin the internal organs are likely to be engorged. The cavities of the heart and large vessels are distended with blood; the lungs are conjested; the brain and meninges are hyperæmic, and there may be serous exudation into the ventricles and at the base of the brain. The mucous membrane of the stomach is congested, and minute extravasations of blood beneath the epithelium were found in forty-four consecutive cases examined by Wichniewski. The urinary bladder may be abnormally full. The blood is often of a bright-red arterial colour throughout. The fact that this characteristic is exhibited by the blood in the internal organs, points strongly to death by cold, for oxygenation to such a depth could not have been effected by diffusion from the surface after death.

Accidental Death from Cold.—The great majority of fatalities from cold are due to accident. During severe winters drivers have been found frozen to death in their seats, and children who have strayed away have perished from cold and exposure. In mountainous regions, climbers who become lost in the snow not infrequently succumb to the cold. The depression of the nervous system produces a condition of lethargy and somnolence which, though resisted for a time, eventually compels the sufferer to lie down. Muscular movements soon cease, a state of coma supervenes, and finally death takes place. Snow, however, is a bad conductor of heat, and instances are not rare of persons who have been buried for a considerable interval of time, recovering under proper treatment.

Homicidal Death from Cold is rare, but occasionally infants abandoned in unfrequented places perish from the exposure (*v.* p. 64). Suicide by exposure to cold is practically unknown.

Death from Starvation may occur rapidly when there is absolute deprivation of food, or may be gradual owing to the supply of nutriment being defective in quality or quantity. If both food and water are withheld, death ensues much more quickly than in cases in which solids alone are lacking. Exposure to cold in conjunction with starvation hastens death. The duration of life, when both food and water are cut off, is about eight or ten days, but varies with the age and physical condition of the individual. When water is obtainable, life may be maintained for six weeks, and even longer periods have been recorded.

Signs and Symptoms of Starvation.—It is important for the medical jurist to be familiar with these, as he is sometimes called upon to examine a living person said to have been insufficiently or improperly fed. The craving for food passes off in from one to three

days, and is succeeded by sensations of uneasiness or pain in the epigastrium. Great distress is caused by the insatiable thirst. The face becomes pale, the cheeks sunken, the eyes hollow and wild in expression, the mouth dry and parched. Muscular weakness and bodily emaciation progressively increase. A peculiar fœtid odour is exhaled from the body. The temperature gradually falls, and before death may be two or three degrees below normal. The urine becomes scanty and highly coloured, and the fæces soon cease. The pulse is weak, but may be either slower or quicker than normal. The abdomen sinks in, and the bony framework becomes prominent. Mental symptoms appear. Imbecility and hallucinations may be succeeded by coma and death; or a state of maniacal delirium may terminate fatally. The immediate cause of death appears to be reduction of the bodily temperature.

Post-mortem Appearances.—The body is much emaciated. The skin is dry, wrinkled, and scurfy, in some cases presenting a dirty brownish appearance. A disagreeable odour is frequently noticeable. Internally, the characteristic feature is the diminution of fat in all parts of the body. In cases of slow starvation bodily wasting proceeds to an extreme degree, and all traces of fat may have practically disappeared from the tissues. When death has been due to sudden complete deprivation of both food and water, emaciation is not so pronounced, and fat may still be present. The body, for instance, of the Welsh fasting girl, who died after eight days' complete starvation, was described as "plump," and exhibited a layer of fat from half an inch to an inch thick beneath the skin of the chest and abdomen. The muscles and tissues generally are wasted. The stomach and intestines are atrophied and shrunken; and, owing to the thinning of their walls and absence of fat, they may be quite translucent. The lungs, heart, and large vessels are collapsed and anæmic. The liver and kidneys are shrunken; the pancreas may have almost disappeared; the bladder is contracted and nearly empty. Owing to absence of stimulation by food, the gall-bladder is usually found distended with bile. The nature of any traces of food found in the stomach or intestines should be noticed, especially in the case of infants.

Before expressing an opinion that death was due to starvation, the medical examiner must satisfy himself that none of the pathological conditions which may produce emaciation are present. The more important of these are stricture of the œsophagus from any cause, malignant disease, tuberculosis, Addison's disease, diabetes, progressive muscular atrophy, chronic diarrhœa, dysentery, and sprue. In infants and young children, bodily wasting may be caused by congenital syphilis, rickets, chronic gastro-intestinal catarrh, and, occasionally, congenital stricture of the pylorus.

Accidental Starvation.—Instances of accidental starvation occur among ship-wrecked seamen, miners entombed by falls of rock, and during famines. Perhaps the most numerous cases are those furnished by infants who have been improperly fed; deaths which are responsible for a large part of the infant mortality among

the poorer classes. A certain number of these cases are due to wilful or culpable negligence, but a far larger proportion arise from the appalling ignorance which exists among the poor on the subject of infant feeding. Bread, porridge, or other farinaceous materials are frequently given to children too young to assimilate them. Beer, meat, tea, and potatoes are sometimes other articles of diet. The child accordingly suffers from slow starvation, and probably also gastro-intestinal catarrh. Such cases are not infrequently the subject of inquiry in the coroner's court, and it is often a very difficult matter to draw the line between culpable neglect and sheer ignorance.

Homicidal Starvation. — Cases occur chiefly among two classes of persons, infants and servant-girls.

Slow starvation is the method sometimes adopted by baby-farmers to dispose of infants handed over to them. In other cases the child is abandoned, and, if in an out-of-the-way place, probably dies from the combined effects of exposure and inanition. By 24 and 25 Vict., c. 100, sec. 56, to unlawfully abandon or expose any child under the age of two years in such a manner that its life is endangered, or its health is, or is likely to be, permanently injured, is a misdemeanour punishable by penal servitude to the extent of three years. The Cruelty to Children's Act, 1894, provides that if a person over sixteen years of age, who has the custody or care of any child under the age of sixteen, wilfully assaults, ill-treats, neglects, abandons, or exposes such child in a manner likely to cause it unnecessary suffering or injury to its health, that person shall be guilty of a misdemeanour. Various regulations for the safe-guarding of children hired out to nurse are made by the Infant Life Protection Act, 1897.

Mention may be made here of the deaths of infants whose parents have neglected to obtain medical assistance during the period of illness. Such conduct may result from simple negligence, or may be due to belief in "Christian science," "faith-healing," or some other fad. But, whatever the motive, failure to take reasonable care constitutes "neglect" and is punishable. If it can be shown that a child's life could have been saved or prolonged by calling in medical advice, those who had charge of the child and failed to take this course are guilty of manslaughter. In 1898, a member of the "Peculiar People" was sentenced to four months' imprisonment with hard labour for neglecting to provide proper medical attendance for his child.

Instances are not rare of the starvation of servant-girls by their mistresses. As a rule the victims are half-witted, or are terrorised by the authority exerted over them. By 24 and 25 Vict., c. 100, it is enacted that whosoever being legally liable, either as master or mistress, to provide any apprentice or servant with necessary food, clothing, or lodgings, wilfully and without lawful excuse refuses or neglects to do so, is guilty of a misdemeanour and is punishable by three years' penal servitude.

In 1877, four persons were convicted at the Central Criminal

Court of causing the death of one, Harriet Staunton, by starvation. The importance of this case to medical men lies in the fact that a doctor, who had seen the woman shortly before she died, gave a certificate of death from natural causes. Suspicion being subsequently aroused, a post-mortem examination was made, and evidence of starvation was found. The possibility of death from natural causes not having been fully excluded by the autopsy, the capital sentences originally passed were commuted.

Suicidal Starvation, by peristent refusal to take food, occasionally occurs among lunatics and hysterical individuals.

CHAPTER IX.

WOUNDS AND MECHANICAL INJURIES.

CONTENTS.—Definition of wounding—Types of wounds and injuries—Contusions, punctured, incised, lacerated wounds, gunshot wounds, injuries without signs of external violence—Procedure in a case of wounding—Identification of blood stains—Questions arising in cases of wounding—Accidental, suicidal, and homicidal wounding; general considerations—Wounds of special regions of the body; their causation and effects.

Definition of Wounding.—To constitute a wound, in the eyes of the law, there must be a breach of continuity of the skin. The definition was formerly of importance, as it sometimes enabled a prisoner to set up the defence that the injuries he had inflicted were not wounds, and he might thereby succeed in escaping punishment. Now the statutes (24 and 25 Vict.) which deal with offences against persons are so worded that it is no longer necessary to define wounds or injuries in criminal charges. Unlawfully and maliciously wounding or inflicting any **grievous bodily harm** upon any person, with or without any weapon or instrument, is a misdemeanour punishable by three years' penal servitude. If any person wound, cause grievous bodily harm to, shoot at, or attempt to shoot at any other person with intent to maim, disfigure, disable, do grievous bodily harm to, or commit murder against that person, he is guilty of felony, and can be punished by penal servitude for life. To **disable** refers to the causing of a permanent, and not merely a temporary disablement. The grievous bodily harm need not be either permanent or dangerous, so long as it seriously interferes with health or comfort. How great a latitude is given to the words is shown by the fact that at the Leeds Assizes in 1883 a midwife, who had conveyed syphilis to a number of women she had attended, and through them to their husbands, was convicted of having unlawfully and maliciously caused grievous bodily harm, and was sentenced to twelve months' hard labour.

Types of Wounds.—Wounds may be conveniently classified as contusions, punctured, incised, lacerated wounds, gunshot wounds, and injuries without external signs of violence.

Contusions or bruises are injuries of the subcutaneous tissues without breach of the surface, and are not therefore legally wounds. The characters of a contusion are pain, swelling, and discolouration, due to the extravasation of blood into the tissues. Blebs and bullæ may form over the part in severe cases. When the hæmorrhage is deep-seated it may be some days before the bruise "comes out," and it may then not appear over the site of the injury. A blow on the scalp, for instance, may be followed by effusion into the eyelids, or

an injury to the neck of the humerus by the appearance of ecchymosis in the region of the elbow, the blood having travelled beneath the fascial planes. The colour of a bruise is blackish-purple, but, as the hæmoglobin disintegrates, it passes through various shades of blue and green to a yellow, which fades, in course of time, into the normal hue of the skin.

The medical witness is not infrequently called upon to express an opinion as to the violence of a blow from the appearance of the bruise it has produced. Several factors have to be borne in mind. Where the tissues are lax and vascular, as in the eyelids or vulva, considerable effusion and discolouration may be produced by comparatively slight violence. The presence of bony resistance beneath the site of the blow increases the effect, as is seen in the ease with which the shin is bruised. On the other hand, if the area struck is supported by soft and yielding tissues or organs, no ecchymosis may follow. A blow on the abdomen, for instance, may cause serious injury to the viscera without producing any bruising on the surface. The condition of the tissues themselves affects their powers of resistance. A strong man, in good health, is not so easily bruised as one whose flesh is soft and flabby. Women and children often exhibit ecchymoses very readily. It is particularly important to remember this when examining a woman to whom violence is said to have been offered, or a child who, it is alleged, has been excessively chastised or otherwise ill-treated. In hæmophilics, severe bruising may follow the slightest blow. Pathological conditions sometimes give rise to subcutaneous hæmorrhages which might be mistaken for the effects of violence. Paroxysms of whooping-cough may cause extravasations beneath the conjunctivæ, and, less frequently, about the neck and face. Spontaneous ecchymoses may also occur in purpura, scurvy, hæmophilia, various forms of erythemata, and asphyxia.

Ante- and Post-mortem Contusions.—Violence to the body immediately after death produces ecchymoses indistinguishable from those received during life. Signs of inflammation or changes of colour are, however, vital phenomena, and a contusion exhibiting these characteristics must have been inflicted at least several hours before death. The distinction between bruises and hypostases was described on p. 32.

Punctured Wounds or stabs are produced by any form of sharp, narrow instrument, such as a needle, hat-pin, knife or bayonet, or a comparatively blunt weapon when sufficient force is used. The aperture in the skin is generally a little smaller than the object which produced it. Owing to inefficient drainage, punctured wounds readily suppurate.

Incised Wounds are those made by sharp, cutting instruments, such as knives, choppers, broken glass, or crockery. As a rule, they are greater in length than in depth, and exhibit edges cleanly cut and free from contusions. Sometimes a fall on a sharp stone causes an incised wound, but in that case the margins are apt to be less regular, and may show more or less bruising. Occasionally a sudden

blow with a blunt instrument over a bony prominence produces a splitting of the tissues, closely resembling a wound made by a sharp weapon. A blow on the scalp with a policeman's truncheon, or the impact of a cricket-ball against the malar bone, may lay open the tissues as cleanly as if they had been cut with a knife. Owing to retraction of the tissues, an incised wound gapes, and tends to assume a fusiform shape. The retraction is greater when the incision runs across the muscular fibres than when it is parallel to them. Hæmorrhage from an incised wound is apt to be considerable owing to the vessels having been cut cleanly across.

Lacerated Wounds are characterised by tearing rather than cutting of the tissues. They are produced by blows with blunt objects, missiles, machinery, wheels of a vehicle, bites of an animal or human being, &c. The wound is usually irregular in shape and depth, and the margins are jagged and contused. Portions of tissue may be torn out, and further loss may be subsequently occasioned by sloughing. Owing to the irregular tearing of the arteries, there may be little hæmorrhage. Suppuration is a frequent occurrence.

Gunshot Wounds.—The character of a gunshot wound varies with the weight, velocity, and shape of the bullet, the direction and distance from which the shot was fired, and the part of the body struck.

The modern, conical bullets travelling with high velocity show little tendency to deflection, and cause usually clean, straight wounds. The experience of the surgeons in South Africa, of injuries produced by the Mauser bullet, was that the entrance and exit wounds were in most cases so similar in appearance that it was impossible to differentiate between them, and frequently so small that it was difficult to locate them. There was very little contusion of the surrounding tissues, damage being practically confined to the actual track of the bullet, and bones were often pierced as cleanly as if by a drill. Such injuries usually heal readily by first intention, for there is but little tendency for portions of clothing to be carried into and infect the wound; and the bullet will have been sterilised by the heat of the explosion and passage through the air. The freedom from sepsis, and limitation of the damage, explain the remarkable recoveries which were observed during the Boer War after the passage of bullets through the intestines, lungs, brain, or other vital organs.

Old-fashioned, spherical bullets produce larger wounds than the modern missiles, and the surrounding tissues exhibit greater contusion. The exit wound is larger and more lacerated than the lesion caused by the entry of the bullet, and shows everted edges.

Explosive and expanding bullets, such as the Dum-Dum, inflict terrible injuries on the soft parts, and comminute the bones.

A charge of small-shot, fired from a distance, produces a number of small separate wounds corresponding to the individual pellets. When discharged from a short distance away, an irregular wound is produced where the pellets are concentrated, surrounded by a more or less peppered area. If the shot is fired quite close to the

body, a single large wound, with ragged and contused edges, is formed.

Bullets after piercing the skin are sometimes deflected from the straight line by impinging on bones, and pursue an irregular and often remarkable course through the body. Such a deflection is not so likely to occur to a bullet travelling with high velocity as to one moving less quickly. Several cases are recorded in which a bullet has produced an entrance wound in the front of the body and an exit wound at the side or back, nevertheless without having passed through the body, but having been deflected by a rib and travelled right round between or beneath the muscular planes.

The writer on one occasion examined a would-be suicide who had discharged a revolver once towards the back of his head and twice over the region of the heart. The first bullet caused a scalp wound in the occipital region without injuring the cranium, the second travelled upwards towards the left acromion process, the third passed outwards beneath the skin and muscles of the chest and emerged under the left arm. A good recovery quickly followed. The man was "wanted" by the police, and had not feigned the attempt to take his life.

When a fire-arm is discharged close to the body the clothing may be burnt, the skin scorched, and the hair singed. If ordinary gunpowder is used, the skin is blackened by the smoke and engrained with particles of unburnt powder; in exceptional cases, however, there is no blackening. Experiments made during the Monson trial in 1893 showed that amberite powder did not cause scorching or singeing however close to the body it was discharged; Schultze, at distances less than 3 feet, produced an engraining of the skin with light yellow particles; and with nitro powders there was a yellowish discolouration, as well as singeing with the black powder, at distances less than 3 feet.

Injuries without External Signs of Violence.—Serious damage may be done to the internal organs without the production of any contusion or breach of continuity of the skin. The liver, spleen, or bladder may be ruptured, and the intestines perhaps completely divided, by a blow over the abdomen, without external mark. Dr. F. J. Smith mentions the case of a young person with flexible ribs in whom the upper lobe of the right lung was completely torn off, although there was no bruising or grazing of the chest.

Observations to be made in a Case of Fatal Wounding.—Attention must be directed towards the position of the body and its relation to surrounding objects, and to a possible assailant; the clothing; the state of the body generally, and particularly as regards wounds or other marks of violence; weapons with which such wounds might have been inflicted; and stains or hair upon clothes, weapons, articles of furniture, &c.

Preliminary Procedure.—When summoned to attend a case of wounding the medical man's first duty, of course, is to ascertain the condition of his patient. If the wounds are of a trifling character, he will treat them according to the requirements of the circumstances; if they are of a nature likely to prove rapidly

fatal, he must not forget the moral obligation which devolves upon him of obtaining a dying declaration (*v.* Chap. xvii.). When the patient is already dead, the examination may be proceeded with more deliberately. In the case of an obviously accidental death, the practitioner may content himself with taking full notes of the surroundings, and then informing the coroner. If, however, there is the least suspicion of homicide or suicide he should at once send for the police, and should remain in the room until a constable arrives. In such cases the medical man is often the first person trained in habits of observation upon the scene, and he may, in consequence, be a most important witness at either inquest or trial. It behoves him, therefore, to make full notes in writing of all the attendant circumstances before anything is moved. The exact position and appearance of the body should be recorded, the bodily temperature taken, and the presence or absence of rigor mortis observed. Attention must be given to the state of the room. Disturbance of furniture or other indications of a struggle should be noted. The walls, floor, and furniture should be searched for blood-stains, and the appearance of the blood—whether it has spurted to a distance, formed a pool or a trail, exhibits signs of attempts having been made to wipe it up or otherwise remove it, or shows foot-prints—should be described. The presence or absence of weapons, and the exact relation they bear to the position of the body, should be recorded. When the body is out of doors, the character of the surface upon which it is lying—pavement, rough ground, soil, &c.—should be observed, as it may be asserted that the wounds were caused by a fall. Finally, a note should be made of the demeanour of those around, and the explanations they give of the cause of the injuries. The medical man should not proceed further except under an order from the coroner.

Examination of the Clothing.—This is conducted upon the principles described in Chapter iii. The special features to notice are rents and tears, and their coincidence or otherwise with wounds on the underlying part of the body, blood-stains, and burns in the case of gunshot wounds. Portions of the stained area should be cut out, and the tests for blood applied.

Examination of the Body.—The following are the special points to be observed:—The number of wounds; the exact position of each wound; its character, whether incised, punctured, or lacerated; its dimensions, length, breadth, and depth, a probe, however, being used with great gentleness in view of the possible assertion that the wound was deepened by the examiner; the direction of the wound; the condition of its edges and ends; the extent of the hæmorrhage; the presence of clotted blood or foreign bodies within the wound; the condition of the surrounding tissue, whether contused, smoke-stained, or showing evidence of healing, inflammation, or suppuration; the presence of other indications of violence upon or within the body; and the presence or absence of conditions of disease which might have contributed to cause death. In women it may be necessary to examine the genitalia.

The examination of wounds in the living comprises, as far as possible, the same observations.

Examination of Stains Suspected to be Blood.—Fresh blood is more or less bright red in colour. After it has been exposed to the air for some time the colouring matter becomes changed into methæmoglobin, and the stain has now a brownish appearance. This change does not occur for a few weeks in pure air, but takes place much more quickly in towns where the atmosphere is charged with the products of combustion of coal. After a further interval, which is less if the surroundings are damp, the methæmoglobin passes into hæmatin.

Three series of tests can be applied to blood—microscopic, spectroscopic, and chemical. If there is sufficient (it need not be a large quantity) to make a complete examination, blood can be identified with certainty.

Microscopic Examination.—This is only of value when applied to comparatively fresh blood. When the stain is on cloth, a small portion of the fabric is cut out, and gently squeezed with a glass rod on a slide with a drop of normal saline solution or glycerine and water (1 to 7). It is then mounted and examined. If the stain is quite recent, normal corpuscles will be found; in older stains the corpuscles are misshapen and crenated in outline; in still older stains they are completely disintegrated, and unrecognisable. Stains on wood, metal, or plaster should be gently scraped off, and examined in the same manner.

Spectroscopic Examination.—A solution of a recent stain may be prepared by gently agitating strips of the cloth, or shavings of the wood, or chips of the plaster with cold water. Older stains are much less soluble, and must be treated with a saturated solution of borax or very dilute ammonia. The solution is then placed in a tube with flat sides, and examined with the direct vision spectroscope. If the stained area is so small that only a minute quantity of solution can be obtained from it, a micro-spectroscope should be employed.

If the blood is fresh, the spectrum of **oxyhæmoglobin** is probably seen.* A solution of about 0·7 per cent. shows one broad band between Fraunhofer's D and E lines, but, on gradual dilution, this gives place to two distinct bands between D and E. There is also some absorption at each end of the spectrum. If now a drop of ammonium sulphide be added, reduction occurs, and the spectrum of **hæmoglobin**, consisting of a single broad band between D and E with absorption at the ends of the spectrum, is seen. On shaking the tube with air the hæmoglobin is re-oxidised, and the two separate bands reappear, but, on standing, reduction again takes place. The change from oxy- to reduced hæmoglobin is most characteristic, and can be effected as often as desired.

When the blood is not quite fresh, probably the first spectrum obtained is that of mixed methæmoglobin and oxyhæmoglobin, the bands due to the latter becoming gradually fainter as the stain gets older. The spectrum of **methæmoglobin** shows a characteristic

* *See Frontispiece.*

band in the red between C and D, and two fainter bands between D and E. Reduction, in this case also, can be effected by ammonium sulphide, and the broad band between D and E, indicative of reduced hæmoglobin, made to appear.

In a stain which has been long exposed to air the colouring matter will have been converted into hæmatin, and ammonia will have been found necessary in order to obtain a solution. The spectrum obtained, therefore, is that of alkaline hæmatin, consisting of a not very distinct band immediately to the left of the D line. On reduction, however, with ammonium sulphide the very characteristic spectrum of **hæmochromogen** or reduced alkaline **hæmatin** is obtained. It shows two bands slightly nearer the violet end of the spectrum than those of oxyhæmoglobin. The first is very distinct, and is situated midway between D and E. The second, wholly in the green, is broader, and not quite so sharply defined; it begins at E, and extends beyond *b*. On vigorously shaking the solution with air, the spectrum of alkaline hæmatin reappears for a short time.

Hæmochromogen can also be prepared as a confirmatory test, from a solution of oxy- or methæmoglobin, by adding a few drops of strong caustic potash, warming, and then reducing the alkaline hæmatin so formed with ammonium sulphide.

The great value of the spectroscopic tests for blood results from the facts that they are absolutely distinctive, they necessitate only a minute quantity of blood, and can be applied to stains of any age.

Chemical Examination.—A small portion of the stained fabric is cut out, and teased with a glass rod in a drop of tincture of guaiacum and hydrogen peroxide on a white porcelain slab. A blue colour usually forms when blood is present, but may not appear if the stain is very old. The test is delicate, but not conclusive, as various other substances give it.

A scraping of the stain is boiled on a slide with a drop of glacial acetic acid and a minute crystal of sodium chloride. On cooling, microscopic crystals of **hæmin** separate out. These are triclinic plates and prisms of a dark brown colour. This is the best of the chemical tests for blood, but they are all inferior to, and less easy of application than, the spectroscopic methods.

Stains Resembling Blood.—Certain substances produce stains which might at first be mistaken for blood; they are, however, easily differentiated. *Fruit-juices* assume a greenish tint when treated with ammonia, *cochineal* becomes crimson, and *logwood* bluish-black; blood, however, remains practically unchanged. Stains of *red aniline dyes* become yellowish when treated with nitric acid. Spots of *grease*, *paint*, or *tar* may be dissolved off in ether or benzene, and examined spectroscopically. *Carmine*, *alkanet root*, and certain other substances yield spectra presenting a superficial resemblance to those of blood-derivatives; they cannot, however, be made to go through the series of changes characteristic of hæmoglobin. Rust-stains on knives may be dissolved off in nitric acid, and the usual

Prussian blue or sulpho-cyanide tests for iron applied. Stains of blood and rust mixed may be subjected to a preliminary test by Ganttner's method. This consists in placing a drop of a solution of hydrogen peroxide upon the stain, when numerous bubbles of hydrogen are evolved. The reaction, however, is only conclusive evidence of organic matter among the rust, not necessarily blood. To confirm the presence of blood, the stain should be scraped off, treated with a little dilute ammonia, and filtered. The rust will remain on the filter, and hæmoglobin or one of its derivatives can be detected in the filtrate.

Differentiation of Human Blood from that of Other Animals.—It is not possible to distinguish human blood from that of other mammals, with the exception of the *Camellidæ*, though the corpuscles in the blood of most of the domesticated animals are smaller than those in man. The blood of birds, reptiles, and fishes, however, is readily distinguished, when fresh, by the fact that the corpuscles are oval, nucleated, and larger than those of the mammalia. Attempts have been made to differentiate the blood of various animals by means of differences in the crystalline properties of the hæmoglobin; they are not, however, sufficiently practical to be of value for medico-legal purposes. A somewhat elaborate process, based upon the toxic effects produced when the blood of one animal is injected into another of a different species, is still in the experimental stage. All that the medical examiner can say with certainty at present is that the blood is that of a mammal, or that of a fish, bird, or reptile, and this, only when it is sufficiently fresh to contain some normal corpuscles.

Examination of Hair.—Hairs found on weapons, clothing, or furniture may be submitted to the medical expert for identification. Those who have had considerable experience of such work can not only distinguish the hair of lower animals from that of man, but can determine the species of animal from which it has been derived. The characters of human hair are well known. The student will obtain the best idea of the appearances presented by the hairs of lower animals—sheep, cat, horse, &c.—by mounting specimens for himself, and examining them under the microscope. When a hair is forcibly plucked out, the surface of the terminal bulb is rough and irregular, while in a naturally-shed hair it is smooth and rounded. Another point of distinction, to which Prof. Glaister attaches considerable importance, is rupture of the sheath of the bulb in the forcibly-extracted hair.

Questions arising in Cases of Wounding.—Having completed his investigations, the medical jurist is in a position to draw conclusions from the results, and frame answers to the following questions, any of which may be put to him:—

With reference to either the living or the dead—

What is the age of the wounds?
With what weapon were they probably inflicted?
Might it have been the one found?

With reference to the living—

Are the wounds dangerous to life?
Will they leave permanent injuries?
Were they self-inflicted with or without suicidal intent?

With reference to the dead—

Were the wounds inflicted before or after death?
Were they mortal?
Was death accelerated by disease or abnormal development?
Were the wounds accidental, suicidal, or homicidal?

Age of a Wound.—Wounds which are not immediately fatal, undergo changes as healing progresses, or septic processes develop. It is possible, therefore, from the condition of the wound to form a rough estimation of the time which has elapsed since it was inflicted. If the divided surfaces of a cleanly-cut aseptic wound be examined after an interval of from twelve to eighteen hours, they will be seen to exhibit a moist, glossy appearance, due to the escape of lymph. At the end of forty-eight hours the surfaces are covered with a delicate, greyish layer composed of lymphocytes entangled in the fine filaments of the tissues. If the divided surfaces are in apposition, they are weakly adherent in three days, and, when healing continues by primary intention, they are firmly united by connective tissue in from five to eight days.

In wounds in which loss of tissue has occurred, or where the surfaces are not in apposition, healing takes place by granulation. If freedom from sepsis is maintained, the surrounding tissue does not, as a rule, show congestion or swelling after the lapse of forty-eight hours. Granulation tissue can be recognised in from five to eight days. Further progress depends upon the extent of the wound and the recuperative power of the tissues. When a wound is infected, the surrounding tissues become inflamed, and pus appears in from thirty-six to forty-eight hours. Sloughing of portions of tissue or abscess formation may then occur. No definite dates can be assigned to these processes, but evidence of healing may possibly not be present after an interval of several weeks.

Wounds in elderly and debilitated persons heal less readily than those in the young and healthy.

With what Weapon were the Wounds probably inflicted?—This question can only be answered by a consideration of all the circumstances. Speaking generally, the character of a wound corresponds with the weapon employed; and his examination of the body will in most cases have enabled the medical jurist to form some idea of the way in which the injuries were produced. But a weapon may be used in an exceptional manner; blows, for instance, with the flat of a sword may cause contused or lacerated wounds, and we have already noticed that sometimes a rounded object, such as a thick stick or bludgeon, leaves an incised wound. The medical witness should avoid, therefore, being dogmatic, and should content himself by saying that there is nothing incompatible

with the assumption that the weapon produced was the one employed. Hair or blood-stains upon a weapon furnish additional evidence of its use; even after washing, blood may sometimes be detected about the joint of a knife or in the nick for the finger-nail.

Are the Wounds Dangerous to Life?—The answer to this question must be based entirely upon surgical considerations. A definite assertion that the injuries are not serious should be avoided, for it must be remembered that even the smallest wound may become infected, and give rise to fatal septicæmia, pyæmia, or tetanus. Speaking generally, however, the medical man, in forming an opinion, will be guided by the depth and extent of the wound, the organ injured, the amount of hæmorrhage, and the presence or absence of shock.

Will Permanent Injury be caused by the Wound?—This, again, is purely surgical. The consideration of "nervous shock" and functional derangements following violence is deferred to Chapter xvi.

Were the Wounds self-inflicted, without Suicidal Intent?—This may be done by a person who has appropriated money or valuables entrusted to his charge, in order to support a statement that he has been attacked and robbed. Sometimes injuries are self-inflicted, in order to substantiate an accusation of cruelty or assault, or to excite compassion. Wounds of this character are usually incised or punctured, rarely lacerated, and are generally slight in degree; often, in fact, not penetrating deeper than the skin. They are frequently multiple, and are situated on those parts of the body easily accessible to the individual himself. The throat, precordium, and other sites popularly believed to be dangerous are generally avoided, a marked distinction from suicidal wounding. Injuries to the hands are exceptional; *per contra* in real attempts to kill or disable, the victim often receives cuts on the palms or fingers in his efforts to seize the knife. Sometimes the blood is extensively smeared over the surface in the neighbourhood of a wound, in order to produce the greatest display; and it may be found in places where its presence is difficult to explain.

Frequently such wounds on the body or limbs are inflicted first, and then cuts are made through the clothing to correspond. These are often larger than the wounds they are supposed to accompany. When the individual is dressed, it is highly improbable that the correspondence is exact. The skin may be injured where the clothing is intact; and cuts in the clothes may not coincide with each other or with any underlying wound. Prof. Dixon Mann mentions a case of a self-inflicted wound of the arm, the cut accompanying which went only through the cloth, and not through the lining of the coat-sleeve. Sometimes each garment is separately stained with blood. In such a case, instead of finding the usual condition—the article next the skin the most stained, and that on the exterior the least—the examiner may find a superficial layer showing more blood than a deep one. Furthermore, the patterns of the stains on two surfaces in apposition will probably not correspond.

The examiner should obtain from the individual details of the alleged attack with reference to the positions of the parties, the nature of the struggle, the weapon employed, the strength of the assailant, &c. As the story is told, probably many discrepancies between it and the wounds exhibited by the "victim" will reveal themselves.

Wounds of a more serious character are occasionally inflicted by persons who do not show other evidence of insanity. Sexual monomaniacs, for instance, may destroy the organs of generation.

Were the Wounds inflicted Before or After Death?—The distinction is readily made in most cases. Signs of inflammation or repair are, of course, conclusive evidence that the wound was received ante-mortem. On the other hand, wounds inflicted some time after death are quite characteristic. The edges do not gape, and there is very little hæmorrhage unless a large vein has been opened. Difficulty arises only in the case of wounds inflicted immediately after death which exhibit some retraction of the skin, and possibly free hæmorrhage. The appearance of blood-stains in the neighbourhood may afford a means of distinction. When a small artery is cut during life, the blood spurts out, perhaps to a distance of several feet, and leaves a line of splashes over the surrounding furniture or floor. Spurting, however, does not occur from a vessel divided after death, though a pool of blood may be formed.

Were the Wounds found, Mortal?—The importance of this question in charges of murder or manslaughter is obvious. Death from wounding may result immediately, or may follow after an interval from secondary complications. Immediate causes of death are *shock, hæmorrhage, and injury to a vital organ.*

In estimating the amount of shock which a particular wound might give rise to, due importance should be attached to the state of terror the person was probably in before the actual receipt of the injury. Death, in fact, in some cases has resulted from sheer fright without any mechanical violence. Shock is the more likely to follow violence over sensitive nerve-centres; blows on the abdomen or precordium, for example, may be followed by instant inhibition of the motor nerves of the heart. Instances of death from shock have been given on p. 23.

Death from hæmorrhage occurs the more readily when there is a coexisting state of shock. The bleeding may be internal or external, and may be gradual when a small vessel is injured, or sudden and profuse when a large artery is severed. The post-mortem examination shows the heart and large vessels to be nearly empty, and the internal organs pale and exsanguined.

Death from injury to a vital part requires no comment.

When the wound is not immediately fatal, death may subsequently result from septic infection, tetanus, chronic suppuration, &c. Sometimes an injury is caused which leads indirectly to a fatal termination only after a considerable interval of time, as, for instance, the eventual rupture of a traumatic aneurism following a blow, or hydro-

or pyo-nephrosis from stricture of the urethra caused by injury to that canal by a kick in the perineal region.

Was Death accelerated by the Presence of Disease or Abnormal Development?—The bearings of this question in both civil and criminal cases are discussed in Chapter iv.

Are the Wounds Accidental, Suicidal, or Homicidal?—General Considerations.—The Situation of the Body and State of the Surroundings.—Evidence from these sources is obtained chiefly by exercise of the detective faculties. The fact that a body is found in a room with the door and windows fastened on the inside is practically conclusive evidence of suicide; if only the door is locked, the window sashes and sills should be carefully examined for blood-stains or other indication that a person has escaped thereby. When a body is discovered at the foot of a cliff, or bottom of a mine-shaft, accident is a probable explanation. Homicide is indicated when a body is found buried, and usually also when concealed, though occasionally a suicide creeps into an out-of-the-way place—beneath the rafters of a roof, for instance—before destroying himself. Signs that a struggle has taken place point to homicide. This is particularly the case in the open air, where the vegetation surrounding a corpse has been trampled down and broken. In a room, a suicide may have upset the furniture before he took his life. All blood-stains should be examined with minute care, for by the trails formed it may be possible to elucidate the movements of the deceased between the time the injury was received and the moment of death. Footprints should be measured, and the boots or feet of the deceased examined for blood. Impressions of fingers in blood or dirt should be photographed as a possible means, in the future, of identifying a murderer. Signs that attempts have been made to wash away the blood are very suspicious.

The position of weapons sometimes provides a clue. A knife or revolver found firmly gripped in the hand of the corpse furnishes strong evidence of suicide (*v.* p. 34). The absence of any weapon with which the wounds could have been inflicted points to homicide, but not conclusively, for a suicide after giving himself a fatal injury may throw the instrument used out of a window or into a river.

Number of Wounds.—The presence of many wounds of inconsiderable degree raises the presumption of suicide. A single fatal wound may be either suicidal or homicidal. When two wounds, either of which was likely to have been immediately fatal, are found, the probability is that murder has been committed. The man who has shot himself through the heart, for instance, is not, as a rule, able to fire at his brain. Such cases have occurred, however, and the inference of homicide is not therefore always reliable. Prof. Dixon Mann mentions the case of a youth of nineteen who successively shot himself through the brain, the left ventricle of the heart, the abdomen, and the neck. In another case a man, after stabbing himself in the heart with a sharp tool, walked up a flight of stairs, and threw himself from a window.

Position of the Wounds.—Suicidal wounds made with cutting or stabbing instruments are usually inflicted on the front of the body, in easily accessible positions, more often on the left side than on the right. The chest and throat are the favourite sites. Wounds in the back suggest homicide. Lunatics, however, may injure themselves in the most exceptional positions. Cuts on the palms of the hands are indicative of attempts to seize the knife, and therefore strongly suggest homicide. If the victim put up his arms to ward off blows, or protect his head or body, the backs of the hands and fore-arms are likely to be cut or contused. Fire-arms are usually discharged by suicides at the heart or brain, but sometimes the muzzle of a revolver or pistol is placed on the occipital region or behind the ear. A shot-wound in the back is almost certainly accidental or homicidal.

Type of the Wounds.—Incised and punctured wounds are generally suicidal or homicidal. Contused wounds and bruises are, as a rule, accidental, but maniacs have been known to batter their heads in with heavy instruments, or drive nails into their skulls.

Direction, Extent, and Shape of the Wound.—As a rule, an incised wound is deepest where the knife entered and becomes shallower towards the end from which it was withdrawn. From this feature it is sometimes possible to determine whether a wound was made from right to left or *vice versa*. Speaking generally, a suicidal wound runs from left to right, in a direction downwards and towards the middle line of the body, but many exceptions are observed. The track of a bullet-wound will show the direction from which the shot was fired; if from behind, and it can be proved that a gun was used, accident or homicide is indicated. The bullet should be preserved in order that it may be compared with any found in the possession of a suspected person. Slight wounds suggest an attempt to feign an attack, but no reliable inference can be drawn from severe injuries. Cases of cut-throat have been known in which the tissues have been severed so deeply as to notch the vertebræ. The shape of a wound may afford assistance by indicating the nature of the weapon employed. When, for instance, a wound is obviously inconsistent with a weapon found lying by the side of, or in the hand of, a corpse, suspicion is aroused that it has been deliberately placed in such a position with the object of suggesting suicide. Sometimes a wound indicates familiarity with a method employed for slaughtering animals.

In 1904, a man named Fee, a butcher by trade, was convicted at Dublin of the murder of one, Flannagan, whose body had been found buried beneath a manure heap. A knife of the sort used for shaving pigs was found near the body, and the character of the wound showed that the murder had been committed by a person acquainted with the method in which pigs are killed.

State of an Accused Person.—If a person is arrested on suspicion, his clothes should be examined for blood-stains or signs of recent cleansing. An estimate of his physical powers should

be made, and injuries or bruises about him looked for. Weapons in his possession should be searched for blood, hair, &c., and the possibility of their having been used to inflict the wounds on the deceased considered.

The Medico-Legal Features of Injuries in Special Regions of the Body.—**The Head.**—Injuries to the *scalp*, as a rule, are only dangerous to life when they are followed by suppuration, tetanus, or erysipelas. Blows with rounded weapons sometimes cause wounds resembling those made by cutting instruments. Prolonged or difficult labour may have produced a hæmatoma beneath one or other layer of the scalp of a newly-born infant. Such a condition must not be mistaken for the result of violence. As the margin of the effusion becomes indurated, it may simulate a depressed fracture of the skull. The differentiation, however, is not difficult to make, as the edge of the hæmatoma is definitely raised above the surface of the cranium, and can be indented by the finger.

Violence to the head may fracture the cranial bones, or may produce lesions of the brain or cerebral vessels without fracture of the skull.

Fractions of the *vault* of the skull are nearly always due to direct violence. Blows with broad instruments and falls on the head cause, usually, fissured fractures; but when the striking force is limited to a small area, as, for example, by the use of a hammer, the knob end of a poker, or the impact of a bullet, a portion of bone may be driven into the skull and a depressed fracture result. For several reasons the inner table of the bone is always more splintered and damaged by a blow on the head than the outer. When, however, the force is applied from within, as is the case at the exit-fracture produced by a bullet which has completely traversed the skull, the outer table suffers more than the inner. It is thus possible, in a skull which exhibits two gunshot wounds, to distinguish the hole made by the entrance of the bullet from that made by its exit, but this applies chiefly when a large old-fashioned bullet has been used. Fracture of the vault by indirect violence occurs when the skull is bilaterally compressed, as, for instance, between the buffers of two railway carriages.

Fracture of the *base* of the skull may be due to direct or indirect violence, or (most frequently) to extension of a fracture of the vault. Fractures of the base following violence to the vault are now explained on the bursting or compression theory, for details of which works on surgery must be consulted. The line of fracture is more frequently parallel to the direction of the compressing force than at right angles to it. Bilateral compression such as occurs when a blow on the head is received by a person lying on a resisting surface—a pavement, for instance—is apt to produce a complete transverse fracture of the base (or vault). When the violence is unilateral, as in the case of a blow on the side of the head of a person in the erect posture, the fracture is generally confined to that side of the head.

Fracture of the base by indirect violence may also be due to a fall on the feet or buttocks, the force of the impact being transmitted through the vertebral column to the skull; or to a blow on the chin which drives the condyle of the jaw violently against the glenoid cavity.

Direct violence as the cause of fractured base is observed when a sharp object, a fencing-foil or point of an umbrella, for instance, is thrust through the orbit, or up the nose through the cribriform plate of the ethmoid, or when a bullet is fired into the mouth. A stab may penetrate the base in the region of the occiput. A method of killing infants which was at one time frequently adopted was to lift the upper eyelid and thrust a needle through the thin wall of the orbit into the brain. The slight external wound often baffled detection.

Fractures of the skull, as a rule, are not dangerous in themselves, but only in proportion to the injury done to the brain or cerebral vessels.

Cerebral Injuries without Fracture of the Skull. — Effects which may immediately follow violence to the head are rupture of vessels, laceration of the brain, and concussion, the diagnosis of which, from other states of unconsciousness, is given on p. 20. At a later period, cerebral irritation, meningitis, or abscess may develop. Epilepsy and insanity are occasional sequelæ.

The middle meningeal artery is the vessel most likely to suffer. As it crosses the anterior inferior angle of the parietal, it is often enclosed in a bony canal or groove, and a blow on the head which is merely sufficient to detach the dura mater may cause rupture of the artery at this point. Hæmorrhage from other meningeal vessels, or from the venous sinuses, or into the substance of the brain, without fracture of the skull, is rare in young and healthy individuals. Those in whom such an event has apparently occurred are usually elderly, and often intemperate, persons with atheromatous arteries. Frequently they are known to have been in a state of mental excitement or rage at the time the violence was inflicted, so that spontaneous rupture is, at least, a possible explanation. Death in cases of internal hæmorrhage is due to cerebral compression.

The investigation of cerebral injuries may be complicated by the fact that, in some cases, a considerable interval of time elapses between the receipt of the violence and the appearance of the symptoms. When only a small vessel has been lacerated, compression is delayed until sufficient blood has escaped to produce effects. Thus, a person after a potentially fatal blow on the head may walk a considerable distance away, or perhaps return home and go to bed. He is subsequently found by his friends in a state of unconsciousness, from which he never recovers. In such a case all evidence to be derived from the scene of the injury is probably lost.

If asked to express an opinion as to the probability of permanent effects following a cerebral injury, the medical man should give a very guarded answer. Many well-authenticated cases of apparently

complete recovery after the loss of a large amount of brain substance have been recorded. Extensive destruction of the frontal lobes, for instance, has been followed by no other result than a change in the disposition. On the other hand, trivial external wounds may be accompanied by lesions within the cranium, leading to permanent paralysis, epilepsy, insanity, or death.

Hysterical phenomena and "nervous shock" are considered in Chapter xvi.

Wounds of the Face and Ear are rarely fatal, but free hæmorrhage, or paralysis from nerve lesions, may follow. Injuries caused by blows upon bony prominences, such as the malar eminence, the chin, and eyebrow, may present the appearance of incised wounds. The malar bone is so firmly united to the skull that a violent blow upon it may cause concussion of the brain. Injuries to the eyeball may be followed by ophthalmia, detachment of the retina, optic atrophy, and other lesions. A "black eye" is not always the result of direct violence, but may follow, after an interval, a blow on the scalp. Dislocation of the jaw has been caused by yawning, by violent vomiting, and by extraction of a tooth by a dentist. As regards the ear, hæmatoma auris is sometimes idiopathic. Rupture of the membrana tympani, usually on the left side, has been produced by a box on the ear.

Wounds of the Neck.—The vast majority of these are cases of "cut-throat." The significance of the direction of the wound has already been considered. The effects vary with the structures injured. When the great vessels are divided, fatal hæmorrhage is almost certain to occur. Owing, however, to their mobility and depth, and to the projection of the thyroid cartilage, the carotid arteries sometimes escape damage in a marvellous manner. In such a case, if the wound is above the hyoid bone, the attachments of the tongue may be severed, and the falling back of that organ cause death from asphyxia. Sometimes suffocation is caused by blood or mucus trickling into the air-passages. At a later period, death may be due to cellulitis in the neck, œdema of the glottis, or septic broncho-pneumonia set up by aspiration of blood or particles of food. If recovery occur, there may be permanent impairment of the vocal cords.

A remarkable case was tried at the Central Criminal Court in 1898. A man in a fit of jealousy killed his wife with an axe, and then endeavoured to commit suicide by cutting his throat. He recovered, but had completely lost the use of his voice owing to injury of the vocal cords. As he could neither read nor write he was unable to plead to the charge of murder, or instruct counsel for his defence. The trial had stood over from the last two sessions in the hope that the prisoner would regain his speech, but eventually he was tried without pleading. He was convicted, and sentenced to death.

Wounds of the Thorax.—As already stated, a blow over the **heart** may cause sudden death from inhibition. A fatty heart may be ruptured, or an aneurism burst, by external violence without

breach of continuity of the skin. Penetrating wounds of the heart are not always immediately fatal. Persons have been known to run or walk considerable distances before falling. More rarely, life has been prolonged for several hours or days; in one case a man lived twenty days with a skewer traversing his heart from side to side. A fair number of instances of recovery from penetrating wounds of the heart are on record, and occasionally the divided tissues have been successfully sutured. Wounds of the great vessels are almost invariably fatal.

Laceration of the **lung** may be caused by a penetrating instrument, or by the broken end of a rib. Fracture of a rib may result from indirect violence, such as the passage of a cart-wheel over the body. The bone then breaks about the point of maximum curvature—*i.e.*, near the centre—and the broken ends turn outwards so that the lung and pleura are not likely to be injured. On the other hand, a direct blow causes the ribs to be stove in, and laceration of the lung is therefore much more likely to follow. Exceptionally, severe, and even fatal, injury may be done to the lung without external wound or fracture of the ribs. Death from wounds of the lung may be due to broncho-pneumonia, empyema, pleurisy, pneumo- or hæmo-thorax, &c. Some remarkable cases of recovery after complete penetration of the thorax have been observed. A person has survived after having been run through the body with a sword. In one case a man lived fifteen years carrying within his chest part of a foil which transfixed him from ribs to spine. In another case a man lived for ten years after he had been pierced through from side to side by the shaft of a cart.

In women, squeezing or violence to the **breast** may be followed by acute or chronic mastitis or abscess formation. Carcinoma mammæ is believed in some instances to have been caused by injury to the breast.

Wounds of the Abdomen.—Injuries in this region are always liable to be attended with severe shock. Sudden death from inhibition may follow a blow which has not produced any organic lesion, or even external bruising. In other cases death is due to hæmorrhage, peritonitis, or rupture of a viscus. Rupture of the **stomach** or **intestine** is the more dangerous when the organ is distended with food. Recovery not infrequently follows perforation by a small, clean instrument. During the South African War many soldiers, who had been shot through the stomach or intestines, recovered. Frequently it happened that the man had been for several hours without food before he was wounded, and thus a condition eminently favourable to recovery existed. The **liver** may be ruptured by crushing, kicks or blows, or may be lacerated by the end of a broken rib. Rupture of the **spleen** is the more likely to occur when that organ is enlarged. Lesions of the **kidneys** may cause death by extravasation of urine.

Occasionally, death has resulted from peritonitis set up by a sponge or instrument accidentally left in the abdomen after an operation. Such an event may lead to an accusation of malapraxis, and it is

then necessary to determine from the merits of the case whether the surgeon, his assistant, or the nurse should be held responsible. A surgeon pressed for time in a desperate case, and fully occupied with the major details of the operation, might be quite justified in leaving to the nurse who hands them to him the duty of counting the sponges (*v.* also Chap. xvii.).

Fractures of the **pelvis** are generally occasioned by crushing, railway accidents, &c. Fracture of the **sacrum** or **coccyx** may be caused by a kick from behind. Complications may arise from injuries of the bladder, rectum, urethra, or vagina.

Rupture of the **bladder** may also be caused by direct violence to the abdomen, especially when the viscus is distended. Spontaneous rupture, though rare, may follow over-distention from pathological conditions—*e.g.*, impacted calculus or hypertrophy of the prostate. Such a result is the more likely to ensue if the wall of the bladder is weakened by ulceration.

Laceration of the **urethra** in the male may be caused by a kick in the perineum or falling astride a narrow object, such as a spiked gate or rail. Stricture of the urethra, or perhaps fatal extravasation of urine, may follow. Contusions of the **penis** and **testicles** may result from kicks, blows, or accidents. Incised wounds are frequently self-inflicted. Maniacs have been known to open the scrotum and remove the testicles, or shear off the entire genitalia.

Injuries of the **vulva** may be occasioned by kicks, rape, recent parturition, &c. Sometimes women are cut about the external genitalia, perineum, or buttocks by sitting upon the sharp edge of a broken bed-chamber in order to micturate, or by the vessel breaking beneath them. The parts are very vascular, and fatal hæmorrhage may ensue. Death from hæmorrhage has even followed violent, legitimate sexual intercourse, or rupture of the hymen at a first coitus. Injuries of the **vagina** or **uterus** may be caused by attempts to procure abortion. In pregnant women, violence may lead to abortion, separation of the placenta, rupture of the uterus, or other complication. Sometimes the bodies of women are found exhibiting terrible mutilations of the organs of generation, the parts perhaps having been completely excised. Such deeds have usually been perpetrated by an individual of perverted sexual instincts. The sensational Whitechapel murders in 1888, were probably of this character.

Injuries of the Spinal Column and Cord.—Fracture of the **spinal column** may be caused by direct violence, such as a fall or heavy blow on the back or neck, or indirect violence, such as occurs when a person falls on his head, or dives into shallow water and strikes the bottom. In severe injuries of the spinal column fracture is usually associated with compression or laceration of the spinal cord. For anatomical reasons, dislocation without fracture can occur only in the cervical region. The effects of a lesion of the spinal cord vary with the situation. Injury to the medulla or upper cervical portion of the cord is usually immediately fatal, but, in some cases, life has been prolonged for a few hours. Lesions at

other parts may cause spinal myelitis, meningitis, or hæmorrhage, leading to paraplegia, anæsthesia, loss of control of the sphincters, &c. Symptoms of an hysterical character are very common after concussion of the spine; the frequency with which they have been observed after railway accidents having led to the use of the term "railway spine" to describe the condition (*v.* Chap. xvi.).

CHAPTER X.

MATTERS INVOLVING THE SEXUAL FUNCTIONS.

CONTENTS.—Abnormalities of the generative organs—Determination of sex—Impotence and sterility—Impotence and nullity of marriage, legitimacy, and rape—Rape and allied offences—Signs of virginity—Unnatural offences.

Abnormal Formation of the Organs of Generation comes under notice, from the medico-legal standpoint, in cases in which the sex of an individual, whether living or dead, is called in question; or, as a possible cause of alleged impotency or sterility; or, when a prisoner pleads as a defence to a charge of rape or criminal assault that he was incapable of performing the sexual act. The subject is very thoroughly reviewed by Neugebauer, who has collected 930 cases, in an article in the *Brit. Gyn. Journ.*, 1904, p. 227, from which most of the following is taken:—

The cases of hermaphrodism may be primarily divided into *true* and *false*.

True Hermaphrodism.—This strictly means the possession by one individual of both testicles and ovaries with power of copulating as a male, and of becoming pregnant. Such a condition is unknown. A modified form in which testicles and ovaries are combined is extremely rare, and even the existence of this is denied by Neugebauer. Since his article was written, however, a case has been reported by Simon (Virchow's *Archiv*, Bd. clxxii., Heft 1), which appears to be an instance of true hermaphrodism. The individual, aged 23, had well-developed mammæ, but the mental attitude was decidedly masculine. Regularly at intervals of four weeks there was slight hæmorrhage from the genitals lasting for several days. The external organs were an amalgamation of both sexes. With sexual excitement, the object of which was invariably a female, there was erection of the member, and discharge of whitish mucous fluid. A body lying in front of the right inguinal canal was incised, and on microscopical examination showed both ovarian and testicular elements well developed. Moreover, the presence of tube, parovarium, vas deferens, and epididymis was demonstrated.

False Hermaphrodism.—This is much the more common form. It may be defined as a condition in which "the genital canals, the external genital organs, and the secondary sexual characteristics do not completely correspond with the sexual character of the genital glands." Two types are recognised:—

(*a*) **The Masculine Type, in which the External Genitalia of a Male resemble those of a Female.**—In this condition the penis is so small as to look merely like an hypertrophied clitoris, and complete hypospadias exists, the cleft scrotum resembling a

vulva. A testicle may occupy each half of the scrotum, but when, as is frequently the case with such malformations, these organs are undescended, the resemblance to the female may be very close.

(*b*) **The Feminine Type, in which the External Genitalia of a Female resemble those of a Male.**—In such a case the clitoris and prepuce are much enlarged, and appear like a penis; in addition, the labia may be united by a thin median raphé, thus simulating a scrotum.

Neugebauer gives numerous instances of mistaken sex. Among the 930 cases collected by him there were 68 instances of marriage between persons of the same sex. In 59 of these a wife or widow was discovered to be a male, and in 5 the necropsy showed the husband to be a female pseudo-hermaphrodite. One of the latter, married as a man from 27 to 57, died of cancer of the uterus. The sex instinct in hermaphrodites is uncertain; it may be absent, normal, or perverse. Sometimes there is intercourse with both sexes. "Many a mistaken male, brought up as a girl and married as a wife, has had his own mistress out of doors." In 28 instances public prostitutes have been found to be of the male sex. Mistakes of sex have not infrequently led to actions for nullity of marriage. In one case it was the third husband who first recognised the true sex of his spouse. In another, the husband claimed that his supposed wife lay with other women, and made him an object of ridicule. Other instances given are those of two soldiers who were found to be women; one menstruated, the other gave birth to a child. A canoness, after several years' residence in a cloister, was expelled because she was found to be a male. Sometimes the mistake leads to serious errors in surgical treatment. Testicles have been removed for swollen glands, and a male hypospadiac has been mutilated by an operation to remove an hypertrophied clitoris.

Hermaphrodites are often mentally affected, and are not infrequently charged with rape, seduction, and unnatural crimes. In 1894, a governess was condemned to death at Copenhagen. She had abused a little boy, and, to avoid denunciation, poisoned him with chloral. On examination she was found to be a male with hypospadias.

Determination of Sex.—This may be required in nullity of marriage cases; in order to settle a question of inheritance; and to determine how a child shall be brought up. A marriage between two persons of the same sex is void *ab initio*. With regard to inheritance, it appears that when the sex is doubtful the predominence of the features of one sex over those of the other will determine the question, for Coke upon Littleton states that "an hermaphrodite . . . shall be heire either as male or female according to that kind of the sexe which doth prevail."

The distinguishing feature of the female sex is the presence of an ovary, and of the male the presence of a testicle. In a male hypospadiac, if there are well-developed testes, epididymes, and spermatic cords, there is no difficulty in determining the sex; but where there is cryptorchism, with or without arrested development, it may be

a very difficult matter. Similarly it may be difficult to distinguish a female pseudo-hermaphrodite from a male cryptorchid with hypospadias, or even from one without, or merely with balanic hypospadias, when an hypertrophied clitoris traversed by the urethra simulates an erectile penis. In a child, even if a glandular body can be felt, it may be impossible to differentiate between an ovary and a testis; but, in the majority of cases, the true sex declares itself at puberty by the occurrence of either menstruation or seminal emissions. Sometimes the mistake of sex is first recognised when a young girl is brought to a doctor on account of the non-appearance of the catamenia, or for treatment of a painful inguinal hernia, the condition being really due to undescended testicles. After puberty some attention must be paid to the sexual inclinations, state of development of the breasts, character of the voice, and general build of the body. Not too much stress must be laid upon these features, however, for well-developed breasts are sometimes seen in men; while women with normal genital organs may exhibit masculine characteristics even to the possession of beard and moustache.

In the case of a child of doubtful sex, it is generally recommended that it should be reared as a girl until further development settles the matter. Great caution must, however, be observed, for to send a boy to a girls' school may lead to unfortunate results. Neugebauer mentions the case of a male pseudo-hermaphrodite, brought up as a girl, who was appointed foreman in a factory where only women were employed. He "behaved like a wolf in the fold."

Impotence and Sterility.—Impotence means, in the male, inability to perform the sexual act; and in the female, inability to permit the same. The condition must be sharply distinguished from **sterility**, which means incapacity to procreate. As a rule, these defects are associated, but by no means necessarily so, for a man or woman may be sterile without being impotent; while, on the other hand, there have been some remarkable cases of men, certainly impotent in the ordinary sense of the word, who have succeeded in impregnating women, and becoming fathers of families.

Sterility is of comparatively small medico-legal importance; but impotence may be urged as a plea for a decree of nullity of marriage; as a defence to a charge of rape or criminal assault; or as a ground for impugning the legitimacy of an individual.

Causes of Impotence in Males.—These are extremes of age; constitutional disease; local malformations; and psychical influences.

Extremes of Age.—The sexual orgasm may be experienced, and emission of a secretion devoid of spermatozoa, occur as early as the twelfth year, but power of procreation is not usually present until the fourteenth year. As regards old age, many instances are recorded of men over 80 becoming fathers. Casper mentions a case in which spermatozoa were found in a man of 96.

Constitutional Disease.—Many affections, such as kidney disease, dyspepsia, diabetes, and gout, may temporarily reduce the virility; but the power of copulation usually returns when recovery

or improvement takes place. Nervous diseases, particularly tabes dorsalis, and other spinal lesions, are frequent and important causes of permanent impotence. The condition, in such diseases, may be preceded by a period of increased sexual activity.

Local Malformations or Lesions.—The penis may be destroyed by accident, or amputated for disease. This, of course, prevents copulation in the ordinary manner, but the deposition of semen upon the vulva may occasionally be followed by conception, and more than one instance is on record of a man successfully impregnating his wife and becoming a father after he had lost his penis. **Epispadias** and **hypospadias** may or may not cause impotence, according to the degree of malformation. Other conditions which may prevent copulation are, a large hydrocele of the tunica vaginalis, a large irreducible scrotal hernia, tumours of the penis, adherent prepuce, and phimosis. Removal or complete destruction of the testes by disease leads to impotence and sterility, but not necessarily at once. Emissions containing spermatozoa may continue for some months (two years in one case) after castration. In such cases the secretion has been stored up in the vesiculæ seminales. Non-descent of both testicles is usually, but not invariably, accompanied by impotence and sterility. **Monorchids** may be as fruitful as men of normal development.

Psychical Influences.—Lack of self-confidence or feelings of disgust may render a man incapable of performing the sexual act. In some cases a man is impotent towards one woman, but able to have connection with another.

Causes of Impotence in Females.—**Local Causes.**—These are the presence of an unusually tough and resisting hymen; absence, occlusion, or extreme narrowness of the vagina; vaginal tumours; and dyspareunia from prolapse of the ovary, urethral caruncle, or tender carunculæ myrtiformes.

Psychical Influences.—In women of neurotic temperament, attempts at sexual intercourse may lead to hysterical outbursts, and a reflex spasm of the muscles around the vaginal orifice may be set up, rendering coition impossible.

There are many affections and malformations of the uterus and ovaries which render a female sterile, but do not interfere with the accomplishment of the sexual act.

Impotence as Ground for Nullity of Marriage.—If, at the time of its solemnisation, either of the parties to a marriage is incapable from impotence of performing the act necessary to consummation, the marriage is *voidable ab initio*. A marriage is not void in consequence of impotence; a decree of nullity must actually be obtained. A suit for nullity can only be brought by the party who suffers the injury; a person cannot sue on the ground of his own incapacity; nor can a decree be obtained after the death of either husband or wife. A decree will not be granted for an impediment which has only developed after marriage.

The impotence must, usually, be shown to be incurable; but if the cure involve an operation this may not be insisted upon.

A decree was granted in the case of a woman who was impotent after cohabitation of two years and eight months, though it was probable that she would have been cured by an operation not involving a great risk to life, but to which she refused to submit.

Formerly, the rule was that a three years' cohabitation between the parties was necessary before impotence could be inferred. But this is now required only when the impotence is to be presumed merely from the non-consummation of the marriage; and even then, a triennial cohabitation may not be insisted upon, if the court is satisfied from the evidence that the impotence is of a permanent nature. When the impotence arises from an obvious and incurable sexual defect, the length of time the parties have lived together is of no importance. In one case a decree was granted after a cohabitation of three months.

Mere refusal to consummate the marriage is not in itself sufficient ground for a decree of nullity, but, after the lapse of a reasonable time, the court will presume that the refusal arises from impotence. Hysteria on the part of the wife which prevents sexual intercourse is also sufficient ground on which to obtain a decree.

The usual procedure in suits for nullity of marriage on the ground of impotence is for the Court to appoint two medical men, who examine the physical conditions of the parties, and report thereon. The husband and wife may, if they wish, select the two examiners to be appointed.

Impotence and Legitimacy.—Physical incapacity on the part of the father might be asserted when the legitimacy of a child is contested. The question would not arise with regard to the mother, as the point to determine in her case is whether she has actually borne a child or not.

Impotence as a Defence to a Charge of Rape.—From the definition of the crime of rape it follows that an assertion of impotence, even if a fact, is likely to be of little value as a defence to a criminal charge; nevertheless, it is sometimes attempted. In *R.* v. *Frank and Edith Jackson alias Horos*, tried at the Central Criminal Court in 1901, the male prisoner was charged with committing rape under the pretence of initiating a girl into a "theocratic unity and purity league," and the female prisoner with aiding and abetting him. Jackson pleaded impotence, and on examination was found to have only one testicle, but to be quite capable of committing the crime. He was sentenced to fifteen, and the female to seven years penal servitude.

Rape.—Rape is defined as "having carnal knowledge of a woman against her will, by force, fear, or fraud" (Harris's *Criminal Law*). Some prefatory observations are required by this definition. The smallest degree of carnal knowledge is sufficient to constitute the offence. It is not necessary to prove either penetration, rupture of the hymen, or emission of semen; the least touch of the vulva with the male organ is enough to support the charge. The resistance of the woman must be to the utmost of her ability, when she is in a position to oppose the act. But absence of physical resistance

by a woman in a state of extreme terror owing to threats of violence, or otherwise helpless, will not prevent the crime from being rape. The exercise of the will need not be until after the act. Thus, violation of a woman who has been drugged, or anæsthetised, or is in a state of epileptic coma, drunkenness, or sound sleep constitutes rape. Tardieu and others mention instances of rape upon women under hypnotic influence.

Consent is a full defence to a charge of raping a woman over sixteen years of age, but the consent must be to the act of copulation, and the party committing the act must be the one the woman believes him to be. Thus when a medical man, under the pretence of performing an operation upon a woman, took advantage of her, the act was held to be rape. The consent was given to an operation, and not to the carnal knowledge. The Criminal Law Amendment Act provides that when a man induces a married woman to permit him to have connection with her by impersonating her husband, he shall be deemed guilty of rape.

A boy under fourteen is presumed by the law to be incapable of rape, and the presumption cannot be rebutted by evidence as to his physical capacity.

Offences allied to Rape.—The Criminal Law Amendment Act of 1885 makes the following provisions:—

Any person who unlawfully and carnally knows any girl under the age of thirteen years shall be guilty of felony, and may be kept in penal servitude for life. Any person who attempts the same is guilty of a misdemeanour, and may be punished by two years' imprisonment with or without hard labour. Consent in these cases is no defence.

Any person who—(1) unlawfully and carnally knows, or attempts to have unlawful carnal knowledge of any girl being of, or above, the age of thirteen years, and under the age of sixteen years; or, (2) unlawfully and carnally knows, or attempts to have unlawful carnal knowledge of any female idiot, or imbecile woman, or girl, under circumstances which do not amount to rape, but which prove that the offender knew, at the time of the commission of the offence, that the woman or girl was an idiot or imbecile—shall be guilty of a misdemeanour, and on conviction thereof shall be liable to imprisonment for two years, with or without hard labour. But in case (1) it is a sufficient defence to show that the accused had reasonable cause to believe that the girl was sixteen years of age. Consent is no defence to a charge under this section.

Other sections of the Act deal with the procuration or detention of women for immoral purposes; the liabilities of householders, &c., who have permitted the defilement of young girls on their premises; the abduction of girls under eighteen years of age; the suppression of brothels, &c.

When an offence of this character against a young girl or child is under investigation, the medical witness should be prepared to answer questions as to her probable, and apparent, age.

Rape, indecent assault, and kindred crimes are most frequently

committed against children. Of 136 cases recorded by Casper, 119 were on persons below the age of fourteen years.

Those who commit such acts are often insane and weak-minded.

Investigation of a Case of alleged Rape.—This is effected by obtaining from the woman a detailed account of the events; making a complete examination of her body, clothing, and underlinen; and, when an arrest has been made, examining the person and clothing of the accused. The investigation should be made as soon as possible after the commission of the offence.

The story of the outrage should be obtained from the lips of the female herself, and should be heard without interruption. It is important to remember that the statements made by a woman shortly after she has been raped are considered to form part of the *res gestæ*, and are therefore, though hearsay, admissible in evidence. Voluntary statements that she experiences difficulty in walking, pain on passing water, or frequency of micturition, support her story. The amount of force employed, and the exact manner in which it was applied, should be ascertained, in order that corroborative evidence may be subsequently looked for in the form of bruises on the body or limbs. Evidence should be sought as to whether she endeavoured by her cries to attract the attention of others. The possibility of the woman having permitted the act, and then brought a charge of rape to save her reputation, must not be forgotten. Enquiry should be made as to whether the woman was menstruating at the time or not.

When a woman asserts that she was drugged, anæsthetised, drunk, or unconscious from any other cause, enquiry should be made as to the circumstances which occasioned the condition of insensibility, and an endeavour made to estimate the length of time such unconsciousness might have lasted. This may be inconsistent with the story told. The manner in which the woman recovered consciousness, and her procedure subsequent to the outrage—as, for instance, the fact that she went about her occupation as usual, and made no complaint for a considerable time afterwards—may also arouse suspicion as to the truth of her story. Statements that the act was committed during sound, natural sleep must always be viewed with grave suspicion. Such an occurrence is possible, and indeed has occurred in a woman accustomed to sexual intercourse; it is, however, always highly improbable, and in a virgin practically impossible.

While listening to her story, the medical man should note the mental attitude of the woman; is she nervous and excited, or calm and deliberate? If she is a young girl, he should also form an estimate of her apparent age.

Before proceeding further, the medical man should obtain from the woman, or, in the case of a young girl, from her parents or guardians, a written consent to an examination being made.

Examination of the Woman.—The clothing should be completely removed, and the body and limbs searched for bruises, scratches, or other marks of violence. These should correspond

with the story already told. If she was gripped by the arms, bruises should be present upon them; if the legs were forcibly separated, ecchymoses may be found on the inner sides of the calves and thighs. The absence of such signs should arouse suspicion, except in the case of a child, or when the woman admits having made no struggle in consequence of terror or unconsciousness. The physical development of the woman should be noted, and an estimate made of the amount of resistance she is capable of having offered. Rape on a healthy adult female, in full possession of her faculties, is, if she resists, an extremely difficult act for a man to commit unaided. Under circumstances in which she is at a disadvantage, as, for instance, if the skirts are thrown up over her head, and she is prevented from using her arms, successful accomplishment of the act is more likely.

The genitalia may now be examined. The evidence they afford may be either of a positive or a negative character. As we have seen, the merest touch of the vulva with the penis is sufficient to constitute rape. Hence it is conceivable that the act might be committed even against a virgin without any indications being left. In most cases, however, some degree of penetration is effected, and corresponding signs are found. On the other hand, rape with violence may be committed upon a woman who has already had sexual intercourse, and no effects on the genitalia be produced.

In children, and in women when the parts are tender and swollen, Prof. Dixon Mann recommends the application of a 20 per cent. solution of cocaine hydrochloride five or ten minutes before the examination is made, not too freely, however, when the surfaces are raw, owing to the risk of absorption and consequent toxic effects.

The vulva should be examined in a good light for bruises, redness, swelling, tears, and hæmorrhage. The labia are then separated, and the hymen or its remains put on the stretch. If recently ruptured, the membrane exhibits a tear, or series of tears, the edges of which are raw and bleeding. After the lapse of a few days the raw edges heal and contract, and the hymen is then represented by little fleshy tubercles known as carunculæ myrtiformes, which are at first swollen and inflamed. The condition of the vagina should be observed, and several specimens of the contents removed with a pipette for future bacteriological investigation, and microscopic examination for the presence of spermatozoa. A yellow or greenish, muco-purulent discharge is sometimes present after rape, especially in children. The condition of the cervix and state of the uterus should be noted. The hairs on the mons veneris and labia should be searched, and any which are adherent, or matted together, cut off, and examined microscopically for spermatozoa.

When great violence has been used, or when the parts are small, as in children, more serious injuries may have been caused. The perineum may be ruptured, the mucous membrane of the vagina torn, and even the peritoneum opened. Sloughing of the parts, or fatal peritonitis may follow.

Besides the actual evidence of rape, the examiner must note signs

of previous sexual intercourse—viz., patency of the vagina, and a shrunken condition of the carunculæ myrtiformes; and indications of existing or previous pregnancy. These, though of no significance in a married woman, may be of great importance when the outraged female claims to have been a *virgo intacta*. Signs of early pregnancy suggest a motive for a false accusation.

The examination of the corpse of a woman who is believed to have been outraged should be conducted upon similar lines.

Significance of Gonorrhœa in the Female.—When a vaginal discharge is present it should be examined for gonococci. A discharge from this cause, however, is not likely to be present until from three to eight days after infection. Signs of recent gonorrhœa in the female furnish additional evidence of rape if the disease is also found to be existing in the man charged with the crime. On the other hand, gonorrhœa in the woman, when the accused is free from the disease, is, at least, evidence that she has had previous sexual intercourse. Some of the outrages on young girls are the outcome of the superstition that connection with a virgin will cure gonorrhœa.

Sources of Error.—Certain of the appearances usually indicative of rape may be produced by other causes.

Hæmorrhage from the Genitals may be Menstrual.—If the flow is still continuing when the woman is examined, the source of the blood is readily ascertained. The menstrual discharge is usually brown or deep red in colour, and has a peculiar odour and acid reaction. On microscopical examination it is found to contain epithelium from the vagina and uterus; but to make out these characteristics on the often dirty underlinen of the poorer classes is a very difficult matter, and the medical man should never give more than a guarded opinion as to the nature of the hæmorrhage.

The Hæmorrhage may be from Wounds Self-inflicted in order to Substantiate a False Accusation of Rape.—Such injuries may be anomalous in character, and the amount of blood is perhaps larger than would be expected from the lacerations found. The signs of violence are apt to be confined to the genitalia, the woman forgetting to inflict bruises on the limbs, such as would have followed a struggle. If the linen has been deliberately smeared with blood, possibly the outer surface has been more stained than the inner. In one case the blood of a bird was used for the purpose.

A Suspicious-looking Vaginal Discharge in a Child may be due to Natural Disease.—Frequently it is the presence of the discharge which leads the mother to believe that the child has been abused. Among the poor, exposure to cold, lack of cleanliness, and the presence of ascarides may cause pain and redness of the labia, accompanied by more or less vaginal discharge. Weakly and neglected children are sometimes attacked by a serious disease called noma pudendi, allied to cancrum oris, which may produce ulceration and sloughing of the genitals, fœtid discharge, and febrile symptoms frequently terminating in death. The affection is contagious, and often several children are attacked at the same time.

The condition may be mistaken for syphilis as well as for the results of violence.

A Discharge in a Child may have been deliberately produced by Mechanical Violence.—Unnatural mothers have sometimes taken this course in order to accuse an individual of rape on the child. Fournier describes a case in which a mother, for this purpose, irritated the vagina of her daughter, aged 8, with a blacking-brush. The violence had caused a copious discharge of green pus and erosion of the labia; the hymen, however, had not been ruptured. Occasionally in adult women self-inflicted injuries have led to a vaginal discharge.

Examination of the Clothing, and Identification of Seminal Stains.—The clothes should be searched for tears, and stains of mud, blood, vaginal discharge, and semen. Seminal stains are most likely to be found on the back or front of the drawers and chemise, in the neighbourhood of the vagina. On clean linen they have a faint greyish tint, and produce a slight stiffening of the fabric. Such spots should be cut out with as little manipulation as possible, and thoroughly, but gently, moistened in a watch-glass with a few drops of very dilute hydrochloric acid (1 drop to 40 c.c. of water). The preparation should be allowed to remain at least one hour, and in the case of old stains five or six hours, in order to soften the albumen. Half a dozen or more microscope slides are now touched with the piece of cloth. Some of these may be examined at once. Others are stained by drying them over a Bunsen flame, and then putting a little weak gentian violet on the film. The excess of stain is washed off, and the slide covered, and examined with a magnifying power of at least 500 diameters. Owing to their translucency, spermatozoa may be overlooked in the unstained slides, but are readily found in the second series. They may be detected by this method in a stain several years old.

The examination of vaginal secretion or hairs cut from the labia should be conducted in the same manner.

Other methods of identifying semen are described, but the discovery of spermatozoa is the only satisfactory and conclusive test. A human spermatozoon consists of an oval, flattened head, somewhat pointed anteriorly, and a long filamentous tail. Its appearance is so characteristic that nothing can be mistaken for it. Certain organisms, known as *Trichomonas vaginæ*, which are occasionally found in the human vagina, present a superficial resemblance to spermatozoa; but their heads are granular, ciliated, and larger, and the tails shorter, than those of spermatozoa.

Examination of the Accused.—Here, as in other cases, it is necessary to inform the individual that he has the right to withhold his consent to the examination, and to warn him that information derived from the examination may be used in evidence against him. The man should be stripped, and his general physical development noticed. Search should be made for scratches about the face and neck, and bruises upon the limbs

and body, as corroborative evidence of the woman's statement that she offered resistance to the act. The urethra should be examined for signs of gonorrhœa. Rupture of the frænum may be found in cases in which there was great disparity between the parts, and much force was necessary to introduce the penis. Prof. Glaister found this lesion in a man who was accused of raping a girl of thirteen. When arrested, he denied all knowledge of the crime, but at the trial pleaded guilty. The clothing of the individual should be examined for mud, gonorrhœal discharge, seminal stains, and blood.

Can a Woman become Pregnant by an Act of Rape? This question is sometimes put to the medical witness, and must, of course, be answered in the affirmative.

Signs of Virginity.—Although the act of rape may be perpetrated against a woman without causing loss of virginity, nevertheless the existence of the condition is, in most cases, strong evidence that the crime has not been committed. Other circumstances under which the virginity, or otherwise, of a woman may be in question are, suits for nullity of marriage on the ground of impotence, and actions for libel or slander when improper conduct or pregnancy has been alleged.

In a virgin of normal development, the breasts are firm and hemispherical, and the nipples are small and show no pigmented areola. The vagina is narrow and its walls are rugose. The labia are firm, elastic, and in apposition with each other, or, at the most, separated only by a narrow slit. The fourchette and perineum are intact, and the hymen is unruptured. The last-mentioned exhibits great variation within physiological limits; usually it is crescentic in shape, but annular, cribriform, fimbriated, and even completely imperforate types are met with. In texture the hymen may be either extremely delicate or remarkably tough.

When all the signs are present, it is possible to express a fairly decided opinion that the woman is a virgin. It can never be more than an opinion, however, either from the positive or negative standpoint. All the signs of virginity may be lacking, yet the woman may still be a *virgo intacta*. The breasts, especially in obese women, may be flabby and pendulous, and in brunettes there may be a very distinct areola round the nipple. The passage of a uterine fibroid in a virgin may have lacerated the cervix, dilated the vagina, and destroyed the hymen; or the hymen may have been ruptured by accident, or by the introduction of instruments or other foreign bodies. On the other hand, the presence of the signs of virginity is not infallible evidence of the condition. The mammæ of women who have borne several children occasionally present a typical virgin appearance. An intact hymen is sometimes found in a woman who has been a prostitute for years. Accoucheurs occasionally find the hymen unruptured in a woman in her first labour, and it may be so tough that it is necessary to divide it before delivery can take place. In such cases the membrane is of an exceptionally elastic character, and is folded back against the vaginal wall instead of being ruptured by the penis.

Unnatural Offences.—**Sodomy** means sexual intercourse between two males, and may be punished under the Criminal Law Amendment Act by two years' imprisonment, with or without hard labour. Conviction is usually obtained by collateral evidence. The medical evidence may be completely negative, a normal state of the parts of the passive agent perhaps being found, even when the act has been repeatedly committed. In some cases the anus is dilated, and the skin around it smoother than normal. When the act has been recently, and forcibly, perpetrated on a boy, there may be tears in the anal mucous membrane, with inflammation and pain on defecation. It is a somewhat remarkable fact that the subjects of this form of mental depravity are often not, as might be expected, men of low and brutal type, but exceptionally gifted and brilliant individuals.

Bestiality is of little medico-legal importance, but the expert may be required to compare hairs found on the clothing of the prisoner with those of the animal abused.

CHAPTER XI.

PREGNANCY AND LEGITIMACY.

CONTENTS.—General considerations of pregnancy—Conception—Signs of pregnancy in the living and dead—Signs of recent delivery—Signs of remote delivery—Pregnancy and delivery unknown to the mother—Legitimacy—Duration of gestation—Superfœtation.

General Considerations of Pregnancy.—There are several legal purposes for which it may be necessary to determine the existence, or otherwise, of pregnancy in a woman. The medical man may also be required to make an examination for signs of recent delivery, or of remote pregnancy, in either the living or the dead, and to pronounce an opinion upon questions of legitimacy.

Reasons for Admitting or Feigning Pregnancy.—To increase the damages in actions for breach of promise, seduction, or compensation for the death of the husband.

To extort money, or to induce her paramour to marry.

To be excused attendance as a witness. A medical certificate for this purpose will be accepted only if the statement is made that delivery is imminent, or that there are special reasons for fearing that complications might ensue if the attendance were insisted upon.

To stay the execution of the capital sentence. The English law in this case requires that "quickening" should have occurred.

Pregnancy may also be feigned to obtain a spurious heir, the intention of the woman being to pretend later that she has been delivered, and to represent some other person's child as her own. When delivery is feigned, probably an effort is made to avoid a medical examination. On arriving at the house the practitioner is informed that the baby has been born some hours, the labour was easy, the nurse has put on a binder and made everything "quite comfortable," and the patient is reluctant to be disturbed. On asking to see the placenta he is told that it has been destroyed. As an examination should always be made on purely obstetric grounds, the fraud should be detected. The condition of the remnant of the umbilical cord in the infant will very likely not correspond with the asserted time of birth.

In *Salisbury* v. *Rawson* (Chan. Div., 1895) a remarkable fraud of this character was investigated. The plaintiff, who would have taken a life interest in a large estate if she had had a child, pretended to have been delivered in the early morning of February 24th. Only her sister was present, and as the door "would not open," and the handle of the bell was broken, which made it difficult to pull, it was impossible to rouse the household and obtain other assistance. A medical practitioner was not sent for until 5 p.m. the next day, thirteen hours after the "birth," and when he arrived he was assured

that the "mother" was quite comfortable, and did not wish to be examined, a course of procedure which was not insisted upon after the lapse of time, and in the absence of any suspicion of fraud. Among other evidence, at the hearing of the case, it was shown that the plaintiff had obtained, on the evening of February 23rd, a recently-born infant from an unmarried woman; and also that, during her supposed pregnancy, she had worn a black pad which she had spoken of to a friend as "the baby."

Reasons for Concealing Pregnancy:—

To avoid shame, in the case of a single woman, or a woman living apart from her husband.

To conceal infanticide.

To procure abortion.

In Scotland, concealment of pregnancy is a crime, and can be punished with two years' imprisonment.

Concealment of Delivery.—This may be done with the intention of destroying or abandoning the infant. By 24 and 25 Vict., c. 100, s. 60, it is provided that "if any woman shall be delivered of a child, every person who shall by any secret disposition of the dead body of the said child, whether such child died before, at, or after its birth, endeavour to conceal the birth thereof, shall be guilty of a misdemeanour." It is important to notice that the difficulties associated with the question of live-birth do not arise in this connection. Women sometimes display extraordinary fortitude and determination in carrying out their purpose, perhaps, immediately after delivery, walking long distances from the spot, or going about their household work as usual. Prof. Dixon Mann mentions the case of a servant-girl who answered a front-door bell during the interval between the birth of the child and expulsion of the placenta.

In a case which came under the writer's notice, a servant-girl had lived during the entire period of gestation in a house with five other female servants, two of whom slept in the same room with her. These women, and the mistress of the establishment, subsequently stated on oath that they had never at any time suspected the girl's condition. The latter went to bed one evening about 10.30 in great pain, which she told the others was due to monthly illness. A fellow-servant, who was sleeping in a bed only eight feet away, saw and heard nothing until she was aroused by the girl leaving the room at 12.30. It was shown that during the interval she had given birth to a full-term male child weighing 6 lbs. 10 ozs. The newly-delivered mother carried the infant out of the room, down two flights of stairs, and across two landings; she then opened and climbed out of a window, crossed a rough glass roof, and threw the child down from a height of some thirty feet. She then returned to her room, washed herself, and changed the stained linen. At 6.30 she arose, lighted some fires, laid and served breakfast, and otherwise attended to her household work. The body of the child with placenta attached was found later in the day, and, when the illness of the previous evening was recalled, suspicion fell upon the girl. She strenuously denied that the infant was hers, but consented to an examination, which revealed indications of recent delivery. According to

a statement subsequently made by the girl, the infant was her first child (*v.* also p. 123).

Conception.—The medico-legal considerations of this subject include, the relation of conception to menstruation, and to the age of the woman; conception during states of unconsciousness; conception following rape; and conception without rupture of the hymen or penetration. The last two have already been considered.

Conception in Relation to Menstruation.—The occurrence of menstruation is usually the first sign that a girl has reached puberty, and is therefore capable of being fertilised. In this country, the function commences, as a rule, between the ages of 14 and 16, but cases are recorded of its appearance in children of 4, and even less. It ceases usually about 46. Conception may, however, take place before menstruation has appeared; whilst it is in abeyance, as, for instance, during lactation; after the menopause has occurred; and in women who have never menstruated at all.

Conception in Relation to Age.—As regards the earliest age at which conception and child-bearing are possible, many instances are recorded of girls between 13 and 14 giving birth to fully-developed, living infants. Prof. Glaister mentions the case of a girl who became pregnant at the age of 11 years and 5 months, and was eventually delivered of a full-time child. In a case recorded by Dodd, a girl menstruated at the age of 12 months, conceived at 8 years and 10 months, and ultimately gave birth to a living child weighing seven pounds.

The occurrence of pregnancy in children is, in many cases, the outcome of ignorance, the girl having permitted the embrace without any knowledge of its true character. Macnaughton Jones describes a case in which a young girl, pregnant under such circumstances, was delivered under an anæsthetic of a still-born child, and left the hospital without having learnt that she had been a mother. The writer was once consulted by the parents in a case in which a boy of 12½ had had sexual intercourse with his sister aged 14. Both children were aware that they were doing wrong, but were quite ignorant of the real nature and possible consequences of the act.

At the other end of the child-bearing period, many instances are recorded of delivery in women over 50 years of age, some of whom had ceased menstruating several years before the date of conception. Depasse describes the case of a woman who ceased to menstruate at 50, and gave birth to a healthy child at 59. More or less well-authenticated instances of parturition at the age of 60 and over are on record.

Conception during a state of unconsciousness whether produced by the administration of drugs or anæsthetics, or by drunkenness, may undoubtedly occur; and cases are recorded of women remaining in ignorance of their condition until the onset of labour.

Signs of Pregnancy—In the Living.—Detailed information concerning these must be sought for in books on midwifery. It is sufficient here to mention the principal signs, with the addition of

a few points of medico-legal interest. As far as possible the phenomena are considered in the order in which they appear.

Suppression of the Menses.—Usually the first indication that conception has occurred. A woman who is endeavouring to conceal pregnancy may purposely stain her linen with blood in order to simulate menstruation.

Mammary Changes.—May be noticeable by the end of second month. Of little value except in primiparæ.

Hegar's Sign.—Second and third months. This is the most reliable of the early indications of pregnancy.

Morning Sickness.—Most marked during third, fourth, and fifth months. May be due to other causes, or may be absent.

Enlargement of Fundus Uteri.—Third month, but may be recognised by a skilled observer during second month.

Violet Colouration of the Cervix and Softening of the Tip.—Recognisable during third month, or earlier in primiparæ.

Fœtal Movements.—Generally first felt by the mother about the end of the fourth month, but may be perceptible to the physician before she experiences them. When the movements are capable of being felt by another, the woman is said to be "quick" with child. This condition entitles a woman under sentence of death to have her execution delayed until the child is born. It was formerly the custom to appoint a jury of matrons to examine the criminal, but this, though still legally required, is becoming obsolete, the examination now being performed by a medical man with or without such a jury.

Uterine Souffle.—Audible towards the end of the fourth month.

Ballottement.—A positive sign of pregnancy when detected by a skilled observer. Available from the end of the fourth to the seventh month.

Fœtal Heart-sounds.—Generally first heard during the fifth month.

After the fifth month the indications are so clear that failure to recognise the condition cannot occur.

In diagnosing pregnancy, it must be remembered that there are several pathological conditions which may produce one or more of the signs and symptoms described above. The chief of these are, ovarian tumour, uterine fibroid, hæmatometra, ascites, and pseudocyesis. Their differential diagnosis will be found in books on midwifery and diseases of women. It may be that the examination has been actually rendered necessary owing to the presence of an abdominal enlargement from one of these causes, for such a condition in a single woman may have given rise to a false accusation of unchastity. The only signs of pregnancy which are infallible, and would therefore justify the examiner in making a statement *on oath* of the condition, are the presence of fœtal movements and the fœtal heart-beat. In most cases these will not be available until at least the middle of the fourth month, and then only if the fœtus is living. When merely the early indications of pregnancy have been found in the woman, the medical man should avoid giving more

than an opinion, if that, and should ask for a further examination after the lapse of an interval of time sufficient for the unmistakable signs to be present.

An assertion of unchastity may be made in consequence of the expulsion from the uterus of a body other than a fœtus. A **carneous mole** is due to hæmorrhage into the placenta or membranes, and is therefore necessarily a product of conception. Chorionic villi will be found on microscopical examination, and in many cases traces of the embryo may be discovered in the fleshy mass. The **hydatidiform mole** is believed by most gynæcologists to be invariably a product of conception, but there are one or two cases on record in which it appears to have developed spontaneously. Care must be taken not to mistake the membranous sac which is sometimes expelled in dysmenorrhœa for an hydatidiform mole.

Signs of Pregnancy in the Dead.—In addition to many of the indications found in the living, an examination of the uterus will reveal the presence of a fœtus, a mole, or signs of recent delivery.

The **corpus luteum** must be referred to, as the medical witness may be questioned about it. Formerly great importance was attached to the size and appearance of this body as an indication or otherwise of pregnancy, but it is now known to possess little medico-legal value. Corpora lutea resembling those of pregnancy, have been observed in virgins who were menstruating or suffering from uterine disease at the time of death; while, on the other hand, the ovaries of some women who have died during pregnancy, have been found to exhibit either no corpus luteum, or one presenting virgin characters.

Signs of Recent Delivery—In the Living.—The woman has the appearance of having just passed through an illness, particularly if an attempt has been made to conceal delivery. The face may be pale or flushed; the skin is usually moist. The breasts are full and firm; the superficial veins dilated; the nipples are enlarged and their areolæ distinct. During the first few days a mucoid fluid containing colostrum corpuscles is secreted. Usually on the third day the breasts become tense and "knotty," and milk is exuded on gentle pressure. The skin over the abdomen is flaccid and wrinkled, and exhibits streaks (lineæ gravidarum), more often pink than white. The labia and perineum may be bruised and lacerated. The vagina is lax, gaping, and blood-stained. The cervix is soft, patulous, and often lacerated; the internal os may be sufficiently open to admit the finger. The uterus is enlarged, and from the position of the fundus it is possible to gauge roughly the time which has elapsed since delivery. Immediately after labour, the fundus is, on the average, about 5 inches above the pubes; and the uterus is firmly contracted, and feels like a cricket-ball within the abdomen. At the end of twenty-four hours it is much softer, and the fundus is one or two finger-breadths above the umbilicus. On the third day, the fundus is about the level of the umbilicus, and, at the end of a week, midway between that spot and the symphisis pubis. At the end of a fortnight the fundus may be still above the pubes, but soon ceases

to be recognisable per abdomen. The lochia consist of almost pure blood during the first three days. About the fourth day, the colour becomes paler, and by the ninth day it is yellowish-grey or slightly greenish.

The earlier a woman is examined after labour the more marked will the signs of recent delivery be. At the end of ten days or a fortnight the parts have practically regained their normal appearance.

Signs of Recent Delivery in the Dead.—Besides many of the signs described above, additional evidence, afforded by the more complete examination of the uterus which is now possible, will be forthcoming. The progress of involution is shown by the following table :—

	Weight.	Length of Cavity.
	Ounces.	Inches.
Shortly after delivery, ...	22 to 33	7
End of a week, ...	16	$4\frac{3}{4}$
End of a fortnight, ...	12	4
End of 5th or 6th week (normal), .	$1\frac{1}{2}$	$2\frac{1}{2}$

The cavity for the first day or two contains clots of blood. The placental site is distinguished from the rest of the internal surface of the uterus by its darker colour, thinner mucous membrane, and the openings upon it of the uterine vessels. Involution progresses more slowly here than elsewhere; hence, at the end of a week or ten days, the placental area projects slightly above the general uterine surface.

Signs of Remote Delivery—In the Living.—As a rule, the birth of a child leaves permanent indications of the event in the body of the mother, and these indications are the more likely to be present the greater the number of children the woman has borne. Nevertheless a positive diagnosis of parity, a considerable time after delivery, cannot usually be made. A typical nulliparous appearance has been found in a woman who has had several children; while, on the other hand, the passage of a uterine fibroid may produce the same local effects as the birth of a child. Still, in most cases, a fairly decided opinion can be expressed.

The most reliable signs are those presented by the vagina and cervix. An unruptured hymen may be regarded as conclusive evidence that parturition has never occurred. In a woman who has experienced coitus, the hymen is usually split or notched in several places, but the tears do not extend completely to the vaginal wall, and between them portions of the membrane may still be recognised. After the birth of a child, however, the hymen is either represented by projecting tags of mucous membrane, or has completely sloughed away. The fourchette is almost invariably ruptured during delivery, and frequently the perineum also. If the

latter has been sewn up, the site of the laceration will be indicated by a scar. The cervix may show no change, but, if it has been lacerated during the labour, it may be irregular and puckered from the contraction of scar tissue. The os is larger than in the nulliparous woman, and may be transverse in shape, rather than circular or oval, with everted edges. White lines (lineæ albicantes) are usually, but not invariably, present on the abdomen after parturition. They may, however, be equally produced by tumour, ascites, or even obesity. Pendulousness of the breasts and pigmentation of the nipples are not reliable indications.

Signs of Remote Delivery in the Dead.—The uterus can now be fully examined. In the nulliparous organ, the upper border is nearly straight, and the lateral margins concave, when viewed from the outside. After parturition, the upper border of the fundus is markedly convex, and the sides straight or slightly convex. If a lateral section of a nulliparous uterus be made, the inner aspects of the walls are found to be all convex, and the cavity is of triangular shape and small capacity. In the parous uterus, the walls, from the inside, are concave. The cavity is, therefore, larger and oval in outline. The placental site may be distinguished as long as twelve months after labour by its pigmentation and by the convoluted margins of the vessels. The walls of the uterine arteries are thicker than in the virgin organ.

Dilatation of the uterus is sometimes the result of a pathological condition.

Ignorance of Pregnancy and of Delivery.—That a woman should remain unaware of her condition up to the time of delivery is a highly improbable circumstance. Such a case, however, is described by Tanner. A married lady of 42, who was anxious to have a child, but had long since despaired of attaining her wish, had no suspicion that she was pregnant until informed by her medical attendant that she was in labour.

The possibility of women being delivered during sleep or other states of unconsciousness may be the subject of enquiry in a case of infanticide. A woman, for instance, who is suspected of having destroyed her child, may assert that she woke up and found the infant dead between her legs. That delivery may occur during a state of unconsciousness is, of course, an every-day experience. An obstetrician may consider it necessary to keep a woman under an anæsthetic during the whole period of labour, though the degree of anæsthesia is, usually, only sufficient to produce insensibility without interfering with the uterine contractions. A woman who has had several children may pass through labour in a remarkably short space of time, and with the minimum amount of distress (*v.* p. 122). In such a case it is quite possible that she might be delivered while in a profound, drunken sleep without any knowledge of the fact. In a primipara, the occurrence is highly improbable.

Legitimacy.—This subject comes under discussion in the Law Courts in two cases. The legitimacy of an individual, who is the presumed heir to a title or property, may be questioned; and the

assertion that her child was not born in wedlock may be the ground for an action for libel or slander on the part of a mother. The law assumes that a child born in wedlock, or at an interval after the death of the husband consistent with the belief that he is the father, is legitimate, even though conception occurred before marriage. But the presumption can be rebutted. In Scotland, the marriage of the parents legitimatises any children previously born to them, but this is not the case in England.

From the medico-legal point of view, the legitimacy of a child may be impugned upon four grounds, viz. :—

(1) That the father was impotent, either permanently, or temporarily from disease or feebleness, at the presumed time of the conception.

(2) That either the husband was too old to have been fertile, or that the wife had passed the period of child-bearing.

(3) That the husband had not had access to the wife within the period necessary in order that he could be the father of the child.

(4) That the child was born too soon after marriage, if the husband denies having had intercourse with the wife before marriage.

The first two of these grounds have been discussed in the sections on impotence and conception. It is permissible, however, to recall that castration, removal of the penis, tabes dorsalis, or other spinal disease, do not necessarily at once render a man incapable of becoming a father. (3) really resolves itself into the question, *What is the maximum length of time gestation can extend over?* and (4) *what is the minimum period of gestation compatible with the viability of the child?*

Duration of Normal Gestation.—There is no means of determining this with certainty. Evidence derived from pregnancy following a single coitus is the most trustworthy, but is by no means positive, for it is known that spermatozoa may live for as long as ten days within the vagina, hence coitus and conception are not necessarily synchronous. The result of a large number of observations is to show that the average period of gestation is about 278 days, though pregnancies of ten days longer are not exceptional.

Abnormally-prolonged Gestation.—That pregnancy may extend over 300 days must be regarded as well-established, but instances of apparently greater duration than this cannot be taken as scientifically proved, having regard to the impossibility of fixing the exact date at which conception occurred.* The view is largely held that the menstrual nisus continues throughout pregnancy, and, at the time when the ninth period should occur, labour takes place. In support of this is the fact that abortion occurs the more readily at the times when menstruation, but for the pregnancy, would have been occurring. There is some evidence to show that if labour fails to come on at the expected time, gestation may continue until

* See, however, the *Lancet*, October 28, 1905, for the details of a recent remarkable case in which a woman of 46 was delivered of an anencephalic monster, 335 days from the last day of menstruation, and 313 since the last intercourse.

another menstrual interval has passed. In such a case the child would probably be abnormally large, and it would certainly be evidence in support of prolonged gestation to show that the child was of exceptional size. So, too, would be the fact that the woman's inter-menstrual periods under ordinary circumstances were abnormally long.

The details of many instances of prolonged gestation are given in larger books. It is sufficient here to mention one described by Taussig (*Amer. Journ. of Obstet.*, Sept. 1901), which he considered to have lasted for 323 days! The woman ceased to menstruate on December 7, 1897, and was delivered on October 26, 1898, of a male child over 11 lbs. in weight, and nearly 22 inches in length.

In France and Scotland, the law assumes the possibility of pregnancy lasting for 300 days, and in Germany 302 days. In England, no legal limit is laid down.

When a dead child is born after abnormally long gestation, the possibility of "missed labour" having occurred must be borne in mind. This means that the fœtus has died, and has been retained within the uterus, labour either having not supervened, or having passed off uncompleted. The occurrence is extremely rare, and there is no doubt that some of the cases recorded were instances of ectopic gestation. Dr. Mary Scharlieb records the case of a woman who last menstruated in October, 1893. Labour never came on, and she was admitted into hospital in September, 1894. She was operated upon, and a much-decomposed fœtus, weighing 12 lbs., was taken from the uterus. The woman died on October 25.

Abnormally-shortened Gestation.—All the recognised signs of maturity may be present in a child a fortnight, and even a month, before its birth. It is, therefore, quite possible for a child to be born, fully-developed, at the end of the eighth month of pregnancy; but if the period of gestation is much under 250 days, the child will show more or less evidence of immaturity. In a case in which the infant is obviously premature, the point to ascertain, therefore, is what is the shortest possible period of gestation after which an infant is viable—*i.e.*, capable of being reared. It is generally considered that a fœtus has very little chance of surviving its birth if born before the end of the 28th week—that is, within 196 days of conception. Nevertheless there are well-established cases of viability after a period of gestation no longer than 180 days. Instances of infants surviving, and growing up, after still shorter periods of intra-uterine life, even in one case 135 days, are recorded, but very few of these are trustworthy.

The recent Poulett peerage case affords an instance in which abnormally short gestation was claimed. William Henry Poulett, who subsequently became the sixth Earl, married on June 23, 1849, and his wife gave birth to a child on December 15, 1849—*i.e.*, less than six months after. The husband, who had separated from his wife on discovering her condition shortly after marriage, at once repudiated the child. On the death of the Earl, in 1899, the offspring of the wife claimed the title. At the enquiry before the House of Lords it was

shown, among other evidence, that the claimant had not exhibited signs of immaturity at birth, and that his mother had been unchaste before marriage. Non-access on the part of the husband before marriage having been satisfactorily proved, the case was decided against the claimant.

Apart from legitimacy, abnormally short gestation may be at issue in questions of paternity, as, for instance, when a woman contracts a second marriage shortly after the death of her first husband.

Superfœtation.—This means the fertilisation of a second ovum in a woman already pregnant. The possibility of such an occurrence may be raised in questions of legitimacy. It is of little practical importance, for, if it occurs at all, it is only under extremely rare and exceptional circumstances.

CHAPTER XII.

CRIMINAL ABORTION.

CONTENTS.—Law relating to abortion—Modes of procuring abortion—Signs of recent abortion in the living—Signs of recent abortion in the dead—Examination of the expelled uterine contents—Questions to be answered.

Law relating to Abortion.—For legal purposes the distinction made by obstetricians between abortion or miscarriage, and premature labour is not recognised. Criminal abortion means the unlawful causing of the expulsion of the uterine contents at any period of pregnancy, whether quickening has occurred or not. The law on the subject is contained in 24 and 25 Vict., c. 100, secs. 58 and 59, which run as follows:—

"Every woman, being with child, who, with intent to procure her own miscarriage, shall unlawfully administer to herself any poison or other noxious thing, or shall unlawfully use any instrument or other means whatsoever with like intent, and whosoever with intent to procure the miscarriage of any woman, whether she be or be not with child, shall unlawfully administer to her, or cause to be taken by her, any poison or other noxious thing, or shall unlawfully use any instrument or other means whatsoever with the like intent, shall be guilty of felony."

"Whosoever shall unlawfully supply or procure any poison or other noxious thing, or any instrument or thing whatsoever, knowing that the same is intended to be unlawfully used or employed with intent to procure the miscarriage of any woman, whether she be or be not with child, shall be guilty of a misdemeanour."

It will be seen from these statements that the *intent* to procure an abortion is the essence of the offence, and the crime is none the less committed if the attempt fails; or even if, as a matter of fact, the woman is not pregnant. Moreover, it is a misdemeanour to supply knowingly the means for the purpose, even if the woman was not pregnant, or never used it, or never intended to use it.

If a woman die from the effects of criminal abortion induced by another, even although she had consented to or solicited the operation, that person is guilty of murder; and if the abortion was her own act she has, in law, committed suicide.

It is of importance for the medical man to realise that, in theory at least, the law makes no distinction between abortion or premature labour induced on justifiable obstetric grounds, and criminal abortion. In actual practice, if the law were put into force in such a case, no conviction would follow. Nevertheless, the medical man who is called upon, in the exercise of his profession, to perform this operation, should always take such precautions as will prevent his

reasons or motives from ever being questioned. Whenever possible the advice and approval of another practitioner should be obtained. At night-time, in the country, or in a case of urgent necessity, this course is not always practicable; the medical man should then inform the relatives of the treatment he is about to adopt.

Modes of procuring Criminal Abortion.—These are three in number, viz.:—

The administration of drugs.
General violence.
Local violence.

Of these, the first is the favourite method of attempting the crime, but the last is the mode most frequently the subject of inquiry in the criminal courts, owing to the fact that it is the likeliest to be followed by the death of the woman.

The following is an analysis of the methods employed, and verdicts returned, in 93 cases of death from abortion which appear in the Registrar-General's reports from 1894 to 1903:—

	Drugs.	Operation.	Otherwise, and not stated how.
Murder, . . .	2	19	13
Manslaughter, . .	10	25	20
Suicide, ...	1	2	1
Total, . . .	13	46	34

Administration of Drugs.—There is no doubt that the sale of drugs for the purpose of producing abortion is very large. A certain section of the press abounds in advertisements of "remedies" warranted "to restore regularity," or pills for female ailments "on no account to be taken by ladies expecting to become mothers." Some of these preparations are harmless, others contain deleterious constituents. The following are the drugs most frequently employed:—

Ergot.—Until recent years this was the substance most often resorted to for the purpose of procuring criminal abortion, but it is doubtful now whether its place has not been taken by lead. Ergot possesses to a marked degree the power of exciting uterine contractions, and is largely employed by practitioners for the purposes of arresting hæmorrhage or securing efficient contraction of the uterus after labour. As an abortifacient, however, ergot, like other ecbolics, has been found by experience to be extremely uncertain, and its use for this purpose has been practically discarded by obstetricians. Probably in non-toxic doses it only causes expulsion of the uterine contents when there is a predisposing tendency

in the woman to abort. When toxic doses are taken, abortion may result from the general constitutional disturbance which follows (*v.* "Poisoning by Ergot"). The woman may, however, die from the poisonous effects of the drug without having been delivered.

Lead.—The use of lead as an abortifacient appears to have become remarkably frequent in the Midland Counties of England during recent years. Diachylon ointment, which consists largely of the oleate of lead, was first employed, but now pills containing lead are sold for the purpose. The cases come under observation in consequence of the development of chronic lead poisoning, a fact to be remembered in the future by the practitioner, when he meets with an unexplained instance of plumbism in a woman. In a large proportion of the cases abortion takes place, but information is still required as to the frequency with which it occurs before other toxic symptoms are produced. Dr. Hall gives the details of twenty cases of chronic lead poisoning in women, which occurred in the district of Sheffield, from June, 1903, to February, 1905.* The possibility of absorption of lead during occupation or from drinking-water was excluded, and twelve of the women freely admitted having taken pills for the purpose of procuring abortion. The symptoms were well marked, the blue line on the gums, colic, constipation, and anæmia being present in all cases, and paralysis, albuminuria, buccal ulceration, &c., in some. Of the twenty women, twelve had miscarried, one was pregnant, and six admitted delayed menstruation. Many other instances of the use of lead for this purpose are now recorded.

Pennyroyal, **savin**, and **rue** are other drugs popularly believed to possess abortifacient properties.

Besides the reputed abortifacients, powerful purgatives such as **colocynth** and **aloes**, irritants like **cantharides** or **arsenic**, emetics such as **tartar emetic**, and other drugs, have been taken for the purpose of causing abortion. When they are successful it is only through the general constitutional disturbance which they cause, and the death of the woman not infrequently follows.

In spite of the uncertainty attending their use, the public have great belief in the efficacy of abortifacients, and a woman who wishes to cut short her pregnancy will probably take drugs before resorting to more drastic measures. In a case of abortion which is under investigation, whether produced by drugs or instruments, evidence that reputed abortifacients have been taken certainly increases the suspicion of criminality. As a rule, it will be found that the woman herself has administered the drugs, the professional abortionist being aware of the likelihood of failure when such means are adopted.

General Violence.—This also is very uncertain in its effects. Some women, particularly if of highly nervous temperament, abort in consequence of a very slight shock, such as a stumble on the stairs or the fright of seeing a mouse; others may suffer the most extreme violence without interruption of pregnancy. During the early months a woman may endeavour to attain her object, without

* *Brit. Med. Journ.*, March 18, 1905.

exciting suspicion, by carrying to excess legitimate forms of exercise, such as cycling, dancing, or playing tennis until thoroughly exhausted. But more dangerous violence may be resorted to, the woman perhaps throwing herself down stairs or jumping from a height. Sometimes these methods are successful, but many cases are recorded in which women have fractured their limbs or sustained fatal injuries without bringing on a miscarriage. A good illustration of the violence which can be sustained is quoted by Corey. A woman, three months pregnant, was tossed by a cow and received an abdominal wound through which the omentum, the descending and transverse colon, most of the small intestine, and the pyloric end of the stomach protruded. The edges of the wound were pared and sutured, and at term the woman gave birth to a healthy and uninjured child. When the violence is inflicted by another, it is usually directed towards the abdomen, but blows, kicks, jumping upon or kneading the abdomen have all proved futile. Sometimes detachment of the placenta follows with fatal results.

Local Violence.—Sharp foreign bodies are introduced into the vagina with the object of passing them into the uterus. Various articles, such as hair-pins, knitting-needles, pencils, catheters, and uterine sounds, are employed. The results attained vary with the degree of skill displayed. When the instrument is used by the woman herself, or by a person ignorant of the anatomy of the parts, fatal injuries may be caused, often without the desired effect having been obtained. The vagina and cervix may be lacerated, the peritoneum opened up, or the bladder perforated. Fatal hæmorrhage sometimes occurs, but peritonitis is the commonest cause of death. When the services of a skilled abortionist are obtained, probably an instrument is successfully passed through the os into the uterus, and, as a rule, abortion follows without complication. Such cases are probably more frequent than is generally supposed, but, as it is to the interests of all parties to preserve silence, the facts rarely become known. It is only when perforation of the uterus or septic poisoning is followed by the death of the woman that public inquiry takes place. The case of Dr. Whitmarsh, who was convicted in 1898 of causing the death of a woman by an illegal operation, is interesting, as the fatal result was due to the drastic measures taken to prevent septic infection. After passing an instrument he gave the woman a douche of mercuric chloride, which occasioned acute mercurial poisoning. At the autopsy, sloughing of the gums and of the whole of the vaginal and uterine mucous membranes was found.

A woman who wishes to procure abortion will sometimes endeavour to get her doctor to pass a sound, by telling him that her uterus is displaced, and that on a previous occasion it was necessary to use an instrument to rectify it. When questioned as to the date of her last menstrual period, she will make a false statement. The medical practitioner should make it a rule never to use the uterine sound without having first thoroughly satisfied himself that his patient is not pregnant.

Signs of Recent Abortion in the Living.—The signs are the more distinct the further the pregnancy was advanced. Within the first two months the ovum is generally expelled entire, and in a few days' time the parts have resumed their normal condition. When abortion occurs after the third month, the ovum is probably ruptured, and there is greater likelihood of the placenta being retained and setting up inflammatory processes. The signs of pregnancy are now more distinct and the os uteri more or less patulous. In the later months of gestation the effects of abortion more and more closely approximate to those of recent delivery (*v.* p. 101).

The cases of criminal abortion which become public have, for the most part, been induced about the fourth or fifth month. One reason of this is that these months are the most dangerous period of gestation at which miscarriage can occur; abortion induced at an earlier date is not so likely to be followed by death. Another is that the woman, especially if a young girl, may not be certain of her condition until quickening occurs, or she may have spent time in trying to achieve her purpose by taking drugs. On the other hand, a woman of experience may resort to instrumental means as soon as she has missed one period. In 1898, Dr. Collins was convicted of producing abortion in a woman who was found, at the autopsy, to be not more than seven or eight weeks pregnant.

Signs of peritonitis or metritis are very likely to be found, for, in the great majority of cases, it is owing to the development of septic processes that attention is called to the woman and proper medical aid sought. Natural abortion is rarely complicated by septicæmia, and the mortality after it is small. Hence, the mere presence of inflammatory trouble is suspicious of traumatic interference.

When making the examination the medical man should endeavour to ascertain if there are any conditions present, such as abnormalities or disease of the uterus or pelvis, which would render natural abortion a likely occurrence. The history of the woman and the explanation she gives of the cause of the abortion should be listened to, but not much reliance can be attached to them in criminal cases. Previous deliveries or miscarriages should be inquired into. Evidence that the woman has a habit of miscarrying at about the same period of gestation, or has had syphilis, increases the likelihood of abortion from natural causes. The course to be adopted by the medical man, with regard to informing the authorities, when he discovers that criminal abortion has been procured, or is made the recipient of a confession to that effect, is discussed under the heading of "Professional Secrecy" (*v.* Chap. xvii.).

Signs of Recent Abortion in the Dead.—Externally, the signs of pregnancy and of recent delivery should be looked for. When the abdomen is opened, careful examination should be made for peritonitis, or other inflammatory mischief, whether generalised, or limited to the vicinity of the pelvic organs. The stomach should be ligatured at each end and removed entire, so that the contents may be analysed for irritant poisons and abortifacients. The in-

testines should be treated in the same way, and the other organs should be preserved. When the intestines have been removed from the body, the peritoneal surface of the uterus and adjacent structures, and particularly the pouch of Douglas, should be very carefully searched for wounds which may have been punctured through the vagina. The whole generative system should now be removed from the body entire, by means of incisions made close to the under surface of the pubic arch and carried round to meet behind the anus. The vagina and uterus are completely slit up, and all punctured wounds or lacerations are carefully noted and measured. If an instrument has been simply pushed straight up the vagina by an ignorant person, wounds of the vagina, especially in the posterior formix, and of the external surface of the cervix, are likely to be found. In the hands of a person with some knowledge of anatomy the instrument may have been passed through the external os, and then injuries are likely to have been produced on the internal surface of the cervix. When a curved instrument has been successfully passed through the internal os, perforation of the fundus or laceration of the uterine wall may have been caused. The rectum and bladder also require examination.

Examination of the Expelled Uterine Contents.—A fœtus may be found, but in many cases this will have been destroyed before the medical man is called in. Examination is then limited to portions of the placenta and membranes which have been retained, and are expelled later, or are removed from the uterus by gynæcological methods. In rare cases moles or membranes expelled during menstruation may have to be examined. It is important to determine the age of a fœtus from the degree of development it exhibits, as follows :—

One Month (end of).—The ovum is about the size of a pigeon's egg, and is covered with chorionic villi. The embryo is about $\frac{1}{8}$ of an inch long measured in a straight line from the head to the caudal curve. The eyes are represented by black dots, and the limbs by bud-like processes.

Two Months.—The ovum is about $2\frac{1}{2}$ inches in its greatest diameter, and the embryo $1\frac{1}{8}$ inch long measured as before. The site of the future placenta is indicated by increased proliferation of the villi at one spot. The openings of the mouth and nose are separated. Centres of ossification have appeared in the lower jaw and clavicle.

Three Months.—The ovum is about 4 inches long; the placenta is formed, and the villi have mostly disappeared from the rest of the chorion. The umbilical cord shows a spiral twist. The fœtus is about $3\frac{1}{4}$ inches in length, and weighs about 3 ounces. The head is clearly separated from the body by the neck, and the ribs are distinct. The penis or clitoris has appeared, but the sex cannot be determined with certainty. The fingers and toes are developed, and rudimentary nails can be detected.

Four Months.—The fœtus is from 5 to 7 inches long, and weighs from 4 to 8 ounces. The head is about one-fourth of the length, and

the bones of the skull are partly ossified. The membrana pupillaris is very distinct. The sex is now distinguishable. Lanugo is beginning to appear.

Five Months.—The length of the fœtus is from 7 to 10 inches, and the weight from 8 to 16 ounces. Hair is present on the head, and lanugo over the whole body. The skin is covered with vernix caseosa. Centres of ossification have appeared in the os calcis and pubes.

Six Months.—The fœtus is from 9 to 13 inches in length, and 1 to 2 pounds in weight. The eyebrows and eyelashes are beginning to form; the hair on the scalp is longer, and less like down. The membrana pupillaris is still present. Fat is commencing to form in the subcutaneous tissues, but the skin is still red and wrinkled, The testes are just below the kidneys. Centres of ossification are present in the manubrium sterni.

Seven Months.—The length is from 12 to 15 inches, and the weight from 2 to 4 pounds. The skin is paler and smoother, and the lanugo is beginning to disappear from the face. The membrana pupillaris becomes thin and transparent. The testicles are near the abdominal ring. Meconium is present in the large intestine. Ossification has commenced in the astragalus. The nails do not reach the ends of the fingers.

Eight Months.—The fœtus is from 15 to 17 inches in length, and from 4 to 5 pounds in weight. The membrana pupillaris has practically disappeared. The testes are usually in the inguinal canals, but sometimes have entered the scrotum, particularly on the left side. The nails have practically reached the ends of the fingers.

Nine Months.—*The Signs of Maturity.*—The average length is 21 inches, and weight 7 pounds, but weights of 5 and 9 pounds are not uncommon. The lanugo has almost disappeared, and the hair on the head is from 1 to 2 inches long and generally dark. The nails project beyond the tips of the fingers, and reach the ends of the toes. Both testicles are in the scrotum. A centre of ossification is present in the lower epiphysis of the femur. This is, of all points, the most reliable indication of maturity.

Questions to be Answered.—Having completed his investigations, the medical man should endeavour to frame replies to the following questions, any of which may be put to him:—Has abortion taken place? Was it procured by criminal means? Are there any conditions in the body rendering natural abortion a likely occurrence? How far was gestation advanced? Was this the woman's first pregnancy? Has an attempt been made to procure abortion in a non-pregnant woman?

CHAPTER XIII.

BIRTH—INFANTICIDE.

CONTENTS.—**Birth**: Medico-legal bearings and definitions—Evidence of, or pointing to, live-birth—Early signs of live-birth—Late signs of live-birth—Positive signs of dead-birth—**Infanticide**: Natural causes of death at, or shortly after, birth—Accidental causes—Methods adopted for killing an infant—Post-mortem examination of a newly-born infant—Examination of the mother and her belongings.

BIRTH.

Medico-legal Bearings and Definitions.—There are two distinct classes of cases in which the question as to whether an infant was born alive or dead comes before the Courts—viz., criminal charges of infanticide (murder), and civil actions anent succession. In each case the legal presumption is that the child was born dead, and it is incumbent upon the party asserting live-birth to prove the statement. Theoretically, the criterion of live-birth is the same in both criminal and civil cases, but, in actual practice, much stronger evidence of the fact is required to support a charge of infanticide than to determine a question of succession. Moreover, the degree of development of the child is of no importance in civil cases, provided it was at least capable of displaying evanescent vitality; on the other hand, in criminal cases, viability as well as live-birth must, as a rule, be shown. It is necessary therefore to consider what meanings the law attaches to the words "child" and "fœtus," "birth" and "live-birth," and to criticise the definitions from both the civil and criminal standpoints. There are no statutory enactments dealing with these matters, the law being entirely derived from judicial rulings. The subject is very thoroughly worked out by Dr. Stanley B. Atkinson in the *Law Quarterly Review* for April, 1904.

Child or Fœtus?—It is necessary to consider at what period of development the product of conception will be looked upon by the law as a child. Definition may be required in cases of disputed succession, and in charges of concealment of birth or infanticide. Each case, as it arises, must be settled upon its own merits, but a greater latitude is allowed in civil than in criminal cases.

In civil cases the question usually at issue is the right of the husband to be "tenant to the courtesy." The law on this subject is thus stated by Blackstone:—"When a man marries a woman seized of an estate of inheritance, and has by her issue born alive which was capable of inheriting her estate; in this case he shall, on the death of his wife, hold the lands for his life as tenant by the courtesy of England." For this purpose, the degree of development of the

child does not matter, provided it is capable of showing even the smallest sign of vitality, such as a movement of the limbs, or a transient feeble pulsation in the cord. Such signs might be manifested by a fœtus of only four months' development, or even less, but they would require to be substantiated by the direct evidence of eye-witnesses. It will be noticed that the mother must have survived the birth of the child. The extraction of a living fœtus by Cæsarian section, after the death of the mother, would not pass the tenancy to the courtesy.

A monster cannot inherit. Blackstone states that "a monster which hath not the shape of mankind hath no inheritable blood and cannot be heir to any land, it is not capable of inheriting"; but if, in spite of deformity, "it hath human shape, it may be an heir." The degree of malformation which would preclude inheritance must be decided separately in each case.

In criminal law it must be shown that the child has reached such a stage of development that it was capable of surviving its birth. Obstetricians generally consider that a child is not viable before the end of the twenty-eighth week, but occasionally a child survives after a shorter period of gestation. Sir James Stephen, in the *Criminal Law of England*, states that concealment of birth does not include concealment of "delivery of a fœtus which has not reached the period at which it might have been born alive." In 1866, Smith, J., in the case of a malformed fœtus of less than seven months' gestation, left it to the jury to say "whether the offspring has so far matured as to become a child, or was only a fœtus, or the unformed subject of a premature miscarriage." In actual practice, a charge of infanticide is rarely brought unless there is not only viability, but distinct evidence that respiration has occurred.

What constitutes "Birth"?—It is definitely established that a child is not born until every part of it has been completely extruded from the body of the mother; if only one foot remain within the vagina the child is not born, in law. Taylor defines birth as the "complete extrusion of the *products of conception.*" But it is not necessary that the placenta and membranes should have been expelled. The terms of this definition prevent respiration, one of the most striking signs of independent existence, from being *legal proof* of live-birth, for, as every practitioner knows, a child may both breathe and cry as soon as the head is born, or even while it is still within the vagina. Although an unborn child has certain civil rights as regards property, &c., it is not "under the King's peace," and a curious legal anomaly therefore arises. Provided abortion has not been procured, the killing of a child in the act of being born is no offence in law, though, if injuries are inflicted before birth which cause the death of the child after birth, murder has been committed.

What constitutes Live-Birth?—This has long been a very vexed question, owing both to difficulties inherent in the subject itself, and to the fact that the rulings of judges untrained in physi-

ology, have not always been in accordance with scientific facts. The substance of many rulings may be summed up in the statement: *To constitute live-birth a child must have had a separate existence after it was completely born.* But this only removes the difficulty a step farther back, for we have now to consider what constitutes a separate existence. In the first place, it is clear that separate existence does not necessitate physical separation of the mother and child, or even partial birth, for a child may live for several minutes within the uterus after the death of the mother, and it is said that there is always a chance of its survival if Cæsarian section is performed within a quarter of an hour. Secondly, it may be pointed out to the student that separate existence does not require that the cord should have been cut, for the child may be independent of the maternal circulation long before this is done. Some judges have insisted upon independence of the circulation. Thus Parke, J., in 1833, says, "There must have been an independent circulation in the child or the child could not be considered as alive"; and Blackburn, J., in 1863, "An independent existence—that it should be completely born and have an independent circulation." These rulings were probably based upon the belief that the same blood circulated between the mother and child through continuous vessels in the placenta. The student of physiology now knows that the fœtal circulation is really independent from its very commencement. The fœtal blood always maintains its identity, and is driven through the fœtus, cord, and fœtal portion of the placenta by the action of the fœtal heart.

A more scientific statement was made by Wright, J., in 1901: "The true test of separate existence in the theory of law, whatever it may be in medical science, is the answer to the question, Whether the child was carrying on its being without the help of the mother's circulation? If yes, then it had a separate existence, even though it might not be fully born. If no, it had no such separate legal existence" (*R.* v. *Mary Pritchard*, Shrewsbury Spr. Ass., 1901). To the medical mind this definition seems to be equivalent to taking respiration as the criterion of separate existence, for until that occurs the child can hardly be said to be carrying on its being by itself. It is true that if a child does not breathe, and the blood has ceased to be aërated by the maternal circulation, a brief period elapses before it is asphyxiated, but during that period it would be more correct to describe the child as dying rather than carrying on its being; and even then, until death occurs, life is maintained by oxygen present in its blood which has been derived from the oxygen in the maternal blood. Similarly, under this ruling, the child which is living in the uterus of its dead mother has not a separate existence, for it is not carrying on its being without the help of the mother's circulation; it is carrying it on by means of residual oxygen in its blood, which was derived from the mother's blood before her death.

The definition of live-birth involves a good deal of hair-splitting and legal subtlety, and its chief importance is to students for exam-

ination purposes. In actual practice, as we have already seen, the question is of no importance in cases of concealment of birth, while a charge of infanticide is very unlikely to be pressed, or, if it is, to be followed by a conviction, unless the child has fully respired. Civil cases in which the question arises are rare, and when they do occur very small indications of post-natal vitality, provided they are satisfactorily attested by eye-witnesses, will be accepted as evidence of live-birth.

Evidence of, or pointing to, Live-Birth.—Transient signs of life which may be observed at the moment of birth are pulsation in the cord, movements of the limbs, eyelids, or mouth, slight gasps for breath, and crying. Such indications produce no effect in the body which can be recognised after death, and they must, therefore, be proved by the evidence of those who were eye-witnesses of the birth. The mere hearing of a cry without ocular proof that the child was born is not sufficient, for a child may cry as soon as the head is free, or even while it is still within the vagina, and several authenticated instances are recorded in which crying was audible while the child was still *in utero*.

A remarkable instance of this phenomenon, which is termed *vagitus uterinus*, is described by Dr. Temple Smith (*Brit. Med. Journ.*, Feb. 4, 1905). The head was delayed above the brim, and as the parts were not sufficiently dilated to admit of rapid delivery it was decided to turn. While feeling for the knee, the child was heard to cry twice distinctly, and again when the foot was brought down, the cries being heard by the nurse and two medical men. It was born three hours later, somewhat asphyxiated, but was easily revived and lived.

The signs of live-birth which can be found on post-mortem examination of the body fall into two classes: (1) those which indicate the establishment of functions necessary to life—*e.g.*, respiration—and must therefore be present very shortly after birth, and are not absolutely conclusive, inasmuch as they may be present before complete birth; and (2) those, such as changes in the stump of the umbilical cord, which can occur only if the child has survived at least a good many hours, and are, therefore, conclusive evidence of live-birth.

Early Signs of Live-Birth—Signs of full Respiration—Changes in the relations of the Thoracic Organs.—When the thorax of a child which has not breathed is opened, the thymus gland and pericardium are found to occupy nearly the whole of the cavity. The lungs lie close to the vertebral column and are scarcely visible, only their anterior borders projecting forwards close to the thoracic wall. The highest point of the diaphragm is on a level with the fourth or fifth rib. After full respiration, the expanded lungs occupy a much larger proportion of the thoracic cavity and nearly cover the thymus and pericardium, and the diaphragm is depressed to the level of the sixth or seventh rib.

Changes in the Lungs—Colour.—Before respiration, the lungs are pale brown or chocolate-colour, and have been compared in appearance to adult liver. The colouration is uniform, and never

mottled. After respiration, the colour becomes lighter and redder, and is mottled or marbled in appearance, exhibiting either bright red patches on a dark bluish-red ground, or bluish patches on a bright red ground. This marbling is very distinctive; according to Prof. Glaister, it is absolutely characteristic of natural inflation.

Consistency.—Before respiration, the lungs are firm and compact like adult liver, and do not crepitate on squeezing. After respiration, the lungs are elastic and crepitant. On cutting into them, and compressing the cut surfaces, a blood-stained froth escapes.

Shape and Volume.—After respiration, the volume is much greater, and the previously sharp margins become rounded.

Weight.—This is much increased owing to the influx of blood.

Specific Gravity.—Before respiration this is greater than that of water, in which, therefore, the lung sinks. After respiration it is less, and the lung accordingly floats.

When all these signs are present, it may be definitely stated that full respiration has occurred. We may even go further, and say that their presence is practically conclusive evidence of live-birth in the legal sense of the term; for it is almost impossible that the limited breathing, which alone can occur when the head is born but the thorax is still subjected to compression by the vaginal walls, could produce complete inflation of the lungs. The only other means by which such appearances could be produced is **artificial inflation.** This is a difficult thing to do, especially for an unskilled person, and is almost always incomplete. It is generally said that after artificial respiration the colour of the lungs is bright red and uniform, instead of being mottled. If much force has been used, some of the air vesicles may have been ruptured by over-inflation. Some observers state, however, that all the natural appearances may be produced by artificial respiration if Schultz's method has been employed. The distinction is rather of theoretical than practical importance, for artificial respiration is scarcely likely to be resorted to where the intention is to destroy the child. It might conceivably be urged in a civil case.

Partial Respiration. — When a child has only feebly respired, the evidence of the function to be found in the lungs is correspondingly slight. The parts of the lungs which are usually the first to be affected by respiration are the thin margins, particularly the border of the upper lobe on the right side. In these places some of the alveoli may be observed to be expanded, and the surface shows the characteristic mottled colouring. The following test has been devised to ascertain partial inflation after incomplete respiration; it is based upon changes in the specific gravity of the expanded portions of the lungs:—

The Hydrostatic Test.—It has already been stated that the lungs, after full respiration, float in water, while fœtal lungs sink. By refinements of this method of treatment it is possible to recognise degrees of inflation less than that produced by full respiration. It is generally recommended that the hydrostatic test should be commenced by removing the lungs and heart *en bloc*, and placing them

in water. If the mass float, a high degree of buoyancy in the lungs is indicated; if it sink, the heart is removed, and the observation is repeated. Each lung is now tested separately. If either float, it is removed from the water, subjected to firm uniform pressure by placing it under a smooth board and standing upon it, and its buoyancy is again observed. Each lung is now cut into several pieces, and each piece is separately tested in the same manner, both before and after compression.

The object of the compression is to drive out gases generated by putrefaction, or air which has entered mechanically. Respired air in the alveoli is not expelled by pressure unless the tissues are absolutely crushed.

The deductions to be drawn from the test are as follows:—If the lung floats as a whole, and all the pieces float, after having been subjected to compression, complete inflation has occurred. If some of the pieces sink and others float after the application of pressure, partial inflation of the alveoli has taken place. If all the pieces sink, the strong probability is that the child has not breathed at all.

Possible Fallacies in the Hydrostatic Test.—*The lungs, or portions of them, may float, although respiration has not occurred.*

(1) **From Artificial Inflation.**—The test affords no certain means of distinguishing this condition from natural respiration. In the great majority of cases, however, it has been found by experiment that air so introduced is expelled by pressure, but this is not absolutely invariable.

(2) **From the Presence of Gases Generated by Putrefaction.**—Such gases will be expelled by pressure. If the lungs, or portions of them, float after compression, respired air is also present. When a lung floats in virtue of putrefactive gases, decomposition must have advanced to a considerable extent, and signs of it will accordingly be found in other parts of the body. The nature of the gases present can often be inferred from the appearance of the lung. Bubbles of gas are seen between the pleura and pulmonary tissue, and, by gentle pressure with the finger, can be made to run along beneath the pleura, showing thereby that they are not contained within the alveoli. If the cut surface of a portion of putrefactive lung be compressed under water, comparatively large bubbles ascend to the surface. When only respired air is present, the bubbles liberated are much smaller.

The lungs, or portions of them, may sink, although respiration has occurred.

(1) **From Disease.**—Pulmonary disease is rarely found at birth. When present, it is extremely improbable that the disease would be so wide spread as to affect every portion of the lungs.

(2) **From Incomplete Respiration.**—Though the lungs, as a whole, sink, the strong probability is that portions cut from the margins will float.

(3) **From Complete Atelectasis.**—In very exceptional cases the lungs have been found completely unexpanded and presenting all the fœtal characters, although the child survived its birth for, perhaps,

several hours, during which period crying and respiratory movements of the chest were observed. The explanation of this phenomenon is not quite clear; it has been suggested that sufficient aëration takes place through the walls of the trachea and bronchi to keep the tiny spark of life going for a short time, or that the lungs gradually collapse as the infant dies, or that the air in the lungs is absorbed by the circulation after respiration has ceased.

(4) **From Advanced Decomposition.**—When the tissues are softened and broken down by putrefaction, pressure will drive out respired air as well as putrefactive gases.

Air in the Stomach and Intestines.—This furnishes a test of live-birth, or, rather, of respiration, to which some observers attach considerable importance. In the act of respiration a certain amount of air is swallowed, and, if the child breathes for an hour or two, the stomach will be more or less inflated, and air will penetrate into the duodenum. The presence of air is determined as follows:—A ligature is placed around the cardiac end of the œsophagus, two ligatures around the pylorus, and a ligature at the termination of the duodenum. The organs are now removed together, thrown into water, and their buoyancy observed, first united, and then separated. The floating of both duodenum and stomach affords strong evidence that the child has breathed for some time, or that artificial respiration has been adopted. Floating of the stomach alone indicates that breathing only occurred for a short period. If putrefactive gases have developed, the test is, of course, inapplicable. Absence of air from the stomach cannot be regarded as proof that respiration has not taken place. This test is merely confirmatory of respiration; it affords no legal proof of live-birth.

Late Signs of Live-birth.—These are changes which only occur if the child survive birth for at least several hours. Their presence, therefore, constitutes conclusive evidence of live-birth, and they are also of value as providing a means whereby some estimate of the length of time the child lived may be formed.

Changes in the Umbilical Cord.—In the newly-born infant the stump of the cord is firm and fleshy. After an interval, rarely less than twenty-four hours, it begins to show signs of mummification, the process commencing at the ligature and gradually spreading back to the navel. The mummified part is flattened, dry, shrunken, and parchment-like in appearance; at the junction with the unchanged portion there is a circle of inflammatory redness. The cord drops off from about the fifth to the ninth day, but signs of separation in the form of a line of hyperæmia and swelling around the navel, with, perhaps, a little exudation, may be observed as early as the third day. Cicatrisation is generally complete about the tenth to twelfth day.

Absence of the cord from the decomposed body of an infant may be due to putrefaction; or the cord may have been cut or ruptured close to the abdomen.

Changes in the Skin.—Immediately after birth the skin of the child is red and congested, the face (in a vertex presentation) is often

swollen and distorted, and the scalp exhibits a caput succedaneum. These appearances pass off in a few days. In from one to four days after birth desquamation begins to occur, the epidermis separating off either as a fine dust or in scales. This process is generally complete in from a week to a fortnight.

Presence of Food in the Stomach.—Swallowing is necessarily a vital act. Traces of milk or other aliment in the stomach or intestines afford incontestable proof of extra-uterine life.

Changes in the Middle Ear.—At birth the middle ear is filled with a gelatinous embryonic substance. As respiration proceeds this becomes gradually replaced by air. The time of the change varies from a few hours to two or three weeks after birth.

Changes in the heart and circulatory system occur at intervals too uncertain for them to be of any practical value.

Positive Signs of Dead-birth.—Under certain circumstances, it is possible to state positively that a child was born dead. These are as follows:—

(1) When it shows signs of intra-uterine maceration. The dead fœtus, if retained within the uterus, and if the membranes are unbroken, undergoes a slow moist degeneration without putrefaction. The body becomes soft, flaccid, and mis-shapen. The cuticle is detached in places, or raised in blebs, and the skin and tissues are stained a brownish-red. A brownish serum collects within the cavities of the body and beneath the scalp. The brain is soft and pulpy, and the attachments of the bones, especially of the cranium, are loosened.

(2) When the fœtus is not sufficiently developed to have been capable of independent existence—that is (in criminal cases), after gestation shorter than five months.

(3) When the fœtus is the subject of congenital malformation of such a nature as to be incompatible with independent existence.

INFANTICIDE.

The consideration of this subject involves a knowledge of the natural and accidental causes whereby an infant may meet with its death during, or shortly after, birth. We shall, therefore, dispose of these first.

Natural Causes of Death during, or shortly after, Birth—Immaturity.—A fœtus of six months' development, if born alive, rarely survives its birth more than a few hours. Infants born at the end of the seventh month are likely to survive only if they receive extreme care and attention.

Malformations.—Some are necessarily immediately fatal. Less degrees permit of life of varying duration. The principal malformations to look for are, abnormalities of the heart and great vessels; defects of the central nervous system, including hydrocephalus; stricture of the œsophagus or pylorus; and occlusion of the rectum.

Disease.—Congenital syphilis, pneumonia, or intra-uterine malnutrition may be fatal shortly after birth.

Maternal Causes.—Death may follow prolonged or difficult labour due to rigidity of the cervix, tonic uterine contraction, abnormal presentations, contracted pelvis, &c., &c.; or may be caused by pressure on the cord or by attempts at intra-uterine breathing, an event particularly liable to happen in breech presentations. The cause of death is either asphyxia or injuries from necessary instrumental interference.

Accidental Causes of Death during, or shortly after, Birth — Suffocation beneath Bed-clothes, &c. — This may happen quite innocently if a woman is delivered alone; or, in the absence of skilled assistance, the child may be asphyxiated by inhaling fæcal matter, meconium, blood, &c. We have already seen that delivery may occur during drunkenness or other states of insensibility. But the unconsciousness which renders the woman incapable of helping her child may not supervene until after delivery. She may, for instance, faint from the pain at the moment of birth, or from excessive hæmorrhage. Husband met with a case in which a child was suffocated in a woman's drawers, which she persisted in wearing during labour from motives of delicacy. It is doubtful whether this should be considered an *accidental* death.

The post-mortem examination in such cases will probably show signs of partial respiration, and probably fæcal material, &c., in the mouth and air-passages.

Twisting of the Cord round the Neck.—This is a comparatively frequent occurrence at birth, and unless the constriction is promptly relieved, death from asphyxia ensues. The cord is soft and broad, so that no abrasion of the skin is produced, and sometimes no mark. More frequently a broad, continuous groove of a livid or deep red colour is found. The medico-legal importance of this is twofold. When a child has been deliberately strangled, the assertion may be made that it was caused by twisting of the cord round the neck at birth. On the other hand, the mark produced in a genuinely accidental case may give rise to suspicion of homicide (*q.v.*).

Precipitate Labour. — Most practitioners have observed instances in which labour was accomplished in a remarkably short space of time. Usually the subjects are women who have borne many children, and in whom the vagina is lax and gaping, and the perineum torn. The writer has met with a case in which a woman was delivered of her thirteenth child, still enveloped in the intact membranes, within ten minutes of the time the pains commenced. Exceptionally, precipitate labour is observed in a primipara. Many authenticated instances are recorded in which women have mistaken the sensations of labour for a desire to micturate or defæcate, and have been delivered while in the position for so doing. In such a case the child falls, head downwards, into the chamber or closet, and, unless promptly rescued, is likely to be drowned. Instances are also described in which women have been suddenly delivered while standing. The child then falls to the ground, perhaps sustaining a fracture of the skull or other injury.

A remarkable case of precipitate labour is recorded by Drs. Rayner and Stuart in *The Lancet* for June 17, 1905. A primipara, aged 26, was left by her husband in good health and spirits at 2 p.m., and, on his return at 4.30, was found dead in a water-closet. She had been delivered in this situation, and the child's head had completely passed through the lower opening of the closet, the body and shoulders remaining above. Forcible attempts were made to extract the child, which was a healthy full-term female, but it was impossible to do so until the commode was taken to pieces and the earthenware pan smashed. An examination of the mother showed that the lower segment of the uterus and the cervix had been bilaterally ruptured through the whole thickness of the muscular wall; the mucous membrane and part of the muscular wall of the vagina had been fissured, and the deeper tissues of the perineum lacerated. Superficially the perineum was intact. Death had been due to shock and hæmorrhage.

The writers add—"From a medico-legal point of view this case also appears to be of interest. A point which presents itself is this: if the birth had not been fatal to the mother it might have been argued with some show of reason that the impossibility of withdrawing the child's head indicated that some means (such as interference on the part of the mother) additional to the forces of expulsion and gravity had been used to get it into the extraordinary position in which it was found."

Death of the Newly-born by Criminal Means, or Infanticide.—The killing of a newly-born infant is not looked upon by the law as a specific crime; it is murder or manslaughter just as much as the killing of an adult. Nevertheless, from the nature of the case, the evidence required differs very considerably from that necessary in an ordinary charge of murder. When the body of a newly-born child is found, the legal presumption is that it was born dead, and, if a charge of infanticide is preferred, it is incumbent upon the prosecution to prove the fact of live-birth. Such proof must be absolutely conclusive of live-birth within the *legal* meaning of the term, and, in practice, a conviction will not follow unless viability also was present.

As a matter of fact, infanticide is a far commoner crime than the number of convictions for child-murder would show. The act is usually committed by a young girl who has been seduced, in order to avoid the shame of exposure. Those who attend the coroners' courts are familiar with the fact that the sympathy of the jury in such cases is always strongly with the mother, and if there is a possible loophole in the medical evidence (or even in some cases in direct contradiction to the medical evidence) they will return a verdict of death from natural or accidental causes. The details were given on p. 98 of a case in which a servant threw her newly-born child from a height on to the ground. The medical evidence showed that there was a fracture of the skull, that the lungs floated as a whole, and that every part floated when they were cut up. But the jury found that the child was accidentally suffocated by the bed-clothes owing to the mother having "fainted" at the moment of birth.

Equally, in the criminal courts, a conviction of "wilful murder"

rarely follows except on the very clearest evidence. In some cases a verdict of manslaughter is found; more frequently the prisoner is convicted of "concealment of birth," the circumstances under which the offence was committed generally rendering this possible. Often the woman is acquitted in spite of clear evidence of crime. The conclusiveness of the evidence of live-birth requisite in charges of infanticide is well illustrated by a case mentioned by Dr. F. J. Smith, which took place at the Central Criminal Court in 1899. "The medical evidence proved that every piece of the lung floated, and a cord was tightly tied round the child's neck, but the medical witness refused to swear that even such complete respiration had taken place after complete birth." The judge thereupon stopped the case (Taylor's *Med. Jurisp.*, vol. ii., p. 230).

Probably a greater number of convictions of child-murder would take place if judges were not by law compelled to pass the death sentence in such cases.

Methods Adopted for Killing Infants—**Suffocation.**—This is probably the commonest method of committing infanticide. The assertion that the child was overlain, or was accidentally suffocated by the bed-clothes while the mother was asleep, is practically impossible of disproof. Evidence of homicide is afforded when the child is found with its mouth stuffed with paper, rags, straw, &c. When the body of an infant is discovered in mud or in a cess-pit, evidence that it was living when placed in that position may be provided by the fact that particles of the mud or other surrounding material have been aspirated into the lungs, or swallowed.

Strangulation. — The frequency with which this method is adopted for killing infants is shown by the figures given on p. 52. If the constricting material is still round the neck of the child, the evidence of criminal intent is clear. When the ligature is not forthcoming, and inferences have only to be drawn from a suspicious-looking mark on the neck, the question becomes more complicated. The assertion may be made that the mark was produced by the twisting of the cord round the neck at birth, and this it may be impossible to disprove. The mark may show that tape or string was employed, but the twisted nature of the umbilical cord itself may produce an impression suggestive of the use of rope. Abrasion of the skin, and injury of the subcutaneous tissues, indicate that a ligature of rougher and stronger material than the funis has been employed. Even if the mark is of the character usually produced by the funis—viz., a broad, smooth, livid groove—it does not necessarily follow that the strangulation was accidental, for the mother may have herself twisted the cord tightly round the neck of the child. Death from twisting of the funis round the neck is usually due to arrest of the circulation through it, and occurs before breathing has commenced. Signs, therefore, that the child has fully respired, indicate, as a rule, strangulation subsequent to birth—*i.e.*, infanticide; exceptionally, however, the noose is not tight enough to prevent partial respiration, but sufficiently tight to cause death by arrest of the circulation in the cord.

Impressions of fingers about the neck may suggest throttling, but may be explained by the woman as due to her attempts to aid delivery.

Wounds and Mechanical Violence.—Wounds will show the same characters as in the adult, and must be examined according to the same methods. The woman may explain bruises and scratches about the face by stating that she seized the head as soon as it was born, and endeavoured to hasten delivery. Careful search should be made for minute wounds caused by thrusting long needles between the ribs into the heart, or through the orbit or fontanelles into the brain. When fracture of the skull is found, the explanation offered may be that the child dropped from the woman while she was standing. In all cases in which precipitate labour is stated to have occurred, confirmatory evidence would be afforded by finding that the child had an unusually small head, and exhibited no caput succedaneum. In the mother we should expect to find an exceptionally roomy pelvis, and an old-standing or recent rupture of the perineum. The cord should be measured to determine whether its length is sufficient to have allowed the child to fall to the ground without rupturing it or separating the placenta. Signs that the cord has been *cut* are inconsistent with the story. Recorded cases in which women have been rapidly delivered while standing or sitting indicate that the fall to the ground rarely fractures the child's skull. On the other hand, experiments (less reliable therefore) made by dropping the bodies of still-born children on to pavement from a height of 1 or 2 feet, have generally caused fracture. In rare instances the skull may be fractured by powerful uterine contraction. In criminal cases, as a rule, more violence is inflicted than is necessary to cause death; the skull may be battered in, and the cervical vertebræ fractured or dislocated. The presence of wounds or fractures in other parts of the body points to homicidal violence.

The effects of difficult labour may be mistaken by the non-medical person for signs of criminal violence. After a slow passage through a contracted pelvis the face of the child may be excessively distorted, bruised, or swollen; or the caput succedaneum may be large and livid; or an effusion of blood beneath the scalp may form a cephalhæmatoma.

Drowning.—If the child has breathed, the post-mortem appearances will be the same as in the adult. When an infant has been drowned in a closet or bed-chamber, precipitate delivery may here also be asserted.

Neglect to Tie the Cord.—When the cord is forcibly ruptured, as by the falling of the infant from the mother, thrombosis is likely to occur in the irregularly divided vessels, and prevent fatal hæmorrhage. Suspicion of criminal intent is aroused if the end of the stump shows that the cord has been cleanly severed with a sharp instrument.

Starvation.—This is rarely resorted to with deliberate intent to kill the infant, as it is too slow a process. Often it is the outcome of ignorance, the child perhaps having been fed on quite inappro-

priate food. If the treatment amounts to culpable negligence it is equivalent to manslaughter.

Other methods occasionally resorted to are exposure to cold, poisoning, and burning. In the last case, if charred bones are found in the ashes of a fireplace, the question may arise as to whether they are those of a human being or of a small animal.

Post-mortem Examination of a Newly-born Infant.—This is conducted in the same manner and upon the same principles as in the adult, but, in addition to determining the cause of death, the examiner must make the following observations:—

(1) The degree of development of the child (*v.* p. 112).

(2) The evidence or otherwise of live- or of dead-birth.

(3) If born alive, the probable length of time the child survived birth.

(4) If born dead, the presence or absence of intra-uterine maceration.

(5) The condition of the stump of the umbilical cord. Has it been cut with a sharp instrument, or forcibly ruptured? Has it been ligatured, and if so, with what material?

(6) The evidence of attention or neglect. Has the child been cleaned, or is the body still covered with vernix caseosa?

(7) Does the stomach contain food, and if so, what is its nature?

Evidence of Criminal Intent in the Conduct of the Mother.—No compulsion can be placed upon, or inducement offered to, a woman suspected of infanticide to make a statement or submit to an examination. The police, however, usually search her room and belongings, and evidence of recent delivery may be forthcoming in the form of blood-stained linen, &c. An intention to destroy or abandon the infant may be inferred from the fact that no baby-linen has been got ready for it. *Per contra*, preparations for its arrival are evidence against infanticide. If the woman voluntarily consents to a medical examination, after having been warned, indications of recent delivery should be looked for.

The probability that infanticide has been committed is increased if the woman is unmarried, for a strong motive then exists for disposing of the child. As a matter of statistics the mortality among illegitimate children is about twice as great as among those born in wedlock. Suspicion is strengthened if the woman has concealed her pregnancy and delivery. When precipitate labour or fainting after delivery is asserted, the subsequent behaviour of the woman is significant. In a genuine case we should expect the woman to summon help as soon as she recovered consciousness. However, a statement that she was frightened, and did not know what she was doing, would probably be accepted as a sufficient explanation by a coroner's jury; it was, in the case described on p. 123.

In some cases, enquiry must be directed towards the state of mind of the woman. Signs of insanity may have been shown during the pregnancy. In insanity of the puerperium, a homicidal tendency is frequently manifested towards the infant. Without being actually insane, a woman may, in a moment of frenzy induced by the pain, kill or injure the child as it is being born.

CHAPTER XIV.

THE FORMS OF INSANITY.

CONTENTS.—Classification of the forms of insanity—Mania—Melancholia—Recurrent insanity—Moral insanity—Delusional insanity—Impulsive insanity—Epileptic insanity—General paralysis of the insane—Toxic insanity—Puerperal insanity—Idiocy and imbecility—Dementia.

Insanity has important legal bearings in both civil and criminal matters. Before considering these it is necessary to give a brief description of the forms of mental disease which are encountered, referring more particularly to the points of medico-legal interest exhibited by each type than to clinical details, for which books on insanity should be consulted.

Classification of the Forms of Insanity.—The law divides insanity into two classes, viz. :—

Dementia Naturalis = Congenital idiocy or imbecility.
Dementia Adventitia = Acquired insanity.

But a condition of feeble-mindedness in children, not amounting to actual lunacy or idiocy, is also recognised by the Elementary Education (Defective and Epileptic Children) Act of 1899. Idiots and imbeciles are the subject of special legislation by the Idiots and Imbeciles Act of 1886, but are included under the term "lunatic" in the Lunacy Act of 1890.

For medical purposes greater subdivision is required. Various classifications of diseases of the mind have been made, but every arrangement is bound to be, to some extent, arbitrary and unscientific, owing to the overlapping of types and the difficulty of exact diagnosis. The classification here adopted is that drawn up by the International Congress of Alienists in 1867, and is as follows:—

Simple Insanity.
- Mania.
- Melancholia.
- Recurrent Insanity.
- Moral Insanity.
- Delusional Insanity.
- Impulsive Insanity.

Epileptic Insanity.
General Paralysis.
Toxic Insanity.
Puerperal Insanity.
Idiocy and Imbecility.
Senile Dementia.
Sequential Dementia.
Dementia due to coarse Brain-lesion.

Some Definitions.—It is desirable, before proceeding further, to define certain terms which are largely used in descriptions of insanity.

A delusion concerns the mind. It is an obviously erroneous belief in some non-existent thing or occurrence, as, for instance, the conception of a lunatic that his doctor is the devil.

An hallucination is a sensory impression for which there is no external stimulus. An hallucination may be experienced by a sane person, as, for example, one suffering from migraine who sees flashes of light or fortification figures, but knows they are the effects of the disease. Belief in the reality of the impression constitutes a delusional hallucination. The subject of delirium tremens experiences an hallucination when he *sees* rats running over his bed, and a delusion when he *believes* that they are actually there.

[**An illusion** is an erroneous interpretation, by the senses only, of an external stimulus, as, for instance, feeling two noses when the crossed fingers are applied to the tip of the organ. If one believed there were two noses it would constitute a delusion.]

Mania.—Several distinct forms of mental disorder are included under this heading. The essential feature is loss of control of the mind. Acute delirious mania, acute mania, and chronic mania are recognised.

Acute Delirious Mania.—The attack may begin suddenly, or after premonitory symptoms of loquacity or melancholia. Frequently there is a definite cause, such as severe mental shock or acute disease. The individual becomes restless, and in a short time may display the most violent excitement, incessantly shouting, singing, or gesticulating. As a rule, he is not dangerous to others, though he may attack those who endeavour to restrain him. His language is incoherent, profane, or obscene, and he is dirty in his habits and perhaps tears off his clothing. Delusions and hallucinations are present, and food may be refused. Sleeplessness is a marked feature. Some cases run a course of a few days or weeks and then recover completely; in others the temperature rises, rapid wasting takes place, and finally death occurs from exhaustion.

Acute Mania.—This condition differs from acute delirious mania chiefly in that the onset is gradual, the temperature normal, the wasting less, and the termination usually not fatal. Acute mania may be the only form of mental unsoundness displayed, or the attacks may alternate with periods of melancholia or other types of insanity. The condition may be associated with general paralysis of the insane, epilepsy, or neurotic states such as asthma or hysteria.

Sleeplessness and depression may be the first symptoms. After a short period, restlessness, irritability, and outbursts of violent temper are manifested. The appetite becomes capricious, the bowels are usually confined, the tongue is tremulous and furred, the breath offensive, and the complexion sallow. Memory becomes impaired. Great loquacity is displayed, but there is con-

fusion of ideas, the patient passing rapidly from one subject to another. The speech becomes incoherent and often obscene, and the voice hoarse from constant shouting, singing, or talking. He may display violence towards his attendants, or tear his clothes and bedding, or endeavour to destroy everything within his reach. He is filthy in his habits and often indecent in his behaviour. Delusions and hallucinations are common. The patient hears voices or music and sees strange animals. He detects smells in his food and asserts that he is being poisoned. Often the delusions take the form of self-exaltation, the individual believing himself to be a general, a statesman, or royal personage, or that he possesses great wealth or talent. Disorders of sensation occur, usually diminished sensibility but sometimes hyperæsthesia. The patient gradually becomes thin and physically weak, at least in the power of offering resistance. The power of endurance in some cases, however, is most remarkable. A maniac may continue to shout, talk, and gesticulate for days and nights in succession without sleep, and with very little nourishment.

In some cases moral perversion is a more marked feature than intellectual impairment. Habits of intemperance or masturbation may be displayed. The conversation and ideas are lascivious, the clothes are removed and the person displayed with an utter disregard for decency. Sexual crimes and unnatural offences are committed. From the medico-legal point of view this type of mania is of importance, for the sufferer may find himself in the police court, the subject of a criminal charge, before his mental condition has been recognised.

Complete recovery may follow acute mania, but often permanent changes result. The patient may be eccentric for the rest of his life, or may remain the victim of one special delusion.

Attacks of mania may alternate with periods of melancholia. **Folie circulaire** is a form of mental disorder in which periods of mania, melancholia, and comparative good health occur in cycles.

Chronic Mania is met with following acute mania, or associated with melancholia or dementia. Various types exist, but the characteristic features are weak-mindedness, chattering incoherence, violence of temper, delusions, and hallucinations. The condition may persist for many years, with occasional attacks of acute excitement or periods of melancholia.

Melancholia.—The characteristic feature of this condition is great mental depression. It may be the only form of mental disorder manifested, or it may be associated with dementia, mania, or general paralysis of the insane. Lassitude, lack of interest in the surroundings, and sleeplessness are often the earliest symptoms. The bodily health soon becomes impaired. Appetite is lost, and there may be refusal to take food; the tongue is furred, the breath offensive, and the bowels are constipated. Feebleness of the circulation is a frequent characteristic; in consequence, the pulse is weak and often slow, the hands blue and cold, and the temperature sub-

normal. Respiration is generally slowed. The skin is dry and sallow and the body emaciated.

According to the mental symptoms, three types of the condition may be recognised—viz., simple melancholia, active melancholia, and melancholia with stupor—but hard and fast lines cannot be drawn between them.

Simple Melancholia. — The patient exhibits great mental depression, anxiety, or fear. He is listless and neglectful of his occupation, and sits weeping or bemoaning his fate. Delusions and hallucinations are common. Sometimes the condition is an exaggerated form of hypochondriasis, the individual being convinced that he is suffering from some terrible bodily affection. One man believes that his blood is turning into water, another that his intestines are decomposing and are being passed *per anum*, another that he has no heart or brain. The delusions may be of a sexual character, particularly if the condition has followed habits of masturbation or sexual indulgence. A man believes that he has made himself impotent, or excited divine wrath by his acts; a woman that she is improperly pregnant, and is disgraced. Religious melancholia is a common type, particularly at times of "revivals." The victims are in a state of intense misery because they have committed the unpardonable sin, or are possessed by the devil. Delusions of persecution, financial ruin, or guiltiness of crime are frequent.

Active Melancholia. — The patient is restless and agitated in his misery, and exhibits signs of the most terrible anguish. He weeps, wrings his hands, tears his hair, and loudly bewails his piteous plight. He may rush up and down the room as if trying to fly from his misery; or sit rocking his body to and fro and repeating the same cry of distress for hours together.

Melancholia with Stupor.—The patient is silent, motionless, and apparently oblivious of his surroundings, but may present the picture of misery. He will sit for many hours in the same attitude, seemingly powerless to move. He must be fed, dressed, and undressed. The saliva may dribble from the lips, and food placed within the mouth remain unmasticated. The urine and fæces are passed into the clothes. Though absolutely apathetic the patient is not unconscious, and may resist everything that is done for him. If left alone he may seize the opportunity to commit suicide. Food may be refused, and feeding by the stomach-tube be rendered necessary. Feebleness of the circulation and shallowness of respiration are particularly marked in this form of melancholia.

The medico-legal importance of melancholia lies in the fact that it is, of all forms of mental disorder, the one in which suicidal tendencies are most pronounced. The unhappy victim resorts to self-destruction as a means of escape from his overwhelming anguish. Such cases are common enough in the coroners' courts, and a diagnosis of the mental condition can often be made solely from the letters the suicide has left addressed to his relatives or the coroner. Patients suffering from melancholia always require careful watching,

and even in asylums there is a risk of their committing suicide by swallowing any small objects they get hold of.

Recurrent Insanity may be either melancholia or mania, or both types combined. The attacks may occur at varying periods throughout life. During the lucid intervals the patient enjoys good health and mental soundness.

Moral Insanity.—In this type of mental disease the moral faculties are perverted, while the intellectual side of the mind remains unimpaired. The characteristic feature is loss of moral control. Shameful deeds are done without motive or compunction. Diabolical crimes may be committed for wholly inadequate gain, and without feelings of remorse. The condition has given rise to much discussion and divergence of opinion in criminal prosecutions, for the layman naturally tends to regard moral insanity as equivalent to excessive depravity; and, indeed, the line between the two is often very difficult, if not impossible, to draw. The treatment of borderland cases, which are partially wicked and partially insane, is one of the great difficulties in the administration of criminal law.

Two groups of cases are recognised, those in whom the condition appears after adult life has been reached, frequently following some mental or bodily affection; and those in whom the moral faculties seem never to have been developed, persons who were peculiar in early youth or childhood.

In the first group, attacks of mania, epilepsy, or other mental disease may have been precursors. Sometimes moral insanity appears after a blow on the head, or an attack of apoplexy, and it may be an early symptom of general paralysis of the insane. The onset, as a rule, is gradual. A man who has hitherto led a blameless life suddenly begins to show alterations in his character and conduct which excite the surprise of his friends. He perhaps takes to drinking, frequents low haunts, is treacherous and untruthful, or becomes morose and savage towards those formerly dear to him. Later an attack of mania may reveal the true nature of the change. Sometimes the moral deficiency is chiefly in the direction of sexual perversion. Offences are committed against decency, and the social laws of the community are outraged. A form with important legal bearings is that in which a propensity to steal is evinced (**kleptomania**). Sometimes rubbish and things of no use to the individual are taken, but often valuable articles are selected, and the thefts are committed with great cunning. The existence of a mental defect of this character is frequently put forward as a defence when ladies of good position are charged with petty thefts from shops. In the great majority of these cases, however, the acts cannot be regarded as the outcome of moral insanity. In real cases of kleptomania other evidence of mental disease is rarely wanting. Many of the sufferers have already experienced attacks of epilepsy or insanity; others are in the early stage of general paralysis.

While moral insanity is characterised by absence of delusion, and clearness or even brilliancy of the intellectual faculties, close attention to the individual will in most cases show that there is some

weakness or want of balance of the mind. He may be excitable and rambling in his conversation. He passes rapidly from one subject to another, and it may be difficult to get him to answer questions, or give a detailed account of himself. The very way in which the immoral behaviour is defended often shows defective reasoning power. Sometimes great skill and cunning is displayed in committing and concealing the misdeeds, but often this is combined with foolish or extravagant behaviour.

The second group of cases are those in whom the moral perversion seems to be due to a congenital defect. The individuals are young persons often with a family history of insanity, epilepsy, or alcoholism. During childhood vicious tendencies and depraved tastes are displayed. A boy, though bright and intelligent, is idle, and refuses to submit to school discipline; he plays truant, lies, steals, and is often guilty of excessive and wanton cruelty to animals. After attaining puberty he indulges in masturbation or other immoral practices, and may commit criminal assaults upon women and children. Sometimes a tendency to incendiarism is displayed, the patient frequently setting fire to the houses of those under whose care he is placed (pyromania). Others accuse innocent persons of having robbed or ill-treated them.

In some cases of moral insanity it would appear that one part of the brain is excessively developed at the expense of another, for the individuals may show exceptional ability for music, mathematics, or other branches of study.

Delusional Insanity.—This is a form of mental disorder which is characterised by the presence of hallucinations and delusions, but is not accompanied by marked mental aberration in other directions. Monomania and paranoia are synonymous terms for the affection. Outside their particular delusions, the individuals often display capacity and reasoning power, and even their erroneous beliefs are defended with great pertinacity and skill. When a person who is suffering from insanity of this type finds from experience that his statements do not meet with sympathy or credence, he not infrequently conceals the delusions. In such a case rational conversation may be carried on for a long period; and even after repeated examinations the medical man may fail to detect any evidence of mental disorder.

Delusional insanity is of great importance from the medico-legal point of view, as, under its influence, persons may bring all sorts of charges against others, or may display homicidal tendencies towards those whom they believe to be their persecutors.

The hallucinations may affect any of the senses. Auditory impressions are very common, voices, music, bells, hammering, &c., being heard. The voices may discuss the condition of the individual, announce their intention of injuring or killing him, or urge him to do various acts or commit violence. The voices may be those of unknown persons, or of acquaintances, who may be subjected to much annoyance in consequence.

Hallucinations of sight are not so frequent, but sometimes visions

of angels, spirits, or deceased persons are seen. Some of the visual impressions are misinterpretations of muscæ volitantes, the patient believing that he sees vermin crawling upon everything he looks at. Hallucinations of smell may lead the individual to accuse others of poisoning him.

Some patients imagine that their thoughts are being read, and, in consequence, they endeavour to keep as far from other persons as possible. Others believe that their health or virility is being sapped by evilly-disposed individuals, or that they are being galvanized, mesmerized, starved, or robbed. The person, often a lady, who seeks protection from the magistrate against such influences, or who goes to the law courts with complaints that property or inventions have been stolen from her, is a familiar figure in the newspapers. Sexual delusions are common. A woman imagines that every man she sees is trying to take liberties with her, or else she fixes upon some particular man, and accuses him of endeavouring to violate her chastity. Sometimes the individual endeavours to escape from his supposed tormentors by frequently changing his place of abode. Dr. Robert Jones mentions the case of a man who went to a lonely spot on the Medway, thence returned to London, and in the middle of the night climbed along the parapet of his hotel into an adjoining house, where he was arrested and charged with burglary. Delusions of jealousy are among the most dangerous forms. A man may become possessed of the idea that his wife is unfaithful to him, and, in consequence, make a homicidal attack upon her or upon her supposed paramour. After an interval of persecution, the delusions may assume a character of self-exaltation, the individual becoming a hero, a martyr, or a king.

Suicide is not so common in delusional insanity as in melancholia, but occasionally a person resorts to self-destruction as a means of escape from the persecutions of which he believes himself to be the victim.

Impulsive Insanity.—In this condition power of controlling the will by the reasoning faculties is lost. The individual is the subject of an irresistible impulse, which, for a longer or shorter period, deprives him of reason and self-control, and compels him to commit acts of violence usually of a suicidal or homicidal nature. In criminal cases, the question of responsibility for the acts committed always gives rise to much discussion, owing to the fact that delusions or other obvious signs of mental disease are either absent or present only to a subordinate degree. Impulses to violence may also be obeyed by those who are suffering from delusions, epilepsy, mania, or other disorders, but in such cases the signs of mental aberration are clear and distinct.

Acts of terrible violence may be committed under the influence of impulsive insanity. From time to time a man, for no apparent reason, attacks and kills, or leaves for dead, his entire family, and then turns his weapon against himself.

Sometimes the impulse arises suddenly, and is as suddenly obeyed. In a case under the writer's notice, a woman, *after* washing her child

in a small bath, drying and partially dressing it, suddenly plunged it back into the water, and held its head under until it was drowned. She then went straight to the police station, and gave information of her deed. In other cases the impulse is felt, and successfully resisted for a time; the individual may even realise the danger he runs of committing suicide or murder, and voluntarily place himself under restraint. The condition may recur after a long period of apparent sanity. Cases have occurred in which an individual, after many years detention in an asylum, has been released under the impression that he is completely recovered, and has, within a few hours of regaining his liberty, committed suicide, or made a homicidal attack on another.

When impulsive insanity is put forward as a defence to a charge of murder, the presence of certain features will support the argument. Absence of motive is a strong point. Frequently, also, the victim is either one near and dear to the prisoner, or else a perfect stranger. The behaviour of the prisoner after he had committed the crime is significant. The subject of impulsive insanity will make no attempt to conceal his act or escape arrest. He may profess total ignorance of the crime, in which case a history of epilepsy may be obtained. It may be found that the prisoner has been previously convicted of violence, or has been under restraint in an asylum, and a family history of mental disease or epilepsy is common.

Epileptic Insanity.—Three types of mental disorder may be associated with epilepsy. These are—(1) idiocy and imbecility; (2) chronic epileptic insanity; and (3) acute epileptic insanity.

Idiocy and Imbecility may supervene in cases of epilepsy occurring in infancy or childhood. The mental development appears to be arrested, or even to undergo retrogression.

Chronic Epileptic Insanity.—Many epileptics display a gradually increasing intellectual degeneration. At first there may be only forgetfulness, periods of mental confusion, or outbursts of bad temper. Later the patient becomes dirty in his habits, uses foul language, attempts acts of violence towards others, or commits unnatural offences. Mental instability is a characteristic feature. At one moment the patient is cheerful and happy, at another gloomy and depressed, or filled with violent passion. Delusions and hallucinations may occur. Dementia or melancholia may develop, and there is then risk of the patient committing suicide.

Acute Epileptic Insanity.—This is an important condition from the medico-legal point of view. It is usually associated with ordinary epileptic fits, but may occur in those who have never experienced a convulsive seizure, and is then termed **masked epilepsy**. The acts, which may or may not be violent, are performed in a peculiar sub-conscious or automatic state, and the individual, on recovering, has often no knowledge of the events which have happened.

In some cases mental symptoms immediately precede the fit. The patient suffers from confusion of thought, loss of memory, hallucinations and delusions, and may give way to outbreaks of

uncontrollable fury. More frequently attacks of acute mania follow the fit. After a longer or shorter period of unconsciousness, recovery is accompanied by an outburst of frenzied excitement and violence, with hallucinations and delusions. The patient endeavours to destroy everything within his reach, and may make furious homicidal attacks upon those around him, or, less frequently, try to commit suicide. Dr. Savage states that such lunatics are, without exception, the most dangerous of all types. Violence, however, is not always displayed; sometimes the patient is quite calm, or merely irritable. In such a condition he behaves in an automatic manner, obeying impulses without conscious purpose. He will walk long distances, perform complicated acts, or commit homicide or suicide with apparently calm deliberation. After an interval of a few hours or days sanity is suddenly regained, and the person may then have no recollection of what has happened, or may dimly remember the events like a vague and distressing dream.

Masked Epilepsy.—The danger of this condition results from the fact that, owing to the absence of the fit, no warning of the attack is given. The discharge of nervous energy seems to expend itself entirely upon the emotional centres of the brain. Instead of the fit there may be an outburst of maniacal fury, during which the individual, in a state of automatism, may commit crimes of brutal violence or effect his own destruction. Sometimes the condition supervenes without initial violence. A person suddenly leaves his home and perhaps wanders about the country for several days. He purchases food when he requires it, and otherwise displays purpose and intelligence in his actions. After an interval he suddenly recovers consciousness, and then finds himself in an unknown place with no knowledge of how he got there. Occasionally kleptomania is displayed. In such a case all sorts of miscellaneous and useless things are taken, as well as articles of value.

A good instance of epileptic automatism is furnished by the case of the man Weiland, who threw an iron fish-plate at the German Emperor, in March, 1901. When arrested, Weiland, who had suffered from epilepsy for many years, alleged that he had been feeling all day long that a fit was coming on. He had at one time been a sailor, and while waiting for the procession to pass he imagined that he was on board ship in a rough sea, and his old captain cried out, "Heave the lead," whereupon he threw the missile he knew not where. It was subsequently proved that he had picked up the iron near where he was standing. On the same night he had frequent spasmodic attacks. Subsequently he made a ferocious attack on his legal adviser, and three warders had to use great force in order to restrain him; he then slept for several hours, and on awakening knew nothing of what had occurred. Weiland was found to be not responsible for his actions, and was sent to a lunatic asylum. He had previously attacked and injured his step-father, and had been under control as insane.

The sufferers from masked epilepsy have, in most cases, previously experienced ordinary epileptic fits. But sometimes the attack is the first symptom of the disease, and when this is so the condition is

very difficult to diagnose. Some of the cases of impulsive insanity are undoubtedly of an epileptic character.

Petit Mal.—This affection also has points of medico-legal interest. During the period of brief unconsciousness indecent acts or offences against the law are committed. A person may commence to undress, or may expose his person; a woman may lift her clothes and publicly micturate. Such acts are liable to be followed by a charge of indecent behaviour. Sometimes thefts are committed. In an instance given by Colman a man deliberately walked out of an ironmonger's shop with a coal-scuttle under each arm.

General Paralysis of the Insane.—This is one of the most important forms of insanity. It occurs more frequently in males than in females, and chiefly between the ages of thirty and fifty-five. The married are affected much more often than the single. The predisposing causes are hard mental work, business worries, anxiety, sexual excess, alcoholism, and injuries to the head. Syphilis, however, is by far the most important factor in the causation, a history of this affection being obtained in at least 75 per cent. of the cases.

The condition is generally described in three stages, between which, however, hard and fast lines cannot be drawn.

First Stage.—The early symptoms are often very difficult to recognise. Incidents, trivial in themselves, may arouse suspicion in the mind of the medical man familiar with the disease, but a long time possibly elapses before these suspicions are converted into certainty, or before signs of mental disorder are perceptible to the patient's friends.

Changes of character are usually the earliest manifestation of general paralysis of the insane. A man, hitherto careful over his business affairs, begins to display forgetfulness, inattention, and unpunctuality. He neglects his appointments and disregards his interests. Perhaps he indulges in wild and reckless speculation and rapidly squanders a large fortune, his behaviour possibly inducing his relatives to apply to the court for a committee to be appointed to look after his property. In other cases moral changes occur. The individual takes to drink, commits sexual crimes, or offences against decency, steals, forges cheques, or misappropriates funds. His demeanour towards his family or friends may alter for the worse. A kindly and amiable man becomes morose or irritable, and gives way to fits of violent temper. At other times he displays wild and hilarious gaiety. Sleeplessness may be marked, and the patient is often inordinately fatigued after moderate exertion. Physical symptoms which may be present early are slight tremulousness of the tongue or lips when speaking, hesitancy of speech, ptosis, strabismus, inequality or contraction of the pupils, or the Argyll Robertson phenomena.

After a variable period the signs of mental disorder become more striking. An unbounded egoism is now often displayed. The individual boasts of his family, possessions, or attainments. His business is flourishing in an extraordinary manner, he is on the high tide of prosperity, and, though manifestly ill, he says he

"never felt in better health in his life." Delusions, frequently of an exalted character, now appear. Though perhaps ruined by his extravagance, he believes himself to be the owner of enormous wealth and gives away millions on all sides, or he may imagine himself to be of royal blood, or possessed of great influence, power, or talent. Periods of melancholia may interrupt the delusions of self-exaltation, and sometimes there are attacks of maniacal excitement accompanied by homicidal tendencies. Masturbation or sexual excess is common, but as the disease progresses power of gratification is lost. Finer movements of the tongue and hand are affected; the speech becomes blurred, the writing shaky, and words or letters are omitted. Some ataxia may develop in the gait. The knee-jerks are generally exaggerated. Optic atrophy may occur.

Second Stage.—This either supervenes gradually or begins with a definite fit which is followed by marked increase in the physical and mental deterioration. Memory fails, and the delusions of wealth or grandeur may disappear. Dementia is frequent. The patient becomes childish, dirty in his habits, and incoherent in his speech. He may be apathetic, emotional, or melancholic. The special senses may be blunted and common sensibility lost. There is a tendency to subcutaneous bruising, and hæmatoma auris may be met with. The bones sometimes become remarkably brittle and are easily fractured, an occurrence which may lead to accusations of maltreatment by the attendants. Incontinence of urine is frequent. The fits are very variable in character; they may resemble the seizures of apoplexy or epilepsy, or may be paralytic, affecting one or both sides. A fit may terminate fatally, or be followed by aphasia, monoplegia, hemiplegia, or marked mental deterioration.

Final Stage.—The patient becomes hopelessly demented, and the muscular weakness and emaciation are now extreme. He sits helplessly in a chair, or is bed ridden. Power of control over the sphincter ani and bladder is lost. Bed-sores tend to form. Blindness and deafness may supervene; the fits become more frequent; and death occurs from exhaustion, or some intercurrent affection.

The course of general paralysis of the insane is not always progressively downwards. Remissions may occur, particularly during the early stages, and for a time the patient may be even apparently cured. Sooner or later, however, the symptoms reappear. Some cases run a rapid course of only a few months.

Toxic Insanity.—The long-continued absorption of certain substances, the chief of which are alcohol, lead, morphia, cocaine, and chloral, may lead to insanity. The symptoms produced by the last three are described in the chapters on toxicology.

Alcoholic Insanity.—Three forms of the condition are recognised—viz., acute alcoholic delirium, delirium tremens, and chronic alcoholic insanity.

Acute Alcoholic Delirium.—This condition may occur after a single bout of excessive drinking. Usually the individuals are

young persons of neurotic tendencies, or unstable and highly excitable minds, often with a family history of insanity or epilepsy. In such persons the consumption of even a moderate amount of alcohol may bring on an attack. The onset is sudden. The individual becomes wildly excited, violent, and unmanageable. He shouts and gesticulates, and may show homicidal or suicidal tendencies. Delusions of persecution may be present, but the hallucinations so characteristic of delirium tremens, are absent. There may be erotic manifestations. The face is flushed, the tongue furred and tremulous, and the temperature often slightly raised. In most cases the symptoms subside after a few hours or a day or two.

Delirium Tremens is usually observed after excessive drinking by a person who is habitually intemperate. Restlessness, depression, and insomnia are the first symptoms, but soon the characteristic delirium commences. The patient mutters incessantly and incoherently, or is noisy and unrestrainable. He mistakes the identity of those around him, and has hallucinations, popularly termed "horrors," in which he sees demons, rats, or insects running up the walls or over his bed. He may display homicidal or suicidal tendencies, and, if unwatched, may suddenly rush from his bed and throw himself out of a window. The temperature often rises to 102° or 103° F., and may be higher in a case which terminates fatally. Recovery usually occurs in a few days time, but hallucinations may persist for months after an attack.

Save under exceptional circumstances, it is best not to send sufferers from delirium tremens or acute alcoholic insanity to an asylum. After recovery such persons are often extremely vindictive, and may make accusations, or start law-suits against the medical attendant. The latter, though protected if he has acted in accordance with law, may nevertheless be subjected to great annoyance.

Chronic Alcoholic Insanity is the result of long-continued intemperance. It may be associated with peripheral neuritis, cirrhosis of the liver, or other affections characteristic of alcoholism. During the early stages the individual evinces mental dulness, stupidity, and forgetfulness. He is inattentive to his business, untidy in his dress, and untrustworthy in his conduct. His hand is shaky and his speech tremulous. Later, hallucinations and delusions develop. Frequently these take the form of suspicion of those about him. The patient believes that he is the victim of plots, or that attempts are being made to poison, starve, or ruin him, or that his wife is unfaithful to him, and he may then show homicidal tendencies towards his supposed persecutors. Voices which accuse, threaten, or abuse him are frequently heard. Sexual delusions are common, the patient believing that his virility is being destroyed. Erotic manifestations and kleptomania may occur. Suicide may be attempted. From time to time outbursts of violence or attacks of delirium tremens may occur. In the final stages dementia supervenes.

Dipsomania.—While alcoholism may cause insanity, in many of

the cases in which the two conditions are associated the rôle is reversed, the mental disease being itself the cause of the intemperance. The most striking effect is the perversion of the moral sense. The individual will lie, steal, or resort to the meanest subterfuge in order to gratify his craving for alcohol.

Puerperal Insanity.—Pregnancy and parturition are among the most frequent causes of insanity in women. Four classes of cases are recognised according to the epochs at which the symptoms appear—viz., the insanity of pregnancy, of labour, of the puerperium, and of lactation. Of these, insanity of the puerperium is the commonest. In all varieties primiparæ are the most likely to suffer, and the greater the age of the woman, the greater is the tendency for insanity to develop. Hereditary influences, the shame of admitting seduction, nervous shock, anxiety, exhaustion from repeated child-bearing, or prolonged lactation are important predisposing causes.

Insanity of Pregnancy.—The symptoms do not, as a rule, appear until after the third month. Melancholia is the most frequent type, and may be associated, especially in primiparæ, with a profound belief that delivery will be fatal. There may be apathy and indifference, or violent aversion towards the husband. Delusions of poisoning may lead to refusal of food. Suicidal tendency is strong. Sometimes the moral senses become perverted; dipsomania, kleptomania, or erotic passions may be displayed. Attacks of violent excitement or acute mania may occur.

Insanity of Labour.—Violent delirium of a transient nature is sometimes caused by the pain of delivery. Recovery, as a rule, takes place as soon as the child is born. The medico-legal importance of the condition, which can scarcely be regarded as a definite form of insanity, arises from the fact that in her frenzy the mother may injure the child, or perhaps crush the head between the thighs as soon as it has passed the vulva.

Insanity of the Puerperium.—This may be regarded as embracing cases in which insanity develops within the first two months after delivery. The mental disorder may take the form of mania, melancholia, or dementia, the first being the most frequent. The sooner the symptoms show themselves after delivery, the more likely are they to be those of mania, particularly during the first fortnight.

Within a few days after delivery, transient mania may come on with great suddenness. There is incoherent delirium, violence, and delusions, under the influence of which the patient may injure herself or destroy her child. The condition may pass off as quickly as it occurred, leaving no recollection of the attack. Generally there are premonitory symptoms. Insomnia is characteristic. The patient becomes depressed or irritable, and evinces an unreasonable dislike to her husband or the nurse. She displays apathy towards the child. Maniacal excitement rapidly develops. She shouts, screams, or chatters, often using blasphemous or obscene language. She throws the bed-clothes off, tries to get up, and endeavours to strike those around her. Suicidal tendency may be marked, or attempts may be

made to destroy the child. Delusions are frequent, and may be of a sexual character, leading the patient to accuse herself or her husband of unchastity. Food may be refused. Erotic tendencies and masturbation are common, and the patient is often dirty in her habits. Sometimes the milk is suppressed, and the lochia suddenly arrested. After a variable period, melancholia or dementia may supervene, but in most cases complete recovery eventually occurs.

When the symptoms do not appear until a fortnight after delivery, melancholia may be the prevailing type from the commencement. The symptoms are mental depression, sleeplessness, delusions, refusal of food, suicidal tendencies, and impulses to commit infanticide.

Insanity of Lactation.—This appears in from two to eighteen months or more after delivery. Melancholia is the most frequent form, but attacks of excitement or mania may occur at the commencement or from time to time subsequently.

Idiocy and Imbecility.—Idiocy is a condition of mental deficiency due to imperfect development of the brain during either infancy or early life. The term imbecility is sometimes used for degrees of idiocy above the lowest. A number of types of idiocy are recognised, into the classification and special characteristics of which we need not enter here. Idiots of the lowest class lead a more or less automatic or vegetable-like existence. They require to be fed, dressed, and kept clean. They may be silent and apathetic, or utter meaningless cries. Others of slightly higher capacity can walk, have some power of speech, and amuse themselves with trivial occupations like young children. These types early find their way to asylums, and rarely give rise to medico-legal questions.

Still higher in the scale are cases which display some degree of intelligence or cunning, leading up gradually to conditions of simple weak-mindedness. A certain number of habitual criminals belong to this class. Questions of responsibility for crime, or capacity of managing property, may arise in connection with such individuals.

Dementia.—This is a condition of weak-mindedness or mental deficiency. It differs from idiocy in coming on later in life, and is due to a functional arrest of the faculties or physical breakdown of the brain.

Senile Dementia is caused by the physiological decay which accompanies old age. The senses gradually become weakened, the intellect dulled, and the memory impaired. The individual exhibits loss of self-control, irritability, and childishness. He becomes dirty in his habits, and requires constant attention. There may be periods of excitement or melancholia during which there is risk of suicide. Sometimes erotic tendencies are present, and may lead the individual to attempt indecent assaults upon young girls. Eventually muscular weakness becomes extreme, the patient is bed-ridden, and dies from pneumonia or some other intercurrent affection.

Besides dementia, senile insanity may take the form of melancholia, mania, or paranoia.

Acute Primary Dementia is met with occasionally in young persons, usually under the age of twenty. Girls are more frequently attacked than boys. The condition may follow riotous living, sexual excess, masturbation, over-work, rapid growth combined with bad feeding, or fright or shock. Some cases show merely loss of self-confidence or excessive timidity. In severer instances there is vacuity or childishness.

Secondary Dementia may be the termination of mania, melancholia, general paralysis, and other forms of insanity, or may be the outcome of epilepsy or chronic alcoholism.

Dementia Due to Coarse Brain-lesion may follow cerebral tumour, apoplexy, embolism of the cerebral vessels, depressed fracture, &c.

CHAPTER XV.

THE LEGAL RELATIONSHIPS OF INSANITY AND OTHER ABNORMAL STATES OF MIND.

CONTENTS.—Method of placing an idiot under restraint—Methods of placing lunatics under restraint: the reception order on petition; urgency order; summary reception order, &c.—Medical certificates of lunacy—Liability in signing certificate—Care of lunatics—Lunacy and civil capacity: management of property; testamentary capacity; liability on contracts; nullity of marriage; partnership; evidence—Insanity and criminal responsibility—Inebriety and criminal responsibility—Hypnotism—Somnambulism—Feigned insanity.

The Legal Relationships of the Insane are of great importance in matters both civil and criminal. Idiocy or lunacy may be the ground for depriving a person of his legal right to liberty and his right to manage his property, for disputing the validity of a will, for repudiating a contract, or for obtaining a decree of nullity of marriage. In the criminal courts, the question at issue is either the capacity of the prisoner to plead to a charge, or his responsibility for the acts he has committed.

Method of Placing an Idiot under Restraint.—Under the Idiots and Imbeciles Act of 1886, an idiot can be placed in an institution registered for the purpose on receipt of (1) a medical certificate to the effect that the person is an idiot or imbecile, and is capable of receiving benefit from the care of the institution; and (2) a statement from the parent or guardian respecting his condition. A judicial order is not required.

Methods of Placing Lunatics under Restraint.—Seven different processes are employed in England and Wales according to the circumstances. It is important for the practitioner to be familiar with the requirements of the reception order on petition, and the urgency order. The order after inquisition is purely legal, except in so far as medical evidence is required. The other methods are concerned with pauper lunatics, lunatics wandering at large, and lunatics not under proper control.

Reception Order on Petition.—This is the method of procedure usually adopted in the case of private patients when no great urgency is called for. Five documents are necessary—the petition, the statement of particulars, two medical certificates, and the reception order. Statutory forms, which can be obtained at any law stationers, must be employed.

The Petition must be signed, if possible, by the husband, wife, or nearest relative. When this is not done the reason why another has signed it must be given, and the relation of this person to the

alleged lunatic stated. The petitioner must be of full legal age, must have seen the said lunatic within fourteen days of the date of the petition, must state the circumstances under which the petition is presented, and must undertake to visit the patient either personally or by deputy at least once in every six months.

The Statement of Particulars accompanies, and is attached to the petition. In sets out in full, the name, age, sex, occupation, &c., of the person it is desired to put under restraint, together with full details of the present attack, and any past attacks he may have suffered, and whether any near relative has been afflicted with insanity.

The Medical Certificates.—Two are required. Whenever possible, one should be obtained from the usual medical attendant of the alleged lunatic. If this is not practicable, a certificate to that effect, signed by the petitioner, must accompany the petition. A medical practitioner is disqualified from certifying if he or she is either the petitioner (or, in the case of an urgency order, the person signing it); the superintendent, proprietor, or medical attendant of the asylum, hospital, or house; any person interested in the payments on account of the lunatic; or the husband or wife, father or father-in-law, mother or mother-in-law, son or son-in-law, daughter or daughter-in-law, brother or brother-in-law, sister or sister-in-law, partner or assistant of any of the foregoing persons. Furthermore, neither of the certifying medical practitioners may be the father, father-in-law, son, son-in-law, brother, brother-in-law, or corresponding female relative, or partner, or assistant of the other of them.

Each of the medical practitioners who signs a certificate must personally examine the alleged lunatic separately from the other, and not more than seven days before the presentation of the petition.

The Reception Order.—The petition and accompanying documents, when ready, are presented to a Judicial Authority who is either a judge of county courts, a stipendary magistrate, a justice of the peace, or a chairman of a board of guardians specially appointed for the purpose under the Lunacy Act. The Judicial Authority, if he is satisfied with the medical certificates, may, forthwith, sign the reception order, or he may appoint a day, not more than seven days after the presentation of the petition, for its consideration, and he may himself visit the lunatic. The petition is considered in private, and no one except the petitioner, the alleged lunatic, some one person appointed by the alleged lunatic for the purpose, and the persons signing the medical certificates, all of whom are bound to secrecy, can, without leave or order of the Judicial Authority, be present. The consideration may be further adjourned for not more than fourteen days, after which the Judicial Authority must either grant the order, or dismiss the petition, giving his reasons for so doing.

A reception order remains in force for seven days, within which time the lunatic must be removed to the house or asylum. It may be suspended by a medical certificate to the effect that the patient

is unfit for removal, but must be executed within three days after the medical man certifies that the lunatic is capable of being removed.

The Urgency Order.—This is employed when it is necessary, either for his own welfare or for the safety of those about him, to place the lunatic under restraint without further delay. The person who signs the order should, when possible, be the husband, wife, or a relative of the patient. If another sign, the reason for so doing must be given, and the relationship of that other to the lunatic stated. The person signing must be of full legal age, must have seen the lunatic within two days of the date of the order, and must not be related within the degrees before mentioned, to the person signing the medical certificate. The intervention of a Judicial Authority is not required. The order must be accompanied by a statement of particulars, and one medical certificate. The medical man must have seen the lunatic within two days of his reception, and must state that it is expedient for his welfare that he should be forthwith placed under care and treatment. The same rules as to disqualification exist as in the case of a petition.

An urgency order is only authority for detaining a person for seven days, or, if a petition has been presented, until it has been disposed of. An urgency order may be made, if called for, pending the settlement of a petition. If made before presentation the fact must be stated in the petition.

Summary Reception Order.—Every constable, relieving officer, or overseer of a parish who has knowledge that any person within his district or parish, who is not a pauper, and not wandering at large, is deemed to be a lunatic, and is not under proper care and control, or is cruelly treated or neglected by those in charge of him, shall within three days give information on oath to a Judicial Authority. The Judicial Authority then directs two medical men to examine the alleged lunatic, and proceeds as if a petition had been presented.

Order for a Lunatic Wandering at Large.—Any person (whether a pauper or not) who is deemed to be a lunatic and who is wandering at large, may be apprehended by any constable, overseer, or relieving officer of the parish, and taken before a justice, and the justice shall then call in a medical practitioner, and shall examine the alleged lunatic, and, if he thinks the lunacy proved, and the medical practitioner signs a certificate with regard to the lunatic, shall direct the lunatic to be detained in an institution for lunatics.

Order for a Pauper Lunatic.—The relieving officer or overseer of the parish gives notice to a justice, who then obtains one medical certificate and signs the order if satisfied of the lunacy.

Order by Two Commissioners in Lunacy.—Two commissioners may visit a pauper lunatic or alleged lunatic, and sign an order for his detention after obtaining one medical certificate.

Order After Inquisition.—A lunatic so found by inquisition (*v.* p. 147) may be detained in an institution for lunatics or as a single patient upon an order signed by the committee of the person, or if

no such committee has been appointed, upon an order signed by a Master in Lunacy.

It will be noticed that two medical certificates are required for an order on petition; and one for the remaining methods of procedure, except the order after inquisition, for which no such certificate is necessary.

In Scotland and Ireland the procedure required to place a lunatic under restraint differs in several respects from that described above.

Medical Certificates of Lunacy.—The practitioner who signs a certificate of lunacy must be registered, and must be in actual medical practice at the time. He cannot, after signing, act as the medical attendant of the lunatic. If a medical man wishes to continue attending a patient after admission to a single patient house or private asylum, he must not sign the certificate, nor must he derive any profit from the house, or be in any way associated with, or related to, the person who keeps the house.

The medical certificate must be filled up with the most scrupulous care, as even a small inaccuracy may be sufficient to invalidate it. Section 3 of the prescribed form contains two blank spaces, the first headed by the words, "*Facts indicating Insanity observed by myself at the time of the examination*"; and the second by the words, "*Facts communicated to me by others.*" It is of the utmost importance that the statements made under the first heading should be sufficient by themselves to convince an independent reader of the existence of insanity. If this is not the case the petition will fail, however strong the evidence afforded by the facts communicated by others. The latter only serve to strengthen the inference of insanity. The statements should be clearly and concisely made, and the certifier must remember that behaviour obviously indicative of insanity to one familiar with the circumstances and environment of the patient may not necessarily read as such. For instance, to state that a person uses blasphemous language is no evidence of insanity unless it be made clear that it is a new departure, and was not a previous habit of the individual. Again, if a patient suffers from delusions the falsity of which is not self-evident, the practitioner must satisfy himself of the incorrectness of the belief, and add a statement to that effect. Thus, the delusion that he possesses great wealth is not obvious unless the statement is made that the patient is really a poor man, or, at least, does not possess anything approaching the wealth he claims.

Liability of the Practitioner who Signs a Certificate of Lunacy.—Under the Lunacy Act of 1890, "any person who makes a wilful misstatement of any material fact in any medical or other certificate, or in any statement or report of bodily or mental condition under this Act, shall be guilty of a misdemeanour."

Apart, however, from criminal proceedings, the medical man is liable to an action for damages if he has displayed want of good faith or reasonable care. It behoves him, therefore, in every case to exercise the utmost caution before signing the certificate. It must be remembered that the mere existence of insanity is not in itself

sufficient ground for putting an individual under restraint. A man may be incapable of managing his affairs, but quite able to take care of himself, and enjoy his personal liberty. The medical man should be satisfied that the lunatic is either dangerous to himself or others, or is incapable of taking care of himself, and is therefore a fit and proper person to be detained in an institution, and is likely to obtain benefit from the care thereof. As a general rule, cases likely to recover should not be placed in asylums until every effort has been made to obtain adequate home treatment.

Lunatics, after recovery, often display great vindictiveness, and have on many occasions put medical men to trouble and expense by taking legal proceedings against them. Until the passing of the Lunacy Act in 1890, practitioners frequently declined to sign certificates of lunacy owing to the risk they ran of having actions subsequently entered against them. By that Act it is provided that when such proceedings are taken they "may, upon summary application to the High Court of Justice, or a judge thereof, be stayed upon such terms as to costs and otherwise as the court or judge may think fit, if the court or judge is satisfied that there is no reasonable ground for alleging want of good faith or reasonable care." While thus protected against purely vexatious litigation, the medical man is still liable to be put to trouble and expense in obtaining a stay of the proceedings.

The Care of Lunatics.—The **Lord Chancellor** has supreme authority in all matters connected with the insane. Under him come the **Masters in Lunacy**, who hold inquisitions in lunacy, and appoint guardians for the person and property of a lunatic when necessary. **The Commissioners in Lunacy** have extensive powers connected with the management and control of asylums, and they are the guardians and visitors of all certified lunatics whether in asylums or private houses.

Into the regulations concerned with asylums we need not here enter, but it is necessary to refer to the care and treatment of the "single patient." The rights of such lunatics are very carefully guarded, and anyone proposing to take charge of a single patient should previously read through the sections of the Lunacy Act dealing with the subject. The following are the more important regulations:—

A person may receive one lunatic into his house without having a license, provided a reception order, as previously described, has been obtained, and, under special circumstances, the Commissioners in Lunacy may permit more than one person to be detained in the same house. At the end of a month after reception, a report must be sent to the Commissioners of the mental and bodily conditions of the patient. Mechanical restraint must not be applied to the lunatic except for medical or surgical treatment, or to prevent him from injuring himself or others. The lunatic, unless the Commissioners direct otherwise, must be visited at least once a fortnight by an independent medical man—*i.e.*, one who has no connection with the keeper of the house, and has not signed either of the certificates

accompanying the petition. The Commissioners may at any time visit the lunatic, may change his medical attendant, and may, within seven days after their visit, order his discharge if he appears to be detained without sufficient cause. Periodical reports of the patient's condition must be sent to the Commissioners. Notice of the death of the lunatic must be given to the coroner and to the Commissioners.

If a lunatic escapes he may be retaken within fourteen days without a fresh order.

Lunacy and Civil Capacity—Management of Property.—When a person who is possessed of a considerable amount of property is believed to be incapable of taking care of it in consequence of unsoundness of mind, the next-of-kin or anyone interested may apply to a Master in Lunacy to order an inquisition. The application must be supported by affidavits from two medical men regarding the person's mental condition. The alleged lunatic must have notice of the application, and is entitled to demand an enquiry before a jury, unless the master or judge is satisfied that he is incapable of forming and expressing a wish for an inquisition before a jury. The enquiry is conducted in the form of a trial, and medical evidence may be called on each side. If the person is found by the court to be insane, and a fit and proper person to be under restraint, he is placed under the control of a *committee of the person*, and a *committee of the estate* is appointed to look after his property. A lunatic so found by inquisition is termed a *Chancery lunatic*, and is visited at intervals by officials known as *Chancery visitors*. The result of an inquisition is not necessarily, however, to deprive a person of his freedom; he may still be regarded as capable of taking care of himself, even though his affairs have been placed in the hands of others.

An inquisition is a costly process, and should only be resorted to when the individual possesses considerable wealth. A more rapid and less expensive mode of procedure may be adopted in dealing with estates of under £2,000 or £100 yearly income. A committee of the estate may also be appointed to look after the property of a lunatic who is detained in an asylum on an order after petition.

Testamentary Capacity.—In order to upset a will on the ground of insanity, it is not sufficient to prove that the testator was in fact a lunatic at the time he made his will, for valid wills have often been made by persons confined in asylums. It must be clearly shown that he had not at the time a "disposing mind"; or, in other words, that the mental unsoundness did actually influence the testator in the drawing up of his will. Each case must be settled upon its own merits. The evidence or otherwise of a disposing mind is more often to be drawn from the will itself than from the previous mental history of the testator. Hence the question usually turns upon the nature of the will. If it is reasonable and fair it will in all probability stand; if it is grossly unjust it is likely to be set aside.

Even when a testator was not insane his will may be upset if the absence of a disposing mind can be proved. He may, for instance,

have been subjected to undue influence by others, or may have been only partially conscious or mentally enfeebled from illness at the time of making the will. It has been held that a will is valid if the testator has shown—

1. That he knows he is giving his property to the person or persons named.

2. That he knows and comprehends the extent of his possessions.

3. That he comprehends the nature and effect of his act in its bearings on the claims of others, which have had his consideration.

Aphasia in relation to testamentary capacity may be considered here. If a person is unable to express his ideas by any channel of communication, he is, of course, unable to make a will. When the aphasia is purely motor, the difficulty may be overcome by the method adopted by Dr. Edmunds in a somewhat remarkable case. The testator, a lady, was unable to speak or write, but was perfectly sane, and could read. The names of all likely beneficiaries were written upon one series of cards, and the various items of her property upon another. She then selected cards from each series, and grouped them together until all her possessions were bequeathed. The will was proved in open court (*Brit. Med. Journ.*, 1900, vol. i., p. 749).

Liability on Contracts.—A person of unsound mind is always liable for *necessaries—i.e.*, things necessary and suitable to his rank and condition in life—provided no advantage has been taken of his mental incapacity. Moreover, a lunatic is liable on contracts entered into during a lucid interval. With regard to other contracts, they will be held to be binding upon the lunatic if the other contracting party did not know he was insane, and the terms of the contract show that no attempt was made to take advantage of the contract. Lopes, L.J., said, in the case of the *Imperial Loan Company* v. *Stone*, "Contracts made with a person of unsound mind are not voidable at his option if the other party to the contract believed him to be of sound mind at the time the contract was made. In order to void a *fair* contract on the ground of insanity, the mental incapacity of the party seeking to void it must be known to the other contracting party. The defendant must plead and prove both insanity and the plaintiff's knowledge of it, and unless he proves both he is not entitled to void his contract." But if the contract were unfair the defence of insanity would probably prevail.

If a person is too intoxicated to know what he is doing, any contract made by him while he is in that state is voidable—not void; except when things actually necessary for his preservation have been supplied, in which case the contract is binding.

Nullity of Marriage.—Marriage is a special form of contract, and if at the time of its solemnization one of the parties is insane, and incapable of contracting, the marriage may be declared null and void. The insanity must be clearly proved to have existed at the time of the marriage and not merely at the time of betrothal; if it developed subsequently it will not serve as ground for a decree. The burden of showing the insanity rests upon the party asserting it.

Dissolution of Partnership.—On application by a partner, the court may decree a dissolution of partnership when a partner is found by inquisition to be insane, or is shown, to the satisfaction of the court, to be of permanently unsound mind. The application may also be made on behalf of that partner by his committee or next friend.

Evidence of the Insane.—This may be admitted when the judge is satisfied that the lunatic can give a rational account of the events he is called upon to speak to, and understands the nature of an oath. The credibility to be attached to such evidence must depend upon the circumstances. If, however, a person has an attack of insanity after the occurrence of the events, and before the time for giving evidence, he cannot be heard.

Insanity and Criminal Responsibility.—It is a recognised principle of English law that punishment shall not be inflicted upon those who, in consequence of mental unsoundness, are not responsible for their acts. Considerable divergence of opinion, however, exists between the medical and the legal professions as to what is to be regarded as the standard or test of insanity for this purpose. The lawyer naturally regards inability to distinguish right from wrong as the essential criterion of insanity; the medical man would prefer to substitute power of acting rightly or wrongly—volition rather than cognition. The present legal test is derived from the answers of fourteen judges to certain hypothetical questions submitted to them by the House of Lords after the M'Naghten case in 1843. It is unnecessary to go into the entire series of questions and answers, but the operative words which are now quoted whenever the plea of insanity is raised run as follows:—"To establish a defence on the ground of insanity, it must be clearly proved that at the time of committing the act the party accused was labouring under such a defect of reason from disease of the mind as not to know the nature and quality of the act he was doing, or, if he did know it, that he did not know he was doing what was wrong."

The plea of insanity is most frequently put forward in charges of murder, and in many of such cases the test when applied works satisfactorily. A man, for instance, who is suffering from delusions kills another in imaginary self-defence, or because he imagines he has a divine mission to rid humanity of one of its enemies. Under these circumstances the delusions afford obvious evidence of insanity, and the man clearly cannot distinguish between right and wrong. If the case comes to trial, the jury either find the prisoner incapable of pleading, or "guilty, but insane." The prisoner is then ordered "to be detained during his Majesty's pleasure," which means that he is sent to Broadmoor Criminal Lunatic Asylum, and may subsequently be liberated if it is thought safe to do so. But difficulty arises in cases in which, owing to the absence of delusions, the insanity is not obvious to the lay mind, and in those in which the individual, though insane, has shown by his conduct or speech that he was aware he was doing wrong. The best instance of the latter is furnished by the case of a man named Ware who was indicted for

murder at the Shropshire Assizes in 1885. The prisoner, who was in a lunatic asylum, murdered a fellow inmate with an iron bar. He knew that he had killed someone, and refused to give up the bar unless he was promised freedom from punishment. Ware was admittedly insane and irresponsible, and was accordingly sent to Broadmoor without trial, but Mr. Justice Hawkins remarked concerning the case—"It would be impossible to say that Ware did not know that he had killed a man, because he said himself that he had, and it would be impossible for anybody to urge that he did not know it was wrong, for he wanted a promise that he should not be punished, although no man in his senses would suppose that any jury would find Ware responsible for what he had done." Nevertheless had the legal test been strictly applied in this case, the prisoner could not have been found insane, even though confined in a lunatic asylum at the time he committed the deed.

The forms of mental unsoundness which may give rise to difficulty in the criminal courts, owing to the fact that they may not be readily recognisable except to those who have had special training, are impulsive insanity—*i.e.*, complete loss of self-control without the presence of delusions; masked epilepsy or the condition in which a homicidal outbreak takes the place of the fit; moral insanity; early cases of general paralysis; and borderland cases or conditions of weak-mindedness, in which the individual is perhaps partially responsible.

As a matter of fact the theory and practice of the law with regard to insanity often differ very considerably. In spite of the unsatisfactory nature of the test, injustice is rarely done, though often justice is only attained by a circuitous method after lengthy and unnecessary procedure has been gone through. If an individual who has been committed for trial on a charge of murder is clearly insane and irresponsible, the Home Secretary will order his removal to Broadmoor without further proceedings. When a less pronounced case comes up for trial, the question of the prisoner's sanity may be raised before he pleads. Evidence of his mental condition is put before the jury, and if they find that he is insane, and not fit to plead, the prisoner is sent to Broadmoor without trial.

We must now consider what happens when, during the trial, a defence of insanity is raised, but the type of insanity will not come within the four corners of the definition previously given. The course adopted varies with the particular judge. Some judges frankly disregard the M'Naghten ruling, and sum up in such a way as to show their belief in the prisoner's irresponsibility. The jury accordingly, in all probability, return a verdict of "guilty, but insane." Others go fully into the legal test in their addresses, with the result that in many cases the jury, not being medical or legal experts, are completely puzzled by the clash of law and fact. They see that the prisoner is insane; they cannot understand the law not admitting it. In some cases of this description the jury reject the legal test for themselves. If under the whole circumstances

they consider the prisoner should not be held responsible, they let common sense prevail over legal definitions, and find a verdict of "guilty, but insane." In other cases they find a verdict of "guilty," but endeavour to modify it by a recommendation to mercy, and would, if permitted, add a rider. The judge, however, must accept the verdict as one of guilty only, and is obliged to pass the death sentence with its attendant painful ceremonies. But the matter does not end here. In every case in which a verdict of guilty has been found, but the defence of insanity has been raised, the Home Office orders an independent inquiry by two medical experts into the prisoner's mental condition, and this may be the first time that he has come under medical observation since the commission of the act. If these examiners, guided entirely by their own judgment unfettered by legal definitions, consider the prisoner irresponsible, he is sent to Broadmoor as a criminal lunatic. Thus justice is eventually attained.

It is very generally felt that the present procedure is unsatisfactory. When insanity is urged, it would probably be better if in every case the question of responsibility could be disposed of before trial. As regards the test to be applied, if one is really necessary, presence or absence of power of self-control would be more in accordance with medical views than the existing requirements of the law. The Penal Code of France declares that "there is no crime when the accused was insane," and no further definition is attempted, every case being accordingly tried upon its own merits. The suggestion that this course should be adopted in England has met with considerable support in the medical profession.

Abnormal States of Mind other than Insanity.—Under this heading it is necessary to consider the medico-legal bearings of inebriety, somnambulism, and hypnotism.

Inebriety and Criminal Responsibility.—Abuse of alcohol, as we have already seen, may lead to temporary or permanent insanity (*v.* p. 137). Responsibility for crimes committed during these states is decided by the criterion which is applied to any other form of insanity.

Simple drunkenness is no excuse in law for crime, but it may be taken into consideration in forming an opinion of the *motive* or *intention* of the party who acted under its influence. In a case in which a woman was indicted for attempting to commit suicide, it was shown that she was too drunk to know what she was doing, and it was held accordingly that there could be no criminal intention. Similarly, evidence that a drunken person was quite incapable of appreciating the amount of violence he was using, may lead to a charge of murder being reduced to one of manslaughter.

Hypnotism.—This is the process by which certain persons can be thrown into a semi-cataleptic or trance-like state, by making them look fixedly at a bright object held above and near the eyes, or by other methods. When in this condition they may, under the influence of suggestion, perform acts of which they may have no recollection when consciousness returns, and they may be made the

subjects of various deceptions of the mind and senses. The medico-legal question which arises is the possibility of the commission of crime or the signing of documents disposing of property under hypnotic suggestion. Some of those who have specially studied the subject have asserted, though on somewhat weak grounds, that it is not possible by hypnotic suggestion to compel a person to act contrary to his moral dictates. The better opinion appears to be that a degree of control over the hypnotised person can be obtained, not only sufficient to induce him to part with his property, but to make him commit crimes. There is not much direct evidence on the point. Hypnotic influence was unsuccessfully pleaded by Bompard when tried for the murder of M. Gouffé (*v.* p. 50).

In *Kingsbury and Crofton* v. *Howard* (Probate Div., 1898), one of the plaintiffs, a doctor, was said to have exerted undue influence over a lady who had left him £30,000, by hypnotising her. It was shown that he had previously hypnotised, or endeavoured to hypnotise, her for therapeutic purposes. After a long trial before a special jury a verdict was found for the plaintiffs.

Several Continental cases of the perpetration of rape upon women under hypnotic influence are recorded.

Somnambulism.—It is well known that in certain unnatural states of sleep, although the higher cerebral functions are in abeyance, the brain may be in a state of sufficient activity to enable the sleeper to arise from his bed, and perform complicated actions of which he has no recollection when he awakes. The commission of a crime in a state of somnambulism is therefore quite possible. Sleep-walking is often associated with epilepsy. In some persons epileptic fits only occur during sleep, and the condition may have existed for a long time before it is discovered.

In a case tried at Leeds, a young man was charged with an offence under the Criminal Law Amendment Act. He had been found by a girl who was sleeping in the same house, on her bed, clothed in his shirt and trousers. The defence was that he had gone there during sleep. Evidence was given to prove that he had previously walked in his sleep, and on several occasions had been found trying to climb out of a window. It was also shown that his mother and brother were somnambulists. The prisoner, who had hitherto borne a good character, was acquitted. (*Brit. Med. Journ.*, April 20, 1901.)

An allied condition sometimes occurs at the moment of wakening from a nightmare. Before the person is in full possession of his faculties he may attack another sleeping beside him, under the impression that he or she is the spectre of his dream.

Feigned Insanity.—The usual motive for feigning insanity is the desire to appear irresponsible for a crime. Acute mania is the type of mental disorder the criminal assumes most frequently, for the reasons that it is very obvious to others and is probably the form he knows most about. If, however, he has been associated with genuine cases of insanity of other types, he may adopt one of these

as his *rôle*, and may represent himself as suffering from melancholia, dementia, or delusional insanity. As a rule, the part is over-acted, and inconsistencies lead to ready detection, but a clever impostor may require watching for a considerable time. A significant feature is the obvious wish of the malingerer to convince onlookers that he is insane; the real lunatic often conceals his delusions, and forcibly asseverates his sanity.

When **mania** is assumed, violent excitement, shouting, and incoherence are displayed, but the power of endurance which the real lunatic possesses is absent. The impostor soon becomes exhausted. He makes a great show when anyone comes into the cell, but is quieter when alone, even though he suspects that he is being secretly watched. Sleep is probably sound. The real lunatic, on the other hand, may go for days and nights without sleep, and show, during the period, little or no diminution in his violence.

Melancholia, with or without delusions, is sometimes feigned. The cleanness of the tongue and the absence of insomnia, constipation, and circulatory feebleness may assist the diagnosis. Pretending to fall in with the delusions may lead to their detection. Dr. Patmore relates the case of a well-educated man who was sentenced to a long term of imprisonment. Immediately after conviction he became melancholic, muttered incessantly, and took to drinking his urine and eating his fæces. Fraud was suspected, and the surgeon, in the prisoner's hearing, ordered that, "as he was *so very insane*, he should be so far humoured as to be allowed as much of that diet as he could himself produce, and any more from others he might ask for." The prisoner did not again exhibit his unnatural habits, and soon asked for ordinary diet and offered to work properly.

Associated with assumed melancholia there may be refusal of food, and feigned attempts to commit suicide. Trivial wounds, exhibiting the characters described on p. 75, are inflicted. Hanging is attempted just as someone enters the cell, or strangulation is feigned with a noose not sufficiently tight to prevent breathing. Sometimes such attempts are *accidentally* successful. Prisoners have been found dead in their cells under circumstances which strongly point to their not having intended to destroy themselves.

Idiocy, **imbecility**, and **dementia** are not often assumed. The history and absence of malformation of the head or face assist detection.

CHAPTER XVI.

MEDICAL EXAMINATIONS FOR MISCELLANEOUS PURPOSES.

CONTENTS.—Life assurance—Examination of a person seeking to be excused from work, or attendance as a witness, or to get on to a benefit club, &c.—Feigned diseases—The traumatic neuroses, neurasthenia, and hysteria.

Life Assurance.—The practice of most life assurance companies is to appoint one or more medical men to act as chief advisers or referees at the central office, and local examiners in various districts and towns throughout the country. When a proposal of insurance is made, the applicant is examined by the local examiner, or, if there is not one, by any medical man in the neighbourhood whom the company may appoint. His report is then sent to the chief medical officer, who scrutinises it, and advises the company how to act. If the report is satisfactory in every respect, and the life is a first-class one, the insurance is probably effected without further enquiry. If the proposer has a bad family history, intemperate habits, a dangerous occupation, or indications of disease, the chief medical adviser either counsels the rejection of the proposal, or estimates the addition to be made to the annual premium. Candidates living within reach of the central office may be examined directly by the chief adviser.

The duties of the chief officer call for the exercise of great discrimination and judgment, and men of high eminence in the profession are usually appointed to fill such posts. For their guidance special volumes have been written, and life-tables prepared embodying the results of many years' experience. It is not proposed to discuss these matters here, but a few hints to the ordinary practitioner who is from time to time called upon to make an examination for an insurance company may be of value.

In the first place, the medical man should remember throughout the examination that the relations which ordinarily subsist between doctor and patient are materially altered. A person who is ill endeavours to assist his doctor as much as possible by describing fully all his symptoms, and making no concealment of past illnesses or hereditary tendencies to disease. When being examined for life insurance the proposer is anxious to create the impression that he is in a state of the most perfect health, and likely to remain so. Hence previous ill-health, family taints, risk of occupation, consumption of alcohol, &c., may all be—often quite unconsciously and innocently—minimised. Apart, however, from unintentional misrepresentation, the examiner must be alive to the possibility of deliberate fraud. Most of the companies provide printed forms containing a series of

questions, the answers to which are to be filled up by the medical examiner. These differ in various respects, but in all cases an exhaustive examination is required, particular attention being directed towards the heart, lungs, and kidneys. Frauds have been perpetrated by substituting the urine of another person for that of the proposer. The urine should therefore always be passed in the presence of the examiner. Even this proceeding is not quite devoid of risk. Vivian Poore on one occasion was examining a man, who, when asked to pass water, managed to conceal what he was doing by means of his overcoat. Suspicion was aroused by the sound made, which was like the pop-pops of water coming from a narrow-necked bottle. When the beaker was handed to the examiner the urine was found to be quite cold. Examination of a genuine specimen revealed the presence of albumen.

The family history should, when possible, include that of the grand-parents. When a bad family history is found details should be elicited. The writer recently examined a young married woman of nineteen who presented every sign of good health, but was the only one living of a family of five. Four brothers and sisters had died during infancy, and, in addition, the mother had had two miscarriages. Information furnished by the mother clearly indicated that she had syphilis *after* the birth of the applicant, her first child. These facts were stated in the report, and the life was accepted as first class.

Much litigation has arisen over such matters as the interpretation of policies, the correctness or otherwise of the replies to the questions submitted, accidental or natural death (*v.* p. 24), the question of suicide, &c. These cases are extremely interesting, but do not, as a rule, practically concern the ordinary medical man. Expert medical evidence is called, and the question is fought out by the lawyers.

Medical Examinations in which the Examinee is anxious to convince the Medical Man that he is suffering from Disease, Ill-health, or the Effects of an Injury.—The object of the individual may be to obtain a certificate excusing him from work, or attending as a witness, or from fulfilling some engagement, or to get on the sick list of a benefit club, or to support a claim for damages or compensation. Among prisoners the motive is to escape punishment, or to obtain the ameliorated conditions of the infirmary. Under these circumstances the medical man must be fully alive to the possibility that fraud is being attempted. We have already seen some instances of this in the feigning of insanity by criminals awaiting trial, and the conditions under which wounds are self-inflicted to suggest attempted homicide. The various deceptions which are practised may be considered under the heading of

Feigned Diseases.—Two types of cases may be distinguished.

(1) Those in which real symptoms are produced by fictitious means, or in which symptoms actually due to disease are exaggerated, and false ones added.

(2) Those in which there is no organic basis, the apparent symptoms themselves being unreal or purely subjective.

In the first class may be mentioned superficial lesions induced by the application of various irritants to the skin. The substances most frequently used are nitric acid, cantharides, turpentine, croton oil, and mustard. The ulcers and eruptions produced may be detected by their anomalous character, their situation on easily accessible parts of the body, and sometimes by the staining or smell of the agent employed. The irritation of ulcers in order to keep them open and excite charity is largely practised by beggars on the Continent. Sometimes more serious injuries are inflicted. Irritation of the eye is practised until keratitis or perhaps panophthalmitis is induced; bones are broken or joints dislocated. Another type of fraud is to pretend that the effects of some old-standing disease, such as enlargement of a joint, or deformity due to rheumatoid arthritis or gout, have been caused by a recent injury.

In the second group we have the various paralyses, convulsions, fits, tremors, and spasms. Epilepsy with realistic foaming at the mouth, produced by the aid of a piece of soap, is now a little out of date. Diabetes has been feigned by adding sugar to the urine, or even injecting a solution into the bladder; detection results from the fact that cane-sugar is employed. Gravel and small stones may be placed in the bed-chamber utensil, or within the urethra, to simulate calculus. Spitting of blood in order to mimic phthisis is effected by producing a small laceration within the mouth. Deaf-mutism may be assumed by a prisoner on trial, so that apparently he cannot plead; evidence of the imposture is then placed before the jury, and if they find him "mute of malice," he may be tried without pleading. The following ingenious attempt to defraud is related by Dr. Patmore (Quain's *Dict. of Med.*):—"A medical student insured simultaneously in several accident-companies, and after a short time sent in claims to all of them for compensation for a 'fractured leg.' He was visited by various medical officers, but it was not until a more than ordinarily determined surgeon slit open the plaster-of-Paris casing that the leg was found to be sound and to show no signs of fracture. The student had placed the casing on his own leg."

As a rule, these impostures are quickly detected. The symptoms are usually over-acted, and show various discrepancies from known forms of disease. If the patient is watched unsuspectedly, use of the "paralysed" limb may be observed. Informing someone in the hearing of the patient that it may be necessary to "operate" or use the thermo-cautery, or reduce the diet to a minimum, often effects a speedy cure.

When purely subjective pains are complained of, the difficulty of detection may be greater. Frequently the pain may be made to change its position by assuming its existence in a new locality, and making a great show of examining that spot. It may, however, be difficult to differentiate the condition from hysteria.

The Traumatic Neuroses.—These form an important class

of affections from the medico-legal point of view, and are among the most fruitful sources of litigation over claims for damages or compensation. The conditions may follow shock from any cause, but have been so frequently observed after railway accidents, that the terms "railway-spine" and "railway-brain" have been applied to them. The reason for this is that a sudden violent shock is received by the individual at a time when his muscles and ligaments are in a state of relaxation, and he has had no warning to prepare him for the collision. A person who, for instance, is about to be thrown out of a vehicle by the bolting of the horses, has usually a brief interval in which to brace his mind and body to meet the fall.

It is important to notice that the existence of a right of action after a nervous shock unaccompanied by any physical impact is now admitted by the English law. In a case heard before Bigham, J., at the Devon Assizes in 1903, the plaintiffs, husband and wife, who were tenants of a house, sued the defendants who had been excavating the adjoining site. In consequence of the weakening of the foundations the plaintiffs' house suddenly showed signs of collapsing, and the female plaintiff hurried out of the threatened building to ask what she should do, leaving her children behind her. As she was returning the collapse took place, but the children had in the meanwhile been removed by the neighbours. The plaintiff sustained a severe mental shock and fright with subsequent injury to her health, although she had in no way been struck by the falling débris. The judge directed the jury to determine whether the shock had been due to (1) the plaintiff's fear for her own personal safety, (2) fear for the safety of her children, or (3) fear for herself and her children. The jury found for the last, and the judge then said that the plaintiff was not entitled to damages for that part of the shock which arose from fear for the safety of her children, but only for the fear for herself, and directed the jury to apportion, which they did successfully, awarding the plaintiff £250 damages.

Three types of traumatic neuroses may be distinguished, for the full details and diagnosis of which, books on nervous diseases must be consulted. These are as follows :—

(1) **Simple Traumatic Neurasthenia.**—A person after receiving a shock or jar to the spine, which may or may not have been accompanied by actual injury, perhaps recovers quickly and completely from the immediate effects, and goes about his avocations as usual. Then, in the course of a few days or weeks, symptoms of neurasthenia develop. He becomes nervous and irritable, and cannot concentrate his attention upon any subject, or attend to his work. He is easily fatigued, sleeps badly, and suffers from despondency. There is usually severe headache, and pain and tenderness in the back. Disturbance of digestion, with loss of weight and appetite, follow. The pulse is weak, and there may be irregularity in the action of the heart and palpitation on the least excitement. The temperature is often subnormal, and there may be retention or dribbling away of the urine. Melancholia may develop in severe cases.

(2) **Cases with Hysterical Symptoms.**—In these, in addition to the purely neurasthenic features, there may be tremors, paralyses, spasms, hyperæsthesia, anæsthesia, disorders of the special senses, and other phenomena. Two cases which came under the writer's observation may be briefly described as examples. A man who had twisted his foot a fortnight previously in a defective tramway line in a factory, came up to hospital in a cab, and limped painfully into the out-patient room, with the aid of crutches. He was voluble and excited, but his chief concern appeared to be, not the treatment of the injured limb, but to learn how long the condition was likely to last, and whether he would be permanently disabled, as he was preparing a claim for compensation. On examination, the foot was found to be rigid, and twisted inwards into a position of marked talipes varus, so that only the outer side touched the ground. An anæsthetic was administered, under which the foot at once assumed its normal position. The man walked out of the hospital unaided, much to the surprise (and perhaps disappointment) of himself and his friends.

The second case was that of a man who fell from a telegraph pole. He sustained no obvious injuries except some bruises. When brought into hospital, he complained of pain in the back, and was apparently paralysed in both legs. Sensation was completely absent over the right leg, and impaired over the left. The knee-jerks and plantar reflexes were normal. A remark, made by the visiting physician to those around, that, "by next Wednesday he will be able to feel down to the middle of the thigh," proved a correct prophecy. The patient improved slowly at first, but when assured that no difficulty would be raised over the compensation, rapidly recovered.

(3) **Cases followed by Organic Changes.**—In these (fortunately rare) cases, the symptoms are probably due to a chronic inflammatory condition of the spinal cord following the shock after a longer or shorter interval. There may be mental symptoms, paralysis, disorders of sensation, optic atrophy, and bladder affections. The prognosis is very unfavourable.

When examining a person who is suffering from traumatic neurasthenia or hysteria, the medical man must be prepared to meet with unintentional exaggeration of the symptoms, and as these are so largely of a subjective character, it may be very difficult to assess them at their true value. Apart from this, however, there may be deliberate falsehood. Rose mentions the case of a man who said that his urine was constantly dribbling from him. He had just travelled up to London from a distance of 50 miles, in order to be examined, and when the surgeon asked to see his shirt, which he had been wearing for at least six hours, it was found to be perfectly dry and free from stains.

In affections of a neurotic character, it is well known that the symptoms may drag on with but little change as long as litigation is pending, but when the claim for damages is settled, the sufferer may rapidly improve. It must not be supposed that this indicates

a fraudulent assumption of the condition. The individual is in a state of unstable mental equilibrium, and the change from anxiety over legal affairs to freedom from worry may be quite sufficient to restore him to health.

In the law courts, cases of traumatic neurasthenia and hysteria give rise to much conflict of opinion, and meet with very diverse treatment in the matter of damages. This arises from the impossibility of conveying to a set of jurymen who have no knowledge of medicine anything like an adequate idea of the condition. Statements as to reflexes and areas of anæsthesia merely puzzle the jury, and in most cases they assess the damages according to the apparent, rather than the real severity of the symptoms. The use of the word "hysterical" may unfairly prejudice the plaintiff's case, for the laity attach to the term a significance very different from that in which it is used by physicians. This is well illustrated by the two cases described by Lloyd (*Journ. Amer. Med. Ass.*, 1900). In the first case, a man received a severe electric shock by bringing the end of his umbrella in contact with an arc-lamp. As a result he had typical hysterical paralysis of the arm, and in addition the limb became the seat of a blue œdema which gave it an appearance of being badly damaged. His lawyer succeeded in convincing the jury that the nerves and muscles had been destroyed by the mysterious current, and, in consequence, heavy damages were awarded. In the second case, a woman who had developed an identical hysterical paralysis of the arm, after receiving a blow from a falling sign, failed to obtain a verdict, apparently because it was successfully shown to the jury that the affection was purely hysterical. Lloyd remarks, "These two cases illustrate perfectly the inconsistencies that prevail in our courts. Both cases were unjustly decided. . . . The man got more than his hysteria was worth, and the woman got less."

CHAPTER XVII.

THE OBLIGATIONS, STATUTORY AND MORAL, OF THE MEDICAL MAN.

CONTENTS.—Qualification and registration—Registration of birth—Still-birth—Monsters—Certification of death—Violent, sudden, and suspicious deaths—Dying declarations—Will making—Notification of disease—Transmission of pathological specimens by post—Examination of the living in medico-legal cases—Malapraxis—Operations and consent—Professional secrecy: in criminal matters; in civil matters—The medical man and "undue influence."

General Remarks.—The medical man has many duties besides those of tending and healing the sick. Some of these—such as notification of infectious disease, or certification of death—are imposed upon him by statute, under pains and penalties for the non-performance thereof; others—as, for instance, the obtaining of a dying declaration from a wounded person, or the assisting to prepare a will in an emergency—have only a moral sanction for their performance. The duties of medical officers of health, and those holding other public appointments, are set forth in works on hygiene, &c. We shall consider here the law relating to such matters as come under the cognisance of the general practitioner.

Qualification and Registration.—In this country any unqualified person may profess to treat and cure disease, provided he does not do it in such a way as to imply that he is registered under the Medical Act. If, however, a person wilfully and falsely represents himself to be a doctor or bachelor of medicine, or a physician, surgeon or licentiate in medicine and surgery, or an apothecary, or to hold any medical qualification recognised by law, or to have his name on the medical register, he is liable upon conviction of such an offence to a fine of £20. A qualified medical man is under no necessity to register, and may practise according to his qualifications, but he is subject to certain disabilities in consequence. An unregistered person cannot sue for his fees, or hold medical appointments in the naval or military services, hospitals, gaols, asylums, friendly societies, &c., &c., or act as a medical officer of health. Medical certificates—*e.g.*, certificates of death—signed by him are not valid.

Registration of Birth.—The duty of giving information of a birth falls, in the first instance, upon the father and mother of the child, and in default of them upon the householder and persons present at the birth. If the information has not been given within forty-two days the registrar may call upon the medical man as one of those present at the birth to supply it, but he is rarely troubled

as application is first made to others capable of giving the requisite particulars.

Still-Birth.—The law takes little notice of children born dead, and neither certification nor notification of the registrar is necessary, unless there is a wish for interment in a public burial ground. Usually, the undertaker disposes of the body, but the medical man if present at the birth must give to the parents a certificate to the effect that the child was still-born. If the woman was unattended by a medical man, the midwife or some other person who was present at the birth writes the certificate; a system which affords considerable opportunity for the commission of crime.

We have already considered what the law regards as live-birth, but in actual medical practice the general custom is to neglect trivial and fleeting signs of vitality, and certify all infants which do not breathe as still-born; many indeed will take this course if a child die shortly after birth, even if it has partially respired. Among the poor this custom saves the expense of burial, and probably does no harm; but in a case in which the devolution of an estate might be affected, the medical man must be much more circumspect.

Monsters.—Fortunately the great majority of these die at, or shortly after, birth. Still, the Siamese twins and the "freaks" on view at various exhibitions show that sometimes these errors of nature survive. The destruction of a monster is technically murder.

The Midwives Act of 1902, which came into force on April 1, 1905, is of great, though indirect, importance to the medical profession. It provides for the training, certification, and supervision of midwives, and for the formation of a Central Midwives Board which is empowered among other things to frame rules* "regulating, supervising, and restricting within due limits the practice of midwives." Rule 17 runs as follows:—

"In all cases of abortion, of illness of the patient or child, or of any abnormality occurring during pregnancy, labour or lying-in, a midwife must decline to attend alone, and must advise that a registered medical practitioner be sent for, as, for example, under the following circumstances:—" Then follows a list of all the more serious complications of pregnancy and parturition. The following peremptorily-worded form is supplied to the midwife to be used on such occasions:—

No.....Date.....

Name of Patient.....

Address.....

requires medical assistance at once on account of.....

Signed.....(Certified Midwife)

Sent to (doctor).....

at (address).....

Time of sending message.....

* A copy of these rules, which should be in the possession of every general practitioner, can be obtained from Messrs. Spottiswoode & Co., 54 Gracechurch Street, E.C.; post free, 7d.

The midwife, however, is given very considerable liberty of action. She is, for instance, under no restrictions as to the administration of poisons whether scheduled or not, and there is nothing in the regulations which forbids the use of forceps.

Neither in the governing Act nor in the regulations of the Board is any provision made for the payment of the fees of a medical practitioner called in under the Act. Steps are being taken by the Board and by the British Medical Association to obtain an amendment to the Act rectifying the omission. In the meantime, the payment appears to be at the discretion of the local authorities (v. *Brit. Med. Journ.*, March 11, 1905, p. 565), and in several instances Boards of Guardians, and City and County Councils have expressed their willingness to pay a fee of one guinea in such cases, a wholly inadequate remuneration considering that the medical man is summoned only in cases presenting exceptional difficulty.

Certification of Death.—Section 20 of the Births and Deaths Registration Act, 1874, provides that, "In the case of the death of any person attended during his last illness by a registered medical practitioner, that practitioner shall sign and give to some person required by the Act to give information concerning the death, a certificate, stating, to the best of his knowledge and belief, the cause of death." A fine of 40s. may be inflicted for refusing or failing to give such a certificate. A medical man is permitted to give a certificate without having actually seen the dead body, but this is an undesirable practice as it renders possible the commission of frauds—*e.g.*, on life assurance companies. In view of the provisions of the Friendly Societies Act, 1875, a medical man should not give more than one certificate of death, though he is not specifically forbidden to do so. A practitioner has no right to withhold a certificate for the reason that his fees have not been paid; nor can a fee be claimed for giving the certificate. The duty of giving information of the death to the registrar falls upon the nearest relatives, or some person present at the death.

When to refuse to Certify, or to inform the Coroner of a Death.—The Coroners Act of 1887 enacts that "where a coroner is informed that the dead body of a person is lying within his jurisdiction, and there is reasonable cause to suspect that such person has died either a violent or unnatural death, or has died a sudden death of which the cause is unknown, or that such person has died in prison, or in such place or under such circumstances as to require an inquest in pursuance of any Act, the coroner, whether the cause of death arose within his jurisdiction or not, shall, as soon as practicable, issue his warrant for summoning not less than twelve nor more than twenty-three good and lawful men . . . to enquire as jurors touching the death of such person as aforesaid."

As regards the legal position, there is no statutory obligation upon a medical man to give information to a coroner, whatever the attendant circumstances of a death may have been. When he meets with a case of unnatural death the practitioner has three

alternatives. (*a*) He may give a certificate to the effect that death has been due to unnatural causes. (*b*) He may, upon reasonable excuse, withhold the certificate (*v.* Registration Act, 1874, Sec. 20 (3) and Sec. 29). (*c*) He may, as an act of courtesy, inform the coroner. If either of the first two alternatives be adopted, notice of the death is given officially to the coroner by the registrar. While, however, the medical man is within his strict legal rights in following the first or second of these courses, in actual practice the general custom is for him to communicate directly with the coroner, or, at least, to see that someone else gives prompt information; and this is certainly a desirable proceeding, for it tends to establish harmonious relations between him and the coroner for his district, and perhaps prevents loss of valuable time.

The above remarks apply also to the answering of questions put to a practitioner by a coroner's officer before an inquest. In the vast majority of cases full information is freely and willingly given, but under exceptional circumstances the medical man may think it desirable to reserve his evidence for the witness-box, and he is strictly within his legal rights in so doing.

There are three types of cases in which the question of informing the coroner or withholding the certificate arises. These are as follows:—

(1) **Deaths clearly due to Violence.**—When death is due to recent violence, whether accidental, suicidal, or homicidal, the course is quite plain; there must be an inquest, and there need be no hesitation in giving notice. But the medical man must not forget that death occurring from secondary complications at a considerable time after the receipt of an injury also demands enquiry. Even in a case of murder the legal limit of a year and a day between the receipt of the injury and death applies only to the bringing of a criminal charge, and not to the holding of an inquest.

(2) **Sudden Death from Unknown, but presumably Natural, Causes.**—If the deceased has had no recent medical attendance a certificate cannot be given. Sudden death alone does not render an inquiry necessary, provided the practitioner is satisfied of the cause of death; as, for instance, if he has seen the individual within a few days, and has been treating him for (say) aortic regurgitation. Cases which give rise to hesitation are those in which death has occurred suddenly and unexpectedly after an illness not apparently serious, and to which the practitioner did not anticipate a fatal termination. He may be able to explain the death, although he is not certain of the exact pathological lesion. Under such circumstances the wisest course is to lay the facts fully before the coroner, with a statement that there were no suspicious features attending the death, and that a certificate of death from natural causes is being withheld pending his decision. It will be seen from the wording of the Act that in such a case an inquest should strictly be held, but, in actual practice, the coroner will frequently not consider it necessary to take this course. To take an actual instance: A young man died suddenly while at dinner. His medical attendant

had recently been attending him for severe facial neuralgia, but had not seen him for four days. He was very anæmic, and the circumstances of the death pointed to sudden syncope, but he was not known to have had any cardiac lesion. There was nothing to suggest that death was other than natural. The coroner, after being fully informed of the facts, did not order an inquest, and death was certified as due to heart-failure.

(3) **Deaths under Suspicious Circumstances.**—Of course, if his suspicion of foul play is strong, the medical man should not give a certificate of death from natural causes. Difficulty arises in cases, fortunately rare, in which death has been apparently natural, but perhaps one anomalous symptom, or some incident in the behaviour of those associated with the invalid has aroused slight suspicion of poisoning, in the mind of the practitioner. The position is then one of great perplexity. On the one hand, if the medical man withholds the certificate, thereby rendering an inquest necessary, and death is found to have been due to natural causes, much needless pain and publicity has been caused, and (though this should not influence his decision) his practice is likely to suffer. On the other hand, if the medical man stifles his suspicions, and gives a certificate, he may be failing in his duty towards the deceased; and if fresh facts subsequently come to light an exhumation may be ordered, a proceeding far more painful to the relatives and friends than an inquest would have been. No definite line of conduct can be laid down. Each case must be decided upon its own merits, and the decision must be come to by the exercise of the profoundest judgment after a review of the whole circumstances of the illness and death. But there is one course which the medical man should *not* take, and that is to make a private post-mortem on his own account. The general practitioner is not sufficiently familiar with the post-mortem appearances of poisoning to undertake satisfactorily this task, and the result of his manipulation may be to destroy valuable evidence. If the suspicion is great enough to justify asking for a post-mortem examination, it is great enough to withhold the certificate.

Dying Declarations.—It is the duty of a medical man when he is called upon to attend a person who is likely to die shortly from the effects of violence (including criminal abortion) inflicted by another, to obtain from his patient a declaration of all the circumstances connected with the violence. If death is not imminent, but the injuries are likely to prove fatal eventually, the practitioner should give information to a magistrate, who will then attend and take the depositions. The circumstances under which such declarations are admissible in trials are considered under the heading of "Evidence," p. 177.

A dying declaration should be taken down in the *ipsissima verba* of the person making the declaration. Questions should not be put except when it is necessary to remove some ambiguity or want of clearness. If possible, one or more witnesses should be present. The dying person should sign the declaration if he is able to, though

this is not absolutely necessary, but the writer and witnesses should always sign the document. The medical man should make a note of the mental condition of the declarant.

Will-making.—A medical man is occasionally asked to assist in the drawing up of a will, when, in consequence of the rapid approach of death, there is not likely to be time to obtain the services of a solicitor. It behoves him, therefore, to be familiar with the legal requirements of such a document.

A will can be made only by a person over twenty-one, and of sound, or at least "disposing," mind (*v.* p. 147). The medical man should note carefully the mental condition of the testator, in case the will be contested on the ground of incapacity. A will must be in writing, and signed at the end by the testator, or, if he is unable to write his signature, by someone else and acknowledged by the testator as his, in the presence of at least two witnesses, who are present at the same time. The witnesses must also sign the will in the presence of the testator. If more than one sheet of paper is used, each should be signed by the testator and the witnesses. All alterations in the will, and all codicils, whether separate documents or added to the will itself, must be signed in the same manner. The appointment of an executor must not be forgotten. An attestation clause is not essential, but is desirable. The following form may be used :—

"This is the last will of me, *A. B.*, of , and I hereby revoke all former wills."

"I appoint *C. D.*, of , to be my executor."

Legacies, *Bequests*, and *Trusts*.

"In witness whereof, I, the said *A. B.*, have hereunto set my hand this day of 19 ."

Testator's signature.

"Signed by the above-named testator as his last will in the presence of us, present at the same time, who in his presence, at his request, and in the presence of each other, have hereunto subscribed our names as witnesses."

Signatures of witnesses with addresses and professions or rank.

A witness should not be a beneficiary under a will; if he is, the will is not invalidated, but the legacy to him is void. A witness need not know the contents of a will, which may be so folded that only the signature of the testator and attestation clause are visible. All statements in the body of the will should be clear and free from ambiguity; technical language, in the absence of legal assistance, should be avoided.

Notification of Disease.—Under the Infectious Diseases (Notification) Act, 1889, "Every medical practitioner attending on or called in to visit the patient shall forthwith, on becoming aware that the patient is suffering from an infectious disease to which this Act applies, send to the Medical Officer of Health for the district a

certificate stating the name of the patient, the situation of the building, and the infectious disease from which, in the opinion of such medical practitioner, the patient is suffering." The diseases scheduled in the Act are—smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlatina or scarlet fever, typhus, typhoid, relapsing, continued, and puerperal fever; but the local sanitary authority has power to include other diseases. The practitioner is entitled to a fee of 2s. 6d. for a private patient, and 1s. for a case met with in practice as medical officer of a public body. Failure to notify renders him liable to a fine of 40s.

Under the Factory and Workshops Act, 1901, "Every medical practitioner attending on or called in to visit a patient whom he believes to be suffering from lead, phosphorus, arsenical or mercurial poisoning, or anthrax, contracted in any factory or workshop, shall (unless the notice required by this sub-section has been previously sent) send to the Chief Inspector of Factories at the Home Office, London, a notice stating the name and full postal address of the patient and the disease from which, in the opinion of the medical practitioner, the patient is suffering." The practitioner is entitled to a fee of 2s. 6d; failure to notify renders him liable to a fine of 40s.

Transmission of Pathological Specimens by Post.—When samples of sputum, blood, &c., are sent by post, the following regulations must be complied with:—

"Deleterious liquids or substances, though otherwise prohibited from transmission by post, may be sent for medical examination or analysis, by Registered Letter Post, under the following conditions:—

"Any such liquid or substance must be enclosed in a receptacle hermetically sealed, which receptacle must itself be placed in a strong wooden, leathern, or metal case in such a way that it cannot shift about, and with a sufficient quantity of some absorbent material (such as sawdust or cotton wool) so packed about the receptacle as absolutely to prevent any possible leakage from the package in the event of damage to the receptacle.

"The packet so made up must be marked 'Fragile, with care,' and tendered at a post office for transmission by registered letter post. It must on no account be dropped into a letter-box or sent by parcel post. These regulations will be rigidly enforced. Any postal packet of the kind found in the parcel post, or any postal packet of the kind, whether registered or not, found in the letter post not packed as directed will be at once stopped and destroyed with all its wrappings and enclosures."

"Any person who sends by post a liquid or substance for medical examination or analysis, otherwise than as provided by these regulations, is liable to prosecution, even if he be a patient sending something to his medical adviser for his opinion, or a medical practitioner sending something to a laboratory or elsewhere.

"No liquid or substance of the kind may, under any circumstances, be sent by post to or from any place outside the United Kingdom."

Examinations of the Living in Medico-legal Cases.—It is an established principle of the law of England that no person can

be compelled to give evidence which might tend to incriminate himself. Such evidence might be obtained from an examination of the body of an accused or suspected individual; accordingly no person, whether under arrest or not, can be forced to submit to such an examination. In previous chapters we have considered numerous occasions, such as suits for nullity of marriage, charges of rape, infanticide, concealment of birth, &c., in which a personal examination may be not only helpful, but absolutely essential, in order to determine the question at issue. Nevertheless, it is of the utmost importance for the medical practitioner to realise that under no circumstances may he make such an examination, unless the individual has freely consented to it without persuasion or threat, and understands the purpose for which it is made, and is aware that the results found may be used in evidence against him or her. A coroner, police-inspector, magistrate, or other authority has no right to issue an order for the personal examination of a living person, and a medical man who acts under such an order is not relieved from responsibility. Merely submitting to be examined, under the belief that it is compulsory, is not consent. In the case of a child consent should be obtained from the parents or guardians. A medical practitioner who examines a person without consent renders himself liable to a charge of assault, or an action for damages, and in some instances of this kind (usually in which women have been concerned) heavy damages have been awarded.

A medical man is not infrequently asked to examine a servant-girl who has been sent to him by her mistress in the belief that she is pregnant. Equally, under these circumstances, must he obtain the consent of the girl herself after fully explaining the position to her. It is not right to endeavour to obtain evidence by pretending to examine the chest or abdomen for other purposes. In this, and similar cases, it is desirable to obtain a written consent to make the examination, or, if verbal, to secure the presence of an independent witness.

A word of warning may be uttered here against anæsthetizing a woman, for however brief an interval, except in the presence of a third party. Persons under anæsthetics frequently experience delusions, and women may imagine that rape or indecent assaults are being perpetrated upon them. Thus a false criminal charge may be preferred, quite innocently, against a medical man or a dentist.

Malapraxis.—By this is meant failure to exercise "reasonable skill and care" in the treatment of a patient. A medical man is not expected to be infallible, and will not be held responsible for *bona fide* mistakes in either diagnosis or treatment, provided the mistakes are such that any prudent practitioner might under the circumstances have made, and that no negligence has been displayed. The question is one of fact rather than law, and each case must be decided upon its own merits, but the same degree of skill will not be required from everyone. A specialist, for instance, will be expected to show greater knowledge and skill in matters concerning his own subject than a general practitioner.

Moreover, the attendant circumstances of the case are taken into consideration. A country doctor, acting in the best interests of his patient, may be called upon to perform a major operation at very short notice, and possibly have to administer the anæsthetic himself at the same time. The degree of success under such circumstances is not that which would be expected from a skilled surgeon with help and complete operating appliances at his command.

Want of reasonable skill and care renders a medical man liable to a civil action for damages, and in a case in which gross carelessness has been shown, to a criminal prosecution. The following are illustrative cases, some of which show the leniency of the law even with regard to serious errors, provided negligence has not been displayed:—

Cases decided in Favour of the Medical Man:—

1884. The plaintiff's child had diphtheria, and the plaintiff was asked by the medical man to remove a membrane from the tube by suction. He did so, and caught the disease. The plaintiff urged that he should have been warned of the danger, and that the defendant had mistaken the case for ordinary croup instead of membranous croup. The jury stopped the case.

1894. A clerk claimed damages for having been certified as suffering from scarlet fever, and unable therefore to follow his employment. He was really suffering from erythema, but the case was doubtful, and the rash deceptive.

1899. An aneurism of the leg was opened by mistake for an abscess.

1899. A medical man opened an abscess in the arm and inserted a drainage tube. Subsequently the tube was missed, and was supposed to have been lost by the plaintiff when removing the bandages. Later a second operation was necessary and the tube was found. Evidence was given that it would not have been justifiable to have opened the sinus and searched for the tube.

1902. A lady claimed damages on the ground that a medical man had unnecessarily and improperly prescribed morphia with the result that she had acquired the morphia habit. The jury stopped the case, and expressed an opinion that it should not have been brought into court.

1904. Dermatitis of the knee caused by the application of X-rays to localise a broken needle. The jury held that there had been no negligence.

Cases decided Against the Medical Man—Criminal:—

1875. At the Warwick Assizes, a medical practitioner was sentenced to six months' imprisonment for the manslaughter of a married woman whom he had attended in her confinement. After extracting the child with forceps, he was observed to cut off something and throw it into a privy. This proved to be 15 feet of intestine. At the autopsy, the vagina was found to have been ruptured, and part of the ileum and colon was missing; probably

it had been pulled down in the first instance under the impression that it was the cord.

1895. At the Central Criminal Court, a medical man was sentenced to three months' imprisonment for having caused the death of a woman while delivering her with forceps. It was at first stated that he was under the influence of alcohol at the time, but it was shown that his condition was due to chloral of which he had taken a large dose shortly before attending. The judge stated that the sentence would have been much more severe had the prisoner's condition been due to alcohol.

Civil:—

1904. £100 damages was awarded against a medical man who had used X-rays and high frequency currents in a case of malignant disease, whereby the patient suffered excessive dermatitis and burning of the skin. The jury found that the treatment was "improper, negligent, and unskilful."

1904. King's Bench Division. In 1903 the plaintiff was operated upon by the defendant and was apparently doing well. Subsequently a second operation was necessary, and a sponge was found to have been left within the body. For the defence it was argued that the counting of the sponges was the duty of the nurse, and could not be expected from a surgeon occupied with the main features of the operation. The jury found that the nurse was employed by the defendant and was under his control, and they returned a verdict for the plaintiff, awarding at first one farthing damages. On the judge pointing out that such a finding would involve a new trial, the damages were increased to £25 in consideration of the second operation. In entering judgment, Bruce, J., remarked that he was glad the jury had returned a verdict which cast no reflection on the defendant's skill.

Operations and Consent.—An operation should never be performed on an adult if he or she refuse to allow it. In the case of a child, or a person not in a condition to give consent, permission should be obtained from the guardians or nearest relatives. If, however, delay would be dangerous, a surgeon is justified in operating without consent. Before commencing an operation the limits of which cannot be foretold, the surgeon is well advised to obtain from the patient a written permission to use his own discretion according to the state of affairs he finds. In 1896, an action was brought against a medical man who had omitted to take this precaution, and who was in consequence subjected to much annoyance. The plaintiff's case was that both her ovaries had been removed, although she had only consented to the removal of one, and that she was in consequence sterile. The defendant stated that the decision was left to his discretion; that both ovaries were diseased and their removal was necessary in order to prolong life; and that the plaintiff was sterile before the operation owing to the disease. The jury found for the defendant, and considered that the action should never have been brought. Nevertheless, the case was taken

to the Court of Appeal, and when the decision was there upheld, the plaintiff endeavoured to go to the House of Lords, but was refused permission to sue *in formâ pauperis*.

Professional Secrecy.—It is one of the strictest rules of the ethical code which governs the relations between practitioners and their patients, that all information acquired in the discharge of professional duties should be treated with the most inviolable confidence. Nay, further, the revelation of such secrets, except under legal compulsion, renders the medical man liable to an action in which heavy damages may be awarded. Nevertheless, there are certain occasions on which a medical man is, by law, required to break the rule without special order to do so, as, for instance, in the notification of infectious disease, and the certification of the cause of death; and there are others in which it is his moral duty to do so, or he is justified in doing so for his own protection or for the protection of other persons. The subject is more easily dealt with if we consider professional secrecy in relation to criminal and to civil matters separately.

Professional Secrecy in relation to Criminal Matters.—The medical man, particularly the general practitioner in a poor neighbourhood, frequently comes across cases in his dealings with his patients in which there is clear evidence that crime has been committed. Under some circumstances it may be a very difficult matter for him to determine where his particular duty to his patient to maintain secrecy ends, and his general duty to the community to assist justice and repress crime by giving information to the police, begins. Criminal abortion is the crime the medical man most often becomes aware of, either as the result of his clinical examination of the woman, or by being made the recipient of a confession to that effect when called in to treat her. Other offences are infanticide and concealment of birth. Sometimes the police ask for assistance in the detection of crime. A person, for instance, has been murdered, and it is believed that his assailant was injured in the struggle, or a burglary has been committed, and, from the presence of blood on a broken window pane, it is inferred that the burglar cut his hands. A circular may then be sent to all the medical men in the neighbourhood asking that information may be given to the police, if anyone exhibiting wounds likely to have been so received presents himself for treatment. As an instance, the following circular, which was distributed in Birmingham in 1903, may be given :—

Birmingham City Police,
Detective Department,
Corporation Street,
Nov. 19, 1903.

CHILD MURDER.

Sir,—I beg to inform you that at 9.20 a.m. on November 17, 1903, the dead body of a newly-born female child was found in an opening in Aston Brook Street, in this city, wrapped in an *Evening Despatch*, dated November 16, 1903, and having a piece of lace (probably torn

from underclothing) tied tightly round the neck. The body was warm when found.

A verdict of "wilful murder" has been returned at the inquest, and should you be called upon to professionally attend any woman who appears to have been recently confined under circumstances of this nature, I should be obliged if you would immediately communicate with me by telephone or otherwise.

I am, Sir, your obedient servant,

(Signed) CHARLES HAUGHTON RAFTER,
Chief Constable.

What now should be the behaviour of the medical man under such circumstances? Is he bound to give information to the police whenever he becomes aware that crime has been committed, or should he allow the rule of his profession to prevail? First, as regards the strict legal position, there are two offences in the statute book which he might conceivably be held to commit by maintaining silence. These are:—

(1) **Misprision of Felony.**—This is the concealment of felony committed by another, unaccompanied by anything further which would make the concealer an accessory to the felony.

(2) **Being an Accessory after the Fact**—*i.e.*, one who, knowing that the person assisted has committed a felony, harbours, relieves, comforts, or assists the felon.

Thus, according to the strict *letter* of the law, a medical man who attends a woman, knowing that she has procured abortion, both commits misprision of felony, and becomes an accessory after the fact, for by his treatment he removes the evidence of the crime, and thus assists the felon. Practically, however, misprision of felony is an obsolete offence; while a medical man would only be looked upon as an accessory after the fact in a very gross case, as, for instance, if in order to assist a person to escape justice, he gave a certificate of death from natural causes, well knowing that such death had been caused by criminal abortion, or by infanticide.

A statement made by Hawkins, J., in *Kitson* v. *Playfair and Wife* (Q.B. Div., 1896) is of the utmost importance in this connection. Speaking of divulgence of crime by medical men, the learned judge continued, "If a poor, wretched woman committed an offence for the purpose of getting rid of that with which she was pregnant, and of saving her character, her reputation, and, it might be, her very means of livelihood, and if a doctor was called in to assist her—not in procuring abortion, for that in itself was a crime—but called in for the purpose of attending her and giving her medical advice—how she might be cured so as to go forth about her business—he doubted very, very, very much whether he would be justified in going forth and saying to the Public Prosecutor, 'I have been attending a poor young woman who has been trying to procure abortion with the assistance of her sister. She is now pretty well, and is getting better, and in the course of a few days she will be

out again, but I think I ought to put you on to the woman.' To his mind a thing like that would be monstrous cruelty. . . . There might be cases when it was the obvious duty of the medical man to speak out. In a case of murder, for instance. A man might come with a wound which it might be supposed had been inflicted on him in the course of a deadly scuffle. It would be a monstrous thing if the medical man might screen him, and try to hide the wound, which might be the means of connecting the man with a serious crime." (*Brit. Med. Journ.*, 1896, i., p. 883.)

It appears, therefore, from this utterance, that a medical man is expected to exercise his own discretion in giving information of crime which has come to his knowledge. It is no part of his duty to act as a detective, and he is not necessarily bound to obey notices sent to him by the police. It depends on the circumstances in each case. If a murder has been committed, and a wounded person corresponding to the published description of the assailant comes for treatment, the medical man would certainly be failing in his duty as a citizen if he did not give information to the police. On the other hand, to make known, for instance, the fact that one of his patients shows signs of recent delivery is a different matter, and a medical man would in such a case require very strong reasons for violating the rule of professional secrecy.

Abortion requires further consideration. In all cases in which a medical man learns, or suspects, that crime has been committed he should, for his own protection, call in a brother practitioner, or at least inform some responsible person of the state of affairs; if this precaution be not taken, he may himself be suspected of, or charged with, having committed the crime. The cases of abortion which are met with may be divided into two classes—those which have been procured by the woman herself, or with the assistance of a relative or friend; and those in which the services of a professional abortionist have been obtained. As regards the first class, it is quite clear, in view of the strong judicial statement quoted above, that the medical man need do nothing outside his professional treatment. The second type of case cannot be dismissed quite so readily. It is eminently desirable, both in the interests of the profession and of the public, that the trade of an abortionist should be put a stop to, whenever possible. Nevertheless, even in this case, a medical man is very unlikely to be found fault with for refraining to take steps which would entail the sacrifice of his patient's reputation, provided she be not dangerously ill. If exposure has already occurred, and the patient's reputation may be regarded as lost, the case is somewhat different. The practitioner may then advise the woman herself to give information. In one instance in which this course was adopted, a midwife, who was responsible for the crime, was sentenced to five years' penal servitude, while the position of the girl, who turned King's evidence, was no worse than it had been before. Of course, if the woman is dangerously ill, a dying declaration must be obtained, or her depositions must be taken by a magistrate.

When a medical man finds that a woman has purchased drugs from a chemist or herbalist for the purpose of inducing abortion, he may communicate the fact that such drugs are being sold without making any reference to the particular case. It will be recalled that the mere selling of drugs with the intent that they shall be used to procure abortion, whether they are actually taken or not, is an offence (*v.* p. 107). Having received such a hint the police will sometimes work up evidence for themselves. For instance, in 1897 they became aware that a Madame Bedford, "female specialist and medical herbalist," was selling drugs for this purpose. Accordingly, a superintendent wrote to her representing himself to be a married woman two months advanced in pregnancy, and suggesting that he should be supplied with something to procure abortion. He received in return medicine and pills with instructions for their use. Female detectives, sent to the woman with similar stories, were also supplied with pills for the same purpose. On analysis these were found to contain ergotin, savin, aloes, colocynth and other substances. The prisoner was sentenced to six months' imprisonment. Action of this sort would be particularly called for if a medical man had two or three cases of chronic lead-poisoning in pregnant women, and found that they had all been taking pills derived from the same source.

Professional Secrecy in relation to Civil Matters.—A medical man who reveals matters other than criminal in connection with his patients, renders himself liable to an action for libel or slander; but under circumstances in which it is his moral duty to speak, the occasion may be held privileged. A privileged communication may be defined as one made by a person who has an interest to protect, or a legal, moral, or social duty to perform to another having a corresponding interest or duty, for the purpose of protecting his interest, or performing his duty. In every case the question of privilege is one to be decided by the circumstances, but the following recent cases illustrate some of the occasions on which departure from the rule of professional secrecy will, or will not, be held privileged:—

Kitson v. *Playfair and Wife* (Q.B.D., 1896).—The plaintiff's case was that the defendant had published a statement with regard to her, that she had "had a miscarriage under such circumstances that her pregnancy could not have been of a legitimate character," in consequence of which statement she had suffered pecuniary loss. The defendant claimed that the statement was privileged, on the ground that it was made to a brother-in-law of the plaintiff on behalf of his (the defendant's) wife, who was a sister of the plaintiff, and of his daughters. The jury found a verdict for the plaintiff, and awarded £12,000 damages.

Still v. *Morris* (Q.B.D., March, 1900).—The plaintiff, a fireman in the service of the Metropolitan Fire Brigade, claimed damages for negligence and libel against the defendant. The latter, who was the district medical officer, had, in 1899, treated the plaintiff for venereal disease, and had given a certificate to that effect to

the Brigade, in consequence of which the plaintiff was dismissed from his employment. Counsel for the defence quoted the sixth condition of service, which ran, "Every fireman is liable to immediate dismissal for *unfitness*, negligence, or misconduct." The jury stopped the case and returned a verdict for the defendant.

Guy v. *Green* (Leeds Assizes, 1902).—The defendant was called in to attend the plaintiff, who was a barmaid at an hotel, and was requested by the manager to see her. As a result of his examination he informed the housekeeper and the employer that the girl was suffering from venereal disease. Subsequently he made a similar statement to a man who represented himself to be the husband of the plaintiff, though this was shown later not to be the case. It was alleged that he had also made a communication to another barmaid, but this the defendant emphatically denied. At the hearing of the case the judge ruled that the communications to the manageress, to the employer, and to the man who represented himself to be the husband, were privileged, but left it to the jury to decide on the evidence as to the communication to the other barmaid, and they found a verdict for the plaintiff with £75 damages.

Professional Secrecy in the Witness-box.—A medical man has no right to refuse to answer a question on the ground that it would be a breach of professional secrecy (*v.* "Evidence," p. 179).

The Medical Man and "Undue Influence."—Owing to the intimacy which exists between him and his patient, the medical man has exceptional opportunities for observing the mental attitude of the invalid, and the behaviour of others towards him. He may, therefore, be a most important witness whenever it is alleged that a person has been unduly influenced in the disposal of his property, either by will or gift. The question becomes of a more personal character when it is asserted that the medical man himself has exercised undue influence over his patient. In such a case, the circumstances under which the gift or legacy was made will be closely scrutinised by the law. There is, however, no objection to a medical man advising a patient to make a will and assisting in its preparation, provided he does not seek to obtain benefit for himself under it.

When gifts, which unlike legacies are irrevocable, are made, the legal requirements must be most rigidly observed, otherwise the gifts are liable to be set aside by a court of law. It is an established principle of equity that where confidential relations exist between two persons, of such a character that one is likely to acquire habitual influence over the mind of the other, and, in the absence of independent advice, gifts are made to the one by that other, undue influence will be presumed from the mere fact of the relations between the parties. The onus of proving that such was not the case rests upon the person who received the gifts. The strictness with which this rule is enforced is shown by the case of *Radcliffe* v. *Price* (Chan. Div., 1902). The plaintiffs, the executors of a lady who died on March 23, 1900, sought to recover from the defendant, who had been he deceased's medical attendant for eleven years,

gifts amounting to £800, which had been given to him at various periods in 1899 and 1900. No charge of fraud or improper conduct was made, but it was claimed that, in view of the relations between the parties and the absence of independent advice obtained by the donor, presumption of influence existed, and that the gifts were not valid. It was shown that the sum given was only a small fraction of the total property, which was stated to amount to £90,000, and that the deceased had provided for her husband, and had left legacies to relatives, and donations for a museum, public garden, and various charities. Nevertheless, the defendant had to refund the money, and pay the costs of the action. Swinfen Eady, J., said, in giving judgment, "It has been laid down that the relation of patients and physician is a confidential relationship, and where it exists, as it did in this case, the donor must have had competent and independent advice before a gift can be supported."

This decision is of great importance to the profession, for it not infrequently happens that a grateful patient wishes to give his or her medical attendant a sum in excess of his legitimate fees. When this is the case, the medical man should not accept the gift until he is satisfied that a responsible member of the patient's family knows what is being done.

CHAPTER XVIII.

EVIDENCE AND PROCEDURE AS REGARDS THE MEDICAL MAN.

CONTENTS.—Evidence: direct and circumstantial; parole and documentary; certificates, dying declarations and reports; hearsay; common and expert—The medical man as a witness—Procedure—The subpœna—The coroner's court—Other courts—Fees allowed to medical witnesses.

Evidence may be classified in several ways, as follows:—Direct and circumstantial; parole and documentary; common and expert. Each of these divisions has points of significance for the medical witness.

Direct and Circumstantial Evidence.—By direct evidence is meant some positive and conclusive proof of a fact, as, for instance, the statement of an eye-witness of an event. Circumstantial evidence is that derived from various circumstances in connection with the matter under enquiry. As a rule, the evidence given by the medical man is of this nature, as, for example, evidence of identification of blood-stains on the clothing of a person charged with murder, or of signs of recent delivery in a woman accused of infanticide. Before a conviction can be obtained on circumstantial evidence alone, the jury must be satisfied that the statements are credible, and that the evidence is not only consistent with the belief that the accused committed the crime, but is inconsistent with any other belief.

Experimental Evidence is a particular form of circumstantial evidence, and is frequently of a medical character. It is evidence derived from the results of experiments made to establish or disprove various suggested explanations of the matter under investigation. In *R.* v. *Monson*, Edin., 1893, for instance, experiments were made on a cadaver as to the effects of gunfire from various distances. It is sometimes necessary in cases of poisoning to perform physiological tests upon animals, and in a criminal case a judge has power to license experiments on animals when he deems them necessary in the interests of justice.

Parole and Documentary Evidence.—Parole evidence is that given by word of mouth, and, whenever possible, is required by the law in preference to documentary evidence. The statements of persons abroad, whose attendance the court cannot therefore compel, or of persons too ill to travel, may in some cases be taken by commission. In criminal cases, if a witness is ill, his depositions, taken before the committing magistrate, may be read, provided such depositions were taken in the presence of the accused, and that he had an

opportunity of cross-examining the witness. The contents of documents must, however, eventually be made known to the court orally.

Documentary evidence, as regards the medical man, consists of medical certificates, dying declarations, and medical reports.

Medical Certificates.—A medical man whose name is on the register may give a certificate excusing a witness, juror, or person liberated on bail, from attendance at court, in consequence of illness. The nature of the affection should be stated. The judge or magistrate may summon and question the medical man who has signed the certificate.

Dying Declarations.—These are statements made by persons who have been fatally wounded or poisoned, and, although hearsay evidence, are admitted on the assumption that an individual will not die with a falsehood on his lips. The requirements of the law with regard to the admission of dying declarations as evidence are very strict, and must be complied with absolutely to render a declaration admissible as evidence. They are as follows :—

The death of the person who made the declaration must have taken place.

The declaration can only be admitted when a person is on trial for having caused such death.

The subject of the declaration must be the circumstances of the death.

The declarant must have been convinced at the time he made the statement that there was no hope of his recovery, and that death was imminent.

The last condition is most strictly interpreted by the courts. If the slightest hope or expectation of living is expressed, the statement will be invalidated. On one occasion a declaration was held to be inadmissible because the dying person had used the words, "I have no hope of my recovery at present," and in another because the deceased had only stated that she *thought* she would not recover.

Medical Reports are rarely admitted as evidence in trials in England, for the law requires the medical witness to be present in court so that he may give his evidence orally, and be cross-examined upon it. In one case, however, in which a doctor was prevented by illness from attending in person, a written report of matter which was not in dispute was, with the consent of both parties, accepted instead. In Scotland, reports are more frequently employed. A medical man may be called upon by the procurator-fiscal to report upon such matters as wounds in the living, or stains on clothing, or to conduct a post-mortem examination, or analyse the contents of viscera, and report thereon. Such reports should be simple and concise, and should clearly distinguish between the facts observed, and the deductions drawn from those facts.

While written statements cannot be substituted for oral evidence, the medical man should remember that reports made for any purpose may subsequently come under legal enquiry, and may be the subject of cross-examination. It is well, therefore, always to keep exact copies of such documents. The statements made by a medical

witness before a coroner or magistrate, and any reports he may have submitted, are all placed on record. If the case goes to trial at a higher court, any important discrepancies between the statements now made, and those uttered at the previous investigation, will seriously weaken his evidence, and even small differences will be made the most of by the opposing counsel.

Hearsay Evidence.—The general rule is that hearsay or second-hand evidence, whether parole or documentary, is inadmissible, but the following exceptions of medico-legal interest are made :—

(*a*) **Statements which form part of the *res gestæ*—*i.e.***, the actual incidents under consideration or the conduct of the individuals concerned, such as the cries of a person who is being stabbed. An important instance of this rule of evidence is the admissibility of statements made to others by a woman who has recently been raped. Both the fact and full details of any complaint she made are admitted, as showing that her conduct has been consistent with the story she tells.

(*b*) **Statements Showing the Bodily or Mental Feelings.**—"When the bodily or mental feelings of a person are material to be proved, the usual expressions of such feelings, made at the time of question, are admissible as original evidence; for example, what was said to a surgeon immediately after an assault. But the *particulars* of a complaint so made cannot be asked in examination-in-chief; for instance, whether the complainant alleged that the prisoner committed the offence, and how it was done" (Harris' *Crim. Law*).

(*c*) **Confessions**, if made freely and voluntarily.—No confession is admissible if it has been made in consequence of an inducement of a temporal nature. Even such words as, "you had better tell the truth," are regarded as implying a threat or benefit—*i.e.*, an inducement—and a confession obtained by their use is, therefore, inadmissible. But a confession made after the individual has been warned by someone in authority—*e.g.*, a constable—that he need not say anything to incriminate himself and that what he did say would be taken down and used as evidence against him, is admissible.

(*d*) **Dying Declarations** made under proper conditions.

Common and Expert Evidence.—Common evidence is that given by a person who testifies to facts which have actually come under his observation; expert evidence consists of statements of opinion or deductions drawn from facts observed by the witness himself, or related to him by others. The evidence given by the medical man may be of either character. Thus, when he describes the position and extent of a wound, he is acting as a common witness, but when he expresses an opinion as to whether the wound was homicidal or suicidal, or whether the treatment of the wound was or was not correct, he is acting as an expert witness.

The student is sometimes puzzled by the term *skilled* witness. This simply means a person who has special knowledge of the subject upon which he is giving evidence. His testimony may be

either common or expert. For instance, only one who has studied pathology can give evidence of the presence of peritonitis in a body; nevertheless, this, though skilled, is common evidence, for it is the evidence of facts which the witness has himself observed. A statement that the peritonitis was probably caused by an attempt to induce abortion is expert evidence.

The Medical Man as a Witness. — **Language.** — All questions should be answered simply and concisely, and, as far as possible, without the use of technical terms. Medical phrases and names may not only be unintelligible to the jury, but may be wrongly interpreted, and give rise to serious misunderstandings. For instance, on one occasion, a medical witness spoke of an extravasation of blood. This was regarded by the jury as meaning hæmorrhage, and led them to believe that the injury in question was more serious than was actually the case. The term "bruise" should be used for ecchymosis or contusion, "coverings of the brain" for meninges, "main blood-vessel" for aorta, "thigh-bone" for femur, &c. (*v.* also "Hysteria," p. 159). No more than the question asked should be answered.

Notes.—These may be used by a witness to refresh his memory of numbers, dates, &c., but must not be read continuously. The original notes must be employed, and they must have been made at, or very shortly after, the time of the occurrence to which they refer. Counsel may demand to peruse them.

Quotations from Books, &c.—The medical witness should abstain from quoting the opinions of others on any point. If the matter under consideration is one of which he has not had personal experience, he should adopt the views of the best authorities, and give them as his own. Not infrequently, however, counsel will quote a statement in a book with a view to rebutting the evidence just given by the medical man. When this is done, the witness should, before replying, ask for the book, and read the passage carefully, together with the context, as the latter may considerably modify the bare statement. He should note also the date of the book.

Professional Secrecy in the Witness-box.—The medical man may find himself in a very unpleasant position when he is called upon to divulge matters which the ethical code of his profession forbids him to reveal. However, the law of England recognises no privilege in communications between doctor and patient, and the medical witness can be compelled to answer any question that is put to him, save one tending to incriminate himself; refusal to do so renders him liable to be committed for contempt of court. This ruling was first made by Lord Mansfield in 1776 during the trial of the Duchess of Kingston for bigamy, and has been upheld on many subsequent occasions. Nevertheless, the medical man should always be extremely reluctant to make such revelations, and should appeal to the judge or magistrate as to the necessity of answering the questions. The judge will then exercise his discretion, and in many cases will permit the witness to refuse to reply; or he may

allow the answer to be written down and handed to him. If, however, a verbal reply is insisted upon, the medical man can then make it with the consciousness that he has done his best for the interests of his patient. As regards himself, no action will lie for any statements made in the witness-box.

In France, and in many of the States of America, communications between a patient and his medical attendant are privileged, and their disclosure cannot be enforced in a court of law.

Procedure.—The Subpœna.—This is the document by which the attendance of a witness before either a civil or a criminal court is enforced. Without such a summons (unless he has been bound over by a coroner or magistrate at an earlier hearing) a witness may, but is not obliged to attend. A subpœna must be personally served, and, **in a civil case**, if the witness lives at a distance from the court, reasonable expenses for travelling to and from, and residing during the trial of the case, must be paid or tendered at the time of service. If this is not done, the subpœna may be disregarded. Otherwise, failure to appear renders the individual liable to be committed for contempt of court, or to an action for damages. A witness to fact is not entitled to be paid for loss of time, but a professional witness, who is called upon to give evidence on a matter of opinion, is entitled to a fee which varies with the court and circumstances. If a witness attends without having been subpœnaed, he may decline to give evidence until his expenses have been paid, provided he does so before he has been sworn. After he has been sworn he is bound to reply.

In **a criminal case** no tender of expenses need accompany the service of the subpœna. Such payment may be subsequently made by an order of the court or magistrate.

When a person has been committed for trial by a magistrate or coroner, the witnesses examined are usually bound over by recognisance to appear at the trial and give evidence. If they do not appear, the recognisances may be estreated, and the penalty levied.

The Coroner's Court.—The Coroners Act of 1887 provides that, "where it appears to the coroner that the deceased was attended at his death or during his last illness by any legally qualified medical practitioner, the coroner may summon such practitioner as a witness; but if such person was not attended, then the coroner may summon any legally qualified practitioner who is at the time in actual practice in or near the place where the death happened. . . . The coroner may either in the summons, . . . or at any time between the issuing of that summons and the end of the inquest, direct such medical witness to make a post-mortem examination of the body of the deceased, with or without an analysis of the contents of the stomach or intestines." Failure to obey a coroner's summons without good and sufficient cause, renders the practitioner liable to a fine not exceeding five pounds. Nevertheless, though the statute directs that the analysis of the viscera shall be performed by the practitioner, the duty is usually entrusted to an expert.

In London, the County Council has nominated several expert pathologists to conduct post-mortems and assist the coroner in obscure or difficult cases. The summoning of such an expert in preference to, or in addition to, the medical man who was in attendance on the deceased, or one living in the neighbourhood, is at the coroner's discretion. When fairly exercised, this is a most desirable power for the coroner to possess, for, in a large number of cases, the ordinary practitioner is not sufficiently familiar with the post-mortem signs of death from violence or poisoning to perform the autopsy satisfactorily. On the other hand, great dissatisfaction has been caused in certain quarters by setting aside the general practitioner in favour of an expert in cases apparently quite straightforward.

In November, 1905, the British Medical Association, acting as ratepayers, challenged certain repayments made by the London County Council to the coroner for Westminster and South-Western London for fees paid to Dr. Freyberger, an expert pathologist. The cases objected to were classed under the following heads:—

(*a*) Cases in which the medical man in attendance on the deceased before his death gave evidence before the coroner, but was not directed to make any post-mortem examination.

(*b*) Cases in which the medical man in attendance on the deceased during lifetime was neither summoned as a witness nor gave any evidence at all.

(*c*) Cases in which no medical man was engaged in attendance on the deceased either before, or at, or immediately after, his death, and in which the coroner did not summon a medical practitioner in actual practice in or near the place where the death happened.

(*d*) Cases in which a medical man was requested to make a post-mortem examination and to give evidence, but although the jury made no application under Section 21 of the Coroners Act, 1887, Dr. Freyberger was engaged to assist at the post-mortem examination.

After careful consideration the auditor decided to allow the whole of the contested payments (see *The Times*, January 12, 1906). It is understood that an appeal is to be made against the decision.

A coroner's inquest, though it may terminate in the committal of a person for murder or manslaughter, is not a trial, but an enquiry into the cause of death. Hence the coroner is not bound by many of the rules of evidence and procedure which obtain in higher courts. Hearsay evidence, for instance, may be freely admitted. The procedure at an inquest is very simple. After having been sworn, the jury must, by law, "view" the body, which, in some courts at least, merely consists in glancing through a glass window at a figure almost entirely covered up. The coroner then examines the witnesses on oath, and, as he finishes with each one, permits the jury to ask further questions if they wish. Solicitors and others representing interested parties are allowed to be present in the court, but may only question the witnesses by permission of the coroner. At the conclusion of the evidence, the coroner sums up, and the jury return their verdict.

Other Courts before which a medical man may have to appear as a witness in criminal cases are, the King's Bench Division of the High Court of Justice; the Central Criminal Court or the Assize Courts; the Sessions, quarter and petty; City Police Courts, &c.: and, in civil cases, the House of Lords; the Court of Appeal; the various divisions of the High Court of Justice; the Assize Courts; and County Courts. The features of medico-legal interest which may arise in connection with them have been sufficiently considered in preceding pages.

Fees Allowed to Medical Witnesses.—It may be convenient to summarise these briefly here.

Coroner's Court.—For attending to give evidence when no post-mortem examination has been made, one guinea. For making a post-mortem examination with or without an analysis of the contents of the viscera, and attending to give evidence, two guineas. But no fee will be paid to a practitioner for making a post-mortem examination without the previous direction of the coroner. When an inquest is held on the body of a person who has died in an asylum, public hospital, infirmary, &c., the medical officer whose duty it may have been to attend the deceased person is not entitled to such fee or remuneration.

Petty Sessions,* Quarter Sessions, and Assizes.—One guinea per day if the witness resides or practices within 3 miles from the court, and two guineas per day if at a greater distance. For attending to give evidence on the same day in two or more separate and distinct cases, whether in place of residence or otherwise, not more than two guineas per day. But, unless detained from home or business for at least four hours, only half the above fees are allowed. If the witness attends from a distance of more than 2 miles, third class return railway fare is allowed; and if conveyance is other than by railway, not more than one shilling per mile one way.†

High Court of Justice.—King's Bench and Chancery Divisions, one guinea per day if resident in the town in which the case is tried; two to three guineas a day if resident at a distance from the place of trial, with reasonable travelling expenses not exceeding one shilling per mile one way. Probate and Divorce Courts, one guinea per day if resident within 5 miles of the General Post Office; and two to three guineas if resident at a greater distance, with travelling expenses as above.

Court of Appeal.—One guinea per day if resident in London; two to three guineas if resident at a distance, with reasonable travelling expenses.

House of Lords.—Two guineas a day; and one guinea a day for hotel expenses if away from home, with reasonable travelling expenses not exceeding one shilling per mile one way.

In a civil case in any court, the medical man who is asked to give *expert* evidence may make what arrangement he pleases as to his fee, with the litigant's solicitor, before undertaking to appear.

* For exceptions in the case of certain misdemeanours, *v. Brit. Med. Journ.*, Mar. 19, 1904.

† For fuller details see *Regulations as to Allowances to Prosecutors and Witnesses in Criminal Prosecutions.* Spottiswoode & Co., 54 Gracechurch Street, E.C. One Penny.

PART II.—TOXICOLOGY.

CHAPTER XIX.

GENERAL FACTS WITH REGARD TO POISONS.

CONTENTS.—Definition of a poison, and the law with regard to the administration of poisons—Sale of poisons—Action of poisons—Circumstances modifying the action of poisons—Statistics of poisoning by accident, suicide, and homicide—Diagnosis of poisoning—Conduct of the medical man in a case of suspected chronic poisoning—Principles of treatment of poisoning; antagonism—Separation of poisons from organic material, &c.—Classification of poisons.

Definition of a Poison, and the Law with regard to Administration of Poisons.—**Toxicology** is the science of poisons. It is not an easy matter to define a poison tersely, for almost any substance exerts deleterious effects upon the system when taken in sufficiently large amount; perhaps the best definition is that given by Taylor (*op. cit.*), which runs as follows:—"A poison is a substance which, when taken into the mouth or stomach, or when absorbed into the blood, is capable of seriously affecting health or of destroying life by its action on the tissues with which it immediately, or after absorption, comes in contact." Boiling water becomes a poison under this definition, but there is no logical reason why it should not be included. For legal purposes, however, the definition of a poison is unimportant, for the words of the statutes dealing with the administration of poisons are so wide that a criminal cannot now escape on the ground that the substance taken was not a poison. The Offences against the Person Act, 1861 (24 and 25 Vict. c. 100) provides as follows:—

Section 11.—"Whosoever shall administer or cause to be administered to, or taken by, any person, any poison *or other destructive thing* with intent to murder, shall be guilty of felony."

Section 22.—"Whosoever shall unlawfully apply or administer to, or cause to be taken by, or attempt to apply or administer to, or attempt to cause to be administered to, or taken by, any person, any chloroform, laudanum, or other stupefying or overpowering drug, matter, or thing, with intent, in any of such cases, thereby to enable himself or any other person to commit, or with intent, &c., to assist any other person in committing, any indictable offence, shall be guilty of felony."

Section 23.—"Whosoever shall unlawfully and maliciously administer to, or cause to be administered to, or taken by, any other person, any poison *or other destructive or noxious thing*, so as thereby to endanger the life of such person, or so as thereby to inflict upon such person any grievous bodily harm, shall be guilty of felony."

Section 24.—"Whosoever shall unlawfully and maliciously administer to, or cause to be administered to, or taken by, any other person, any poison or other destructive or noxious thing with intent to injure, aggrieve, or annoy such person, shall be guilty of a misdemeanour."

The last section prevents such practices as the adding of emetics or purgatives to whisky which a servant is suspected of stealing, or the surreptitious administration of "drink cures."

It was held in *R.* v. *Hennah* (Bodmin Assizes, 1877) that a thing to be regarded as noxious must have been administered in quantity sufficient to have produced noxious effects. In this case a man was charged with having administered to a young woman 1 to 1½ grains of cantharides in a fig, but as this amount was too small to do harm he was acquitted.

Sale of Poisons.—While no general definition of a poison is attempted by the law, certain substances are recognised as poisons by the Pharmacy Act of 1868, and their sale must be made in accordance with definite regulations framed for the purpose of preventing them from falling into the hands of irresponsible persons. Two groups of poisons are recognised in the schedule, which has been added to from time to time, and is now as follows:—

PART I.

Aconite, and its preparations.
Alkaloids: all poisonous vegetable alkaloids and their salts.
Arsenic, and its preparations.
Atropine, and its preparations.
Cantharides.
* Cocaine and its salts.
Corrosive sublimate.
Cyanide of potassium, and all metallic cyanides, and their preparations.
Emetic tartar.
Ergot of rye, and its preparations.
* Picrotoxin.
Prussic acid, and its preparations.
Savin and its oil.
Strychnine, and its preparations.
Vermin killers, if preparations of poisons the preparations of which are included in Part I.

PART II.

Almonds, essential oil of, unless deprived of prussic acid.
Belladonna, and its preparations.
Cantharides, tincture of, and vesicating liquid preparations of.
Carbolic acid and its homologues and preparations of, if containing more than 3 per cent. of those substances (except for sheep-wash, &c.).
Chloral hydrate, and its preparations.
Chloroform.
* Cocaine, preparations of.
Corrosive sublimate, preparations of.
* Digitalis, and its preparations.
Mercury, ammoniated, * iodide of, red oxide of, * sulphocyanide of.
Morphine, preparations of.
Opium and its preparations, and preparations of poppies.
Oxalic acid.
* Strophanthus, and its preparations.
Vermin killers containing poisons not included in Part I.

* Added August 18, 1905.

When any poison in either Part I. or Part II. is sold, either wholesale or retail, the box, bottle, vessel, wrapper, or cover in which such poison is contained must be distinctly labelled with the name of the article, the word "poison," and the name and address of the seller. In wholesale dealings, however, the regulations are frequently not observed.

With regard to the list in Part I., no poison may be sold to any person unknown to the seller, unless introduced by some person known to the seller; and, upon every such sale, the seller must, before delivery, make, or cause to be made, an entry in a book kept for that purpose, of the date of the sale, the name and address of the purchaser, the name and quantity of the article sold, and the purpose for which it is stated by the purchaser to be required, to which entry he must obtain the signatures of the purchaser and the person, if any, who introduced him.

Arsenic is the subject of further legislation. In addition to the above, if the purchaser be not known to the seller, there must be a witness to the sale, and the entry must be signed by both purchaser and seller. No arsenic may be sold to a person under age, nor may it be sold (with certain exceptions) unless mixed with soot or indigo in the proportion of one ounce of soot, or half an ounce of indigo to each pound of arsenic.

A registered medical practitioner, who has passed an examination in pharmacy in order to obtain his diploma, may dispense to his patients medicines containing poisons; but must label them with his name and address, and must enter the ingredients and the name and address of the person supplied, in a book kept for the purpose. These regulations, however, are frequently not obeyed. A medical practitioner who keeps an open surgery must conform to all the regulations of the Pharmacy Act.

The meaning to be attached to the word "preparation" has on several occasions been the subject of legal argument during prosecutions for infringements of the Pharmacy Acts. In cases heard recently at the Leeds City Police Court, the Stipendiary Magistrate held that the sale of Easton's syrup, and of Rankin's ointment containing veratrine for the destruction of *pediculi*, though sold as a vermin-killer, must be made in accordance with the regulations pertaining to poisons in Part I. The decision in the case of Rankin's ointment was reversed on appeal to the High Court (see *The Pharmaceutical Journal*, December 23, 1905).

Action of Poisons.—The modes of action of poisons may be classed as follows:—

Local Only.—These are poisons, such as the strong mineral acids, which only injure or destroy the tissues they come directly in contact with.

Remote Only.—Poisons which act only after they have been absorbed into the blood, as, for instance, carbon monoxide and opium. Snake-venom, when introduced into the stomach, has no effect.

Local and Remote.—Poisons which affect the tissues they are in contact with, and have a further action after absorption—*e.g.*, arsenic and carbolic acid.

With regard to remote action, it may be pointed out that many poisons exhibit a special affinity for certain organs or tissues, just as the toxins of typhoid or tetanus select respectively the intestines or spinal cord. Thus, morphia and alcohol affect the brain; digitalis and strophanthus act on the heart; cantharides on the kidneys; potassium chlorate and carbon monoxide on the blood; strychnine on the nerve cells of the spinal cord; and curare on the motor nerve terminals. Poisons are eliminated by vomiting, and by the intestines, liver, kidneys, lungs, and, in some cases, skin and saliva. It is for this reason that it is important in a case of suspected poisoning to preserve the fæces, urine, and vomited material; furthermore, poison may sometimes be detected in the liver or bones after failure to find it in the alimentary tract.

Circumstances Modifying the Action of Poisons.—**Amount Taken.**—As a rule, the greater the quantity of the poison taken, the severer are the symptoms, and the more likely are they to prove fatal. Sometimes, however, a big dose sets up vomiting or purgation, by which it is promptly expelled from the body, when a smaller amount would produce toxic effects. Thus, a large dose of tartar emetic may be promptly and completely returned; doses of half an ounce or more of oil of turpentine are usually evacuated by the bowels, while amounts of one or two drams, which are not sufficient to purge, may cause irritation of the kidneys. Students are required to remember for examination purposes a figure in connection with each poison, which is known as the "fatal dose." This is of little practical value, for it represents the minimum amount of the poison which is known to have caused death, and usually the particular death which determined it, was that of a child, an aged person, or someone suffering from disease. Hence the "fatal dose" is not the amount which might be expected to kill a person under ordinary circumstances, and is not by any means necessarily fatal. The fatal doses of strychnine, tartar emetic, and chloral hydrate, for instance, are actually smaller than the maximum pharmacopœal doses. On the other hand, at least with regard to the commoner poisons, recovery has occurred after amounts enormously greater than the fatal dose have been taken. A rough rule for the student to follow when he cannot remember the fatal dose is to put down about twice or three times the maximum pharmacopœal dose. A medical practitioner may be expected in the coroner's court to be familiar with the fatal dose of a poison, and should previously "refresh his memory."

Method of Administration.—This affects the action of a poison according as it influences the rate of absorption. If the poison enters the system but slowly, the kidneys and other channels of elimination may be able to dispose of it before serious effects are produced. Absorption is most rapid when the substance is injected into the **subcutaneous tissue**, or is inhaled by the **lungs** in the form of a gas. Poisons taken into the **mouth** generally pass down into the stomach, but corrosives may prove rapidly fatal by their action on the glottis. In the **stomach**, absorption varies with the condition of that viscus, being the more rapid when it is empty, and slower

when it is distended with food. Poison may be introduced into the **rectum** in the form of an enema; the rate of absorption there is slower than in the stomach, and about twice the amount is required to produce symptoms of the same severity. Poisoning may follow the giving of a vaginal or uterine injection (*v.* p. 110). Substances placed on, or rubbed into, the unbroken **skin** are but slowly absorbed. Death has occurred in eight hours after using boot-blacking containing nitro-benzene which accidentally stained the feet. If the skin is inflamed absorption is more rapid; toxic effects have on several occasions followed the application of picric acid to scalds.

When a poison is taken in small doses frequently repeated over a considerable interval of time, effects very different from those caused by a single large amount may be produced. Instances of this condition, which is known as **chronic poisoning**, follow the drinking of water containing lead, or beer containing arsenic, or the absorption of carbolic acid from the dressings of a wound, &c.

Physical Condition of the Poison.—This also is chiefly a question of absorption. Thus, gases are more rapidly absorbed than liquids or solids; and a poison already in solution, enters the system more quickly than when it is taken as a solid. A hard-coated pill may pass through the intestines quite unchanged. The degree of concentration of a corrosive liquid largely affects its action; an amount of sulphuric acid, for instance, which would be highly dangerous if concentrated, may be taken with impunity when well diluted.

Age of the Individual.—Children are more susceptible to the influence of drugs than adults; and, speaking generally, the dose for them must be reduced in accordance with the accepted pharmacological rule. Larger amounts, however, of certain poisons, than the usual rule would allow, for instance, arsenic, chloral, and belladonna,* will be borne by children; while, on the other hand, opium is badly borne, and must be administered with great caution. Aged persons are more readily poisoned than adults.

State of Health.—As a general rule, a poison is more likely to produce serious symptoms in a person weakened by disease than in one in good health. But to this there are exceptions. Persons who are in great pain, and those suffering from peritonitis, delirium tremens, and acute mania, for instance, exhibit a marked tolerance for opium. Of local diseases, nephritis is the most important, since it tends to check the elimination of the poison; opium, in particular, must be administered with caution to those suffering from granular kidney. Chronic gastritis increases the effect of irritant poisons.

Habit.—A person who is continually taking non-lethal doses of a drug may, in the case of some poisons, acquire a certain degree of tolerance for it, and larger and larger amounts must be given in order to produce the same effects. Physicians are familiar with this in the case of opium. Towards the end of a long, painful illness it is often necessary to give very large doses of morphia, and repeat them at short intervals in order to relieve the symptoms.

* Exceptionally, however, a remarkable susceptibility to the action of this poison is displayed by children, *v.* "Belladonna," Chap. xxiv.

Other drugs for which tolerance can be acquired by habit are alcohol, chloral, tobacco, and cocaine.

Idiosyncrasy.—Some individuals exhibit a constitutional intolerance for particular drugs or articles of diet. Thus, certain persons cannot take eggs, almonds, or shellfish; others develop a rash after a small dose of potassium bromide, or are salivated by a minute quantity of mercury. Opium, belladonna, and potassium iodide are other drugs in the same category.

Statistics of Poisoning—Accidental Poisoning.—The greatest number of deaths from poisoning are due to accidental, negligent, and industrial causes. The Registrar-General's figures show that during the ten years ending 1903, 5,958 deaths of this character occurred in England and Wales, 3,880 being of males and 2,078

	1894-1903.			1883-1892.		
	M.	F.	Total.	M.	F.	Total.
Lead,	1,013	175	1,188	831	209	1,040
Anæsthetics, chloroform, ether, A.C.E, &c., for operation,*	685	387	1,072	249	135	384
Opium and morphine,	536	339	875	503	373	876
Chlorodyne,	66	36	102	56	30	86
Soothing syrups, &c.,	5	3	8	18	22	40
Food, ptomaine poisoning,	296	260	556	25	30	55
Carbolic acid,	184	153	337	169	101	270
Coal-gas,	110	75	185	54	25	79
Arsenic,	66	107	173	37	14	51
Carbon monoxide from kilns, &c. (not in mines),	116	16	132	115	1	116
Hydrochloric acid,	91	35	126	48	18	66
Ammonia,	60	63	123	39	25	64
Alcohol,	57	30	87	81	24	105
Carbon dioxide in wells, &c.,	80	4	84	69	3	72
Chloral hydrate,	65	16	81	89	22	111
Phosphorus,	29	42	71	24	47	71
Strychnine and nux vomica,	43	24	67	22	21	43
Atropine and belladonna,	33	32	65	38	20	58
Oxalic acid and oxalates,	28	28	56	17	9	26
Prussic acid and cyanides,	47	7	54	36	32	68
Sewer gas,	41	13	54	10	...	10
Sulphuric acid,	34	9	43	30	9	39
Mercury,	15	17	32	22	11	33
Aconite,	22	5	27	19	21	40
Paraffin,	19	5	24	9	2	11
Nitric acid,	14	6	20	18	7	25

* Previous to 1898, deaths from anæsthetics for operation, and those due to chloroform otherwise accidentally taken, were not separated in the returns, but only about 6 per annum come within the latter category.

of females. The poisons most frequently responsible are shown in the table on p. 188, the figures for the period 1883-1892 (taken chiefly from Wynter Blyth) being also given for comparison.

Other poisons which accounted for 10 or more deaths from 1894 to 1903 are cocaine, acetic acid, camphor and camphorated oil, potassium bichromate, and fungi.

The apparently enormous increase in ptomaine poisoning is probably due to more correct diagnoses. Deaths from soothing syrups show a marked decrease, but those from chlorodyne have increased. The large number of deaths from arsenic is chiefly due to the epidemic of beer poisoning which prevailed in 1900 and 1901. Increases are to be noticed in poisoning by carbolic acid, hydrochloric acid, ammonia, strychnine, oxalic acid, sulphuric acid, and paraffin; and decreases in poisoning by alcohol, chloral hydrate, cyanides, and aconite. The differences in the sex incidence are chiefly due to differences in occupation. Poisoning by lead, carbon monoxide, and carbon dioxide are much more frequent among men than among women owing to the risks of their occupations. On the other hand, women show an excess in phosphorus poisoning, probably due to their large employment in match factories.

Suicidal Poisoning.—The total number of deaths of this character registered from 1894 to 1903 was 5,051, of which 2,923 were among males and 2,128 among females. The distribution according to sex and poison was as follows:—

	1894-1903.			1883-1892.		
	M.	F.	Total.	M.	F.	Total.
Carbolic acid,	797	826	1,623	219	271	490
Opium and morphine,	432	189	621	330	167	497
Chlorodyne,	36	12	48	8	8	16
Soothing syrups, &c.,	...	...	...	2	3	5
Oxalic acid and oxalates,	270	254	524	115	90	205
Prussic acid and cyanides,	442	45	487	303	41	344
Hydrochloric acid,	204	165	369	83	55	138
Strychnine and nux vomica,	87	92	179	65	85	150
Vermin-killers (chiefly strychnine),	26	34	60	49	69	118
Ammonia,	38	54	92	18	16	34
Phosphorus,	20	60	80	28	56	84
Nitric acid,	48	24	72	18	9	27
Sulphuric acid,	30	22	52	29	24	53
Mercury,	30	22	52	16	8	24
Arsenic,	32	14	46	37	20	57
Coal-gas,	32	8	40	1	...	1
Atropine and belladonna,	12	18	30	12	9	21
Potassium bichromate,	23	5	28	7	3	10
Aconite,	13	8	21	9	10	19

Other poisons responsible for more than 10 suicidal deaths from 1894 to 1903 were chloroform, chloral, aconite, and carbon monoxide from charcoal stoves, &c.

The remarkable frequency with which carbolic acid has been selected as a suicidal poison during the last decade is not very easy to understand, in view of the fact that poisoning by it is usually extremely painful. Since 1900 it has been in Part II. of the Schedule, and the number of deaths has diminished, but not very markedly, the average for the three years preceding 1900 being 171 per annum, and for the three subsequent years 140. Most of the other poisons show an increase, particularly hydrochloric, oxalic, and nitric acids, and chlorodyne. Vermin-killer is the only poison which shows a considerable decrease. The marked disproportion between the sexes in the choice of prussic acid is, presumably, to be explained by the males having greater facilities for obtaining the poison; and a similar reason among females accounts for the excess of phosphorus poisoning in that sex.

Homicidal Poisoning.—The poisons employed for 21 murders from 1894 to 1903, and for 38 from 1883 to 1892, were as follows:—

1894-1903.		1883-1892.	
Strychnine,	6	Cyanides,	14
Carbolic acid,	5	Strychnine,	8
Opium,	2	Opium,	6
Oxalic acid,	2	Mercury,	3
Prussic acid,	1	Arsenic,	2
Sulphuric acid,	1	Carbolic acid,	1
Nitric acid,	1	Sulphuric acid,	1
Ammonia,	1	Vermin-killer,	1
Chloroform,	1	Chloroform,	1
Antimony,	1	Chloral,	1

Diagnosis of Poisoning.—In suicidal and accidental cases the attendant circumstances usually enable a diagnosis to be readily made; a suicide does not, as a rule, destroy the external evidence of his act, and a person who has taken something from a wrong bottle by mistake will proclaim the fact at once. When poison is unsuspectingly taken with food, evidence of the occurrence may be furnished by the fact that a number of persons are suddenly seized with illness at about the same time and with similar symptoms. Chronic poisoning by lead in drinking water, or by arsenic in wall-papers, &c., when suggested by the symptoms, may be confirmed by analysis of the water or paper. Homicidal poisoning in which an endeavour is made to simulate natural disease, and no suspicion of foul play exists in the mind of the medical man, may be extremely difficult to detect. The symptoms produced by irritant poisons may closely resemble those caused by gastro-intestinal catarrh, gastric ulcer, or severe colic; narcotic poisoning may be confounded with apoplectic and other forms of coma; belladonna poisoning may suggest acute mania; poisoning by strychnine, tetanus; and phos-

phorus poisoning, acute yellow atrophy of the liver. Equally, also, may mistakes be made in the opposite direction, sudden acute illness being diagnosed as poisoning. That the difficulty is a real one is shown by the errors which have actually been made.

Some striking instances of failure to diagnose poisoning by antimony became known during the trial, at the Central Criminal Court, in 1903, of Severino Klosowski, *alias* George Chapman, for the murder of Maud Marsh, with whom he had lived. The woman was taken ill in October, 1902, and was first seen by a medical man on the 10th of that month. She was then suffering from great pain in the abdomen, vomiting, and diarrhœa. No diagnosis was formed, but it was thought that the symptoms might be due to gastro-enteritis. As the patient's condition became steadily worse during the ensuing ten days, another medical man was called in on October 21, and after a consultation the opinion was formed that the symptoms were due to some acute irritant poison, probably ptomaine. After they had separated, one of the medical men became suspicious of arsenical poisoning, but it was then too late to save the woman, who died on October 22. On analysis of the viscera and their contents, antimony, equivalent to more than 20 grains of tartar emetic, was found. It was also shown that Marsh had been admitted into Guy's Hospital in July, 1902, with symptoms similar to those with which she died, and a diagnosis of peritonitis had been made, but no cause for it found.

In consequence of these facts, the bodies of two other women with whom the prisoner had lived were exhumed.

The first was that of Mary Chapman (or Spink), who died on December 25, 1897. When the coffin was opened on December 9, 1902, the body was found to be remarkably well preserved, "the face and head were those of a woman who might have been coffined that day." No sign of disease was found in the lungs. Abundant evidence of antimony was found on analysis in the viscera, and the poison had permeated the muscles. The death had been certified as due to phthisis.

The second was the body of Bessie Taylor, who died on February 13, 1901, and was exhumed on November 22, 1902. The tissues were dry and shrunken, but showed no putrefaction and had no odour. No trace of cancer was found. On analysis, antimony equivalent to nearly 30 grains of tartar emetic was recovered from the viscera. In this case evidence was given as to the illness which preceded death. The patient was first seen by a medical man (the same who later attended Maud Marsh) on January 1, 1901, and was found by him to be suffering from vomiting, diarrhœa, and pain in the stomach. The diagnosis, however, was obscure, and between January 1 and February 13 no less than three consultations were held with different medical men. One of these, a specialist in diseases of women, suggested that the woman was suffering from uterine disease, another thought the symptoms were due to a severe form of hysteria, and the third diagnosed cancer of the stomach or intestines. The woman died on February 13, and a certificate was

given stating the cause of death to be intestinal obstruction, vomiting, and exhaustion.

Klosowski was found guilty and was executed.

From this extremely instructive trial it is seen that the various diagnoses which may be suggested, or adopted, to explain the symptoms caused by an irritant mineral poison are peritonitis, gastro-enteritis, ptomaine poisoning, uterine disease, hysteria, cancer of the stomach or intestines, intestinal obstruction, and phthisis. The great difficulty arises from the fact that as such cases are very rare, suspicion of criminal poisoning does not enter the mind of the medical attendant. Nevertheless, it is quite clear that in the above case, although the real cause of the symptoms remained unsuspected until just before the death of Maud Marsh, the medical men were by no means satisfied that the diagnosis they had made was correct. The circumstances of the illness of Bessie Taylor would have at least justified putting the facts before the coroner and withholding the certificate pending his decision.

The evidence from which poisoning may be diagnosed is generally stated as follows :—

The symptoms appear suddenly. In poisoning by cyanides, oxalic acid, strychnine, &c., the symptoms appear immediately or within a few minutes; in poisoning by irritants they are usually not delayed for more than an hour.

The symptoms appear in a person who was previously in good health. On the other hand, poison may be administered to a person who is already suffering from disease.

The symptoms appear soon after medicine or food has been taken. This will not aid diagnosis when the poison has entered the body by some channel other than the mouth. In a case which recently came under the writer's observation, a woman exhibited severe symptoms of collapse in consequence of the administration of an enema consisting of a 2½ per cent. solution of carbolic acid, which was given by a nurse to prepare her for an operation on hæmorrhoids, and which was not returned. In anticipation of the anæsthetic the patient had had no food since the previous evening.

But it must be remarked that these indications are only of value in cases of acute poisoning. When a person is suffering from chronic poisoning, whether by accident or design, the symptoms are likely to appear gradually; ill-health may be experienced before the condition becomes serious; and the symptoms, though possibly exaggerated after the taking of food, continue during the intervals between meals. Diagnosis then rests chiefly with the symptoms, but the following occurrences should arouse suspicion of homicidal poisoning:—

The symptoms do not become steadily and progressively worse or better. It may happen that the poisoner has temporarily finished his supply of the drug, or is obliged to go away for a few days, or the patient himself is removed from the influence. The symptoms then abate, only to return when the poison is again administered. For instance, Maud Marsh recovered in Guy's Hospital, but was taken ill again after her return home; and

with regard to her second illness, we read in the evidence that she was very ill on October 10 and 11; was very much better on October 12, and able to take a meal of pork, potatoes, greens, bread, and ginger-beer; and was "as bad as ever" on October 13. Bessie Taylor, also, after being very ill for some time was found one evening playing the piano, and seemed so much better that her medical attendant said he would not call again unless sent for.

The instructions of the medical man are not fully and accurately carried out. He may find, for instance, that after ordering rectal alimentation only, food is still being given by the mouth, or he may discover that the injections are being administered by a person other than the one he intended. The latter point is also illustrated by the illness of Maud Marsh. In consequence of the gastric irritation, feeding by the mouth was stopped, and nutrient enemas were ordered to be given by the nurse, but it was shown that the poisoner himself gave them, though the medical man had no suspicion of the fact.

The demeanour of someone associated with the patient may be suspicious. It may be noticed that some person displays undue solicitude about the patient's health, insists on preparing the food himself, objects to the obtaining of a nurse, and opposes the invalid's removal to a hospital. These are but trivial indications in themselves, and only serve to augment suspicion aroused by other circumstances.

Persons other than the invalid may take some of the food, &c., and display symptoms of poisoning. Thus Maud Marsh's mother took some brandy intended for her daughter, and suffered from abdominal pain, diarrhœa, and sickness in consequence. The nurse tasted some of the brandy and spat it out, exclaiming, "That has burnt my mouth."

Poison may be detected in the fæces, urine, or vomited material. Whenever he suspects poisoning, the medical man should have these substances examined by an expert analyst. If possible, only those specimens voided or vomited in his presence should be sent, and care should be taken that they are received into a perfectly clean vessel. A hint should be given as to the probable nature of the poison, whether narcotic, irritant, &c., so far as it can be determined from the symptoms.

Conduct of the Medical Man in a Case of suspected Chronic Poisoning.—The position—fortunately rare—of the medical practitioner when he suspects that poison is being surreptitiously administered to his patient is one of great difficulty, and this is particularly the case when the evidence he has is not sufficient to enable him take a bold and open course. If, on the one hand, the medical man takes no steps, or inefficient steps, to prevent the crime, and the patient dies, he is certainly partially responsible, and, in the event of a trial following, is likely to be severely censured. Indeed, this has happened on more than one occasion. On the other hand, it is a very serious matter to suggest felonious poisoning even in general terms; while to make an accusa-

tion against anyone may result in the medical man finding himself the defendant in an action for libel or slander, and this even though his suspicions were well founded, if he has not positive proof.

The risks a medical man runs in dealing with cases of this type are well illustrated by an action which was tried at the Lewes Winter Assizes, February, 1905.

A doctor who was attending a lady for chronic alcoholism found her, on at least two occasions, in a condition of stupor and exhibiting symptoms of narcotic poisoning. He consulted another medical man, who expressed the same opinion, though it is not clear from the report that he had seen the patient. From various indications, the doctor formed the opinion that morphia was being criminally administered, with the object of hastening his patient's death. He considered that he had good reasons for not communicating his suspicions to his patient's brother or husband, and he did not know any other of her relations or any confidential friend to whom he could go. In his dilemma he wrote to the patient's solicitors, who were at that time transacting business for her, marking his letter "private and confidential." The solicitors, however, when sending in their bill of costs to the patient also included the costs of writing to her doctor. This led the brother to enquire as to the nature of the letters, with the result that he brought an action for libel against the medical man. The jury returned a verdict for the plaintiff, with damages of one farthing.

In doubtful cases there are certain steps of a non-committal nature which may be taken before resorting to more serious measures. In the first place, particularly when it is the symptoms which have excited suspicion, the medical man must make quite sure that it is not a case of *accidental* chronic poisoning that he has to deal with. In the succeeding pages we shall see that poison may enter the system from wall-papers, culinary vessels, food, and other often curious and unexpected ways, all of which must be borne in mind. An examination of the urine and fæces can always be made on a purely medical pretext, but the result may be negative. A second opinion is of value and should be obtained, but the general practitioner must always remember that (except in the question of malapraxis, *q.v.*) the law regards all medical men as equal, and that the calling in of a consultant in this and similar cases will not relieve him of, or even halve, the responsibility. Each is as much responsible as if he had acted alone.

A course which may awaken the fears of the poisoner, and cause him to desist from his criminal attempts, is for the practitioner to show that he is not satisfied with his diagnosis, and even to indicate that he suspects poisoning by requiring an analysis of the wall-paper, examining the cooking vessels, &c. Other plans which may be adopted are to send the patient away, or to obtain the services of two trustworthy nurses who will prepare and watch the patient's food, &c.

Finally, comes the question of informing one of the patient's relatives or friends. As to whether this should be done, and who should be informed, is so entirely a matter of circumstances that no

definite rules can be laid down. In appropriate cases it may be wisest to tell the suspected person, or even the patient himself. As a very last resort it may be necessary to inform the police.

The course to be adopted in a fatal case is discussed under the heading of "Certification of Death," p. 162.

Principles of Treatment of Poisoning.—The special measures to be adopted in the case of each poison are given, with the description of that poison, in subsequent chapters. We may here indicate the general principles of treatment, which are:—

Removal of the poison from the system.
Conversion of the poison into an innocuous compound by a chemical antidote.
Neutralisation of the effects of the poison by the administration of a drug acting in an opposite manner; the principle of antagonism.
Treatment of special symptoms.

Removal of the Poison from the System.—The methods of doing this are use of the stomach-pump, emesis, and purgation. Of these, the **stomach-pump** is, in the great majority of cases, the most satisfactory and complete. Contra-indications to the use of the stomach-pump are poisoning by corrosives owing to the risk of perforation, and poisoning by strychnine, at least until chloroform narcosis has been induced, owing to the likelihood of reflexly starting the convulsions afresh. Simple warm water may be used, but often it is advantageous to add to it an antidote to the poison, potassium permanganate, for instance, in the case of opium poisoning, and ferric hydrate in the case of arsenic. If the stomach is loaded with food, it is often desirable to give an emetic before using the tube, in order to prevent clogging.

Emesis.—The great advantage of this method of emptying the stomach is the promptness with which it can be resorted to. Domestic remedies are always at hand, and can be administered while the stomach-tube is being obtained. Tickling the throat with a feather is even more rapidly done, but is not very certain in its action. In poisoning by fungi, the particles of which tend to adhere closely to the mucous membranes, an emetic, in consequence of the greater mechanical violence, is likely to be more efficacious than the tube. Emesis may be difficult to produce in cases of poisoning by narcotics, or by substances which diminish the sensibility of the gastric mucous membrane. Emetics should not be given in poisoning by corrosives. There is considerable difference in the modes of action of emetics, and some are more suitable for certain poisons than others. The following are the emetics most frequently used:—

Mustard and Water.—A tablespoonful of mustard may be given in a tumbler of warm water. It is often prompt and efficacious, and is not depressing.

Salt and Water.—One or two tablespoonfuls may be given in a tumbler of warm water.

Zinc Sulphate.—Thirty grains dissolved in half a tumbler of warm

water may be given, and repeated if necessary. It causes only slight depression.

Ammonium Carbonate.—Thirty grains of this stimulating emetic may be taken, but it is not so powerful as the others.

Ipecacuanha.—From 4 to 6 drachms of the wine or 30 grains of the root may be given. It is not particularly depressing, but may be slow in its action, as the effect is partly due to stimulation of the vomiting centre in the medulla after absorption.

Apomorphine.—This is a powerful emetic acting solely on the vomiting centre. It is of great value in cases of narcotic poisoning when swallowing is impossible, but it is open to the objection that it produces considerable depression, and its use is therefore inadvisable in the presence of severe collapse. Apomorphine is best administered hypodermically in doses of one-tenth of a grain.

Tartar Emetic should be avoided, as it is very depressing.

Purgation.—The administration of a brisk purge in appropriate cases often aids the elimination of the poison from the body. It is particularly called for in the case of poisons, such as fungi and ptomaines, which may have passed into the intestines before the symptoms begin.

Conversion of the Poison into an Innocuous Compound by Chemical Antidotes.—The action of the antidote may be to neutralise the poison, as in the case of alkalies and acids; or to render it insoluble, as, for instance, calcium salts with oxalic acid and sulphates with lead; or to oxidise and destroy it—*e.g.*, opium and potassium permanganate; or to render it less active. An illustration of the last mode of action is afforded by the administration of albuminous material, such as white of egg, in cases of poisoning by corrosive sublimate and other mineral salts. The comparatively insoluble albuminates of the metals are thus precipitated, but, unless promptly removed from the stomach, they will be gradually absorbed, and give rise to renewed poisoning.

Neutralisation of the Effects of a Poison by the Administration of a Drug acting in the Opposite Direction.—This involves the principle of **antagonism**, and the drugs administered may be termed **physiological antidotes.** Theoretically, the antagonist of a poison is a substance which produces precisely the opposite effects of the poison by acting on the same nerve-terminals, nerves, nerve-centres, or organs, stimulating where the poison depresses, and depressing where it stimulates. In practice, however, complete antagonism is not met with. It is found, for instance, that two drugs are antagonistic in many important respects, but not in others; or the antagonism may be more apparent than real, one poison, for example, causing convulsions by acting on the spinal nerve-centres, and the other, paralysis by acting on the motor end-plates in the muscles. Nor, again, has it been found that the theoretical antagonist is in every case the best antidote; or that while one drug is a satisfactory antidote in poisoning by another, the reverse is necessarily the case. These various points are best illustrated by actual examples.

Atropine and Physostigmine.—This is perhaps the nearest approach to complete antagonism that can be found. Atropine by acting on the terminations of the secretory nerves checks the flow of sweat, saliva, and laryngeal mucus, making the skin, mouth, and throat dry; by paralysing the terminations of the vagus, it increases the rate of the heart-beat; and by paralysing the ends of the third nerve, it produces loss of accommodation and dilatation of the pupil. In addition, atropine stimulates the respiratory centre and the higher cerebral centres, causing delirium. Physostigmine, also by acting on the nerve-terminals, increases the flow of saliva and sweat, stimulates the vagus, producing slowing of the heart, and causes the pupil to contract. In spite of this marked antagonism, however, physostigmine is of little value as an antidote to poisoning by atropine, for it is a powerful respiratory depressant, and atropine itself in toxic doses, after preliminary stimulation, depresses the respiratory centre, and abolishes the function of the cardiac muscle, death occurring from heart failure and asphyxia. Moreover, physostigmine produces extreme muscular prostration or motor paralysis, an effect which is not neutralised by the atropine. On the other hand, atropine in small doses forms an excellent antidote to poisoning by physostigmine.

Atropine and Pilocarpine.—This is another instance of marked antagonism, pilocarpine promoting glandular secretion, slowing the pulse, and contracting the pupil. It does not affect respiration, and forms a sound antidote to atropine in spite of its depressant action on the heart.

Morphine and Atropine.—Morphine profoundly depresses the respiratory centre, and also the higher cerebral centres, causing coma. To these actions atropine is a true antagonist and valuable antidote. Morphine also produces profuse sweating and contraction of the pupils, but by acting on the central nervous system. Therefore, the neutralisation of these effects by atropine is an instance of *apparent* and not of real antagonism.

Strychnine and Chloral.—Strychnine produces convulsions by stimulation of the nerve cells in the anterior cornua of the spinal cord. On theoretical grounds, both physostigmine and gelsemium should act as antagonists to strychnine, for they both depress the cells of the anterior cornua, but, as a matter of fact, they are of very little use in strychnine poisoning. On the other hand, chloral, which acts to a certain extent on the spinal cord, but chiefly on the cerebrum, is a valuable antidote.

Other instances of more or less true antagonism are furnished by aconite and digitalis, hydrocyanic acid and strychnine, chloroform and amyl nitrite, &c.

Treatment of Special Symptoms.—This subject belongs to the domain of clinical medicine. Briefly, we have to treat cardiac failure by ether, alcohol, strychnine, caffein or coffee, and digitalis; respiratory failure by atropine, strychnine, ammonia, and artificial respiration; coma by the foregoing and mechanical and electrical stimuli; convulsions by chloroform; long-continued vomiting by ice,

demulcents, and morphia; severe pain (which is very depressing) and profuse diarrhœa by opium, &c., &c.

Post-mortem Examination in Cases of Poisoning.—We have already considered the method of performing the autopsy in a case of poisoning, and the precautions to be observed in dealing with the viscera (*v.* p. 15). If possible, the task should only be undertaken by one who has had special experience in toxicology, for there are many points, as, for instance, the smell of a poison on first opening the body, with which the general practitioner is not likely to be familiar. When the stomach and intestines, after removal from the body, have been opened, and the contents poured into clean vessels, careful search should be made in the folds of the mucous membranes for any solid particles of poison which may be remaining. In the examination of the viscera themselves, it is very important not to mistake post-mortem hypostases, softening from incipient putrefaction, perforation from post-mortem digestion which is rare, idiopathic gastric ulcer, gastro-enteritis from acute dyspepsia, &c., for the effects of irritant or corrosive poisoning.

Separation of Poisons from Organic Material, &c.—The substance to be examined may be the contents of a stomach or intestines, vomited material, urine, fæces, organic tissue, food, medicine, wall-paper, &c. The separation and identification of a poison in one of these complex mixtures requires a high degree of chemical knowledge, and can only be performed by one who has made a special study of the subject. In the succeeding pages no attempt is made to describe the various processes in sufficient detail to be of practical value in the laboratory. It is merely intended to give an outline of the methods employed and the principles involved. So also the tests, which in subsequent chapters are given under the heading of each poison, are those which a student might be expected to be familiar with, or which a practitioner might find useful in a case of accidental or suicidal poisoning. For the details of those processes and tests, which require complicated apparatus or considerable time for their performance, larger books must be consulted.

As a general rule, the analyst has some idea of the class of bodies to which the poison suspected to be present belongs, and this may simplify his work. If he is wholly in the dark as to its nature, and has plenty of material to work with, some preliminary tests, such as Reinsch's, and simple extraction with water or dilute hydrochloric acid followed by group tests for metals and alkaloids, may be made with small portions to determine whether a mineral acid, metallic salt, alkaloid, &c., is present; but, in general, the following routine should be adhered to, different portions being used for the various process and one portion preserved if the material permits:—

Microscopical Examination.—Small solid particles of the poison may be recognised among the débris of food, &c. If fragments of leaves or seeds are found, an endeavour should be made to identify them by comparison with known specimens.

Separation of Volatile Poisons.—The material, diluted with water to a thin consistency if necessary, is acidulated with tartaric acid, and placed in a flask heated by a water-bath and connected with a Liebig's condenser, the vapours being collected in an appropriate receiver. The poisons which pass over in this process are phosphorus, hydrocyanic acid, carbolic acid, chloral hydrate (not very freely under atmospheric pressure), chloroform, alcohol, ether, benzene, nitro-benzene, and aniline. Phosphorus is detected by the illumination of the condensing tube in the dark.

Dragendorff's Process for the Separation of Alkaloids, Glucosides, and Vegetable Principles Generally.—This is a highly complex process, suitable when the analyst has no idea of the type of vegetable poison present.

The substance to be examined is finely divided, digested with dilute sulphuric acid at a temperature of 40° to 50° C. for several hours, and filtered. The process is repeated several times with the residue, and the various filtrates are then combined and evaporated to a syrupy consistency. The syrupy fluid is now mixed with three or four times its volume of alcohol, and macerated at a temperature of 34° C. for twenty-four hours. Next, the alcohol is distilled off, and the acid watery residue, diluted, if necessary, with water to about 50 c.c., is successively shaken up with the following solvents, the order given being adhered to unless the analyst has reason to suspect a particular poison, in which case the appropriate solvent may be used first.

Petroleum Ether.—After repeatedly shaking, the ether is allowed to separate from the *acid* watery fluid, and is removed. On evaporation the following are found in the residue:—*Carbolic acid*, *picric acid*, *camphor*, *ethereal oils*, and *aconitine*.

Benzene.—The acid watery residue from the above is similarly treated with benzene. On separating and evaporating the extract *elaterin*, *cantharidin*, *santonin*, *colchicine*, *digitalin*, and other principles are obtained.

Chloroform.—With similar treatment this yields *cinchonine*, *theobromine*, *saponin*, *papaverine*, *narceine*, *picrotoxin*, *helleborin*, &c.

The aqueous solution is now again shaken up with petroleum ether to remove the chloroform. It is then saturated with ammonia, and the above processes are repeated with the alkaline solution.

Petroleum Ether.—This now dissolves out *strychnine*, *brucine*, *veratrine*, *quinine*, *conine*, *lobeline*, *nicotine*, &c. But, in the cold, only parts of the strychnine and other fixed alkaloids are removed.

Benzene.—This extracts *atropine*, *hyoscyamine*, *strychnine*, *brucine*, *physostigmine*, *quinine*, *cinchonine*, *narcotine*, *coaeine*, *thebaine*, *veratrine*, *aconitine*, and others.

Chloroform.—Extraction by this solvent removes the *cinchonine*, *narceine*, and *papaverine*, and a small portion of *morphine*.

Amyl Alcohol.—This dissolves out *morphine*, *solanin*, *salicin*, and traces of *saponin*, *narceine*, &c., still remaining.

Lastly, the aqueous residue is evaporated to dryness with the addition of powdered glass, and the residue extracted with chloroform which dissolves out *curarine*.

Stas-Otto Process for the Separation of Alkaloids.—This process, of which the following description is merely an outline, has been very much modified by Sir Thomas Stevenson. The chemical relations upon which it depends are as follows:—

The salts of the alkaloids are soluble in water and in alcohol, but insoluble in ether.

The uncombined alkaloids are insoluble in water (practically), but are soluble in ether.

The substance to be examined is twice digested at a temperature of 35° C. with rectified spirit alone, and then several times with spirit acidulated with acetic acid. The acid and non-acid residues, which are kept separate, are next evaporated to syrupy consistency, treated with absolute alcohol and filtered, the process being repeated several times. The last extracts are dissolved in water, filtered, and mixed together. By this means much of the organic matter is got rid of, while the alkaloid is present as a salt in the acid aqueous solution. The latter is now repeatedly shaken with ether, which removes still more of the organic matter, but leaves the salt of the alkaloid untouched. The acid aqueous solution is next made alkaline with sodium carbonate, which unites with the acid radicles, and precipitates the alkaloids uncombined. On further shaking with ether the alkaloids are now dissolved, and can be weighed by evaporating off the ether in a tared basin, and tested.

Group Tests for Alkaloids.—The following tests may be used to identify an alkaloid, as such, in a clear solution free from organic matter:—

Iodine, dissolved in potassium iodide solution, gives a reddish-brown precipitate.

Potassium mercuric iodide produces a white or yellowish-white precipitate.

Phospho-molybdic acid gives a yellow precipitate.

Separation of Metals—The Wet Method.—The substance to be examined is finely divided, and mixed with water until it has the consistency of thin soup. It is then heated in a large flask on a water-bath with some crystals of potassium chlorate, and an amount of strong hydrochloric acid about equal to the weight of the original substance. Further small quantities of potassium chlorate are added from time to time, and the process is continued until the liquid is of a yellow colour, and the organic matter has been destroyed or disintegrated. It is then kept hot until the smell of chlorine has passed off, and is filtered hot in order to keep lead chloride in solution. The filtrate will contain the metal in the form of a chloride, and the usual group tests can be applied to it. The residue must be specially tested for barium sulphate and silver chloride, and if lead was present in large amount some of it may have remained behind. Arsenic is only likely to volatilise if the hydrochloric acid solution is concentrated; still, if its presence is

suspected, it is as well to condense and collect the vapours evolved from the flask.

The Dry Method.—This consists in heating the substance to redness until the organic matter is completely carbonised and then extracting with strong nitric acid. It is not applicable if a volatile metal, such as arsenic, antimony, or mercury is suspected to be present.

Other Methods of Identification of Poisons.—In addition to the foregoing processes, the analyst has at his disposal the **spectroscopic method**, the application of which we have already seen in the identification of gases in the blood-stream; the **biological method**, which consists in observing the effects of the poison on animals; and the **bacteriological method**, which consists in making cultures in appropriate media, and is of particular value in ptomaine poisoning.

Classification of Poisons.—It is not possible to frame a classification of poisons which shall be at once scientific and useful, having regard to the extreme diversity of their origins, chemical compositions, physical characters, and symptoms they produce. If any one of these attributes is employed as the basis of a classification, and strictly adhered to, poisons having one feature in common, but differing widely in all other respects are brought together. Hence the system, though scientific, is of little practical value. The best plan is to make use of all the different possible bases at different times in the manner most convenient, grouping some poisons together for one reason, and others for another reason. Thus, we consider the corrosives together because of the similarity of their action, although we have to associate with the inorganic mineral acids an organic alcohol of the benzene series (carbolic acid); and we group the poisonous gases together because they are gases and enter the system by inhalation in spite of the fact that their modes of action are very dissimilar. The classification here adopted, which is based solely upon convenience, is slightly modified from that given by Prof. Dixon Mann, and is as follows:—

Corrosive poisons.
Irritant poisons (metals and non-metals).
Gaseous poisons.
Poisonous carbon compounds.
Poisons of vegetable origin.
Poisons of animal origin.

In the class of **vegetable poisons** no definite subdivision is made, but, as far as possible, those producing similar symptoms are considered together.

CHAPTER XX.

CORROSIVE POISONS.

CONTENTS.—Sulphuric acid—Nitric acid—Hydrochloric acid—Acetic acid—Oxalic acid and oxalates—Carbolic acid—Creosote—Chromic acid—Caustic potash and soda—Potassium carbonate—Ammonia.

Sulphuric Acid, H_2SO_4.

SULPHURIC acid or oil of vitriol is extensively used in the arts, and is easily procurable in large quantities. In 1903 it was responsible for eleven deaths, six suicidal and five accidental. Sometimes the concentrated acid is thrown over a person with criminal intent, a practice more frequent on the Continent than in England.

Fatal Dose and Period.—Half a drachm given in mistake for castor oil killed a child of one year in twenty-four hours; one drachm proved fatal to an adult in seven days. Death usually occurs in from eighteen to twenty-four hours. 60 to 70 per cent. of the cases are fatal.

Symptoms.—Immediately the acid is taken, intense burning pain is felt in the mouth, the gullet, and stomach, and quickly spreads over the whole abdomen. Violent vomiting and retching, accompanied by gaseous eructations rapidly follow, the contents of the stomach being first thrown up, and then acid blood-stained fluid resembling coffee-grounds mixed with shreds and larger pieces of mucous membrane. Sometimes the mucous membrane expelled forms a more or less complete cast of the stomach or œsophagus. The lips are often excoriated and brownish, especially at the angles of the mouth, but if the poison has been taken in a spoon they may have escaped. The tongue is swollen, and the interior of the mouth whitened and filled with a viscid mixture of mucus, saliva, and corroded membrane, in consequence of which swallowing and speaking are difficult or impossible. The voice is hoarse and respiration laboured. In some cases death occurs from asphyxia owing to swelling of the epiglottis or larynx. Shock is severe, and symptoms of collapse are soon manifested. The pulse becomes small and frequent, and the skin pale, cold, and covered with sweat, but the face may be cyanosed owing to the dyspnœa. The bowels are usually confined, and there may be retention of urine. The vomiting may continue for several hours; the patient gradually becomes exhausted, and death, in some cases preceded by general convulsions, usually occurs within twenty-four hours. Death may occur more rapidly from shock, especially if the stomach has been

perforated. If the person survive the first effects of the acid he may die in from three to eleven days from inflammation of the stomach or œsophagus. Intercostal neuralgia has been observed during this stage, probably due to peripheral neuritis. After an interval of several months, death may occur from chronic inanition owing to impairment of function of the stomach, or stricture of the œsophagus from contraction of the cicatrices.

Treatment.—The acid must be neutralised as quickly as possible. Calcined magnesia is the best antidote, but when not handy, sodium bicarbonate, chalk, plaster from the ceiling, whiting, &c., must be given powdered in water, in spite of the disadvantage of the carbonic acid generated. If none of these substances can be obtained, large quantities of water should be administered to dilute the acid. The stomach-pump should on no account be used owing to the risk of perforation. Morphia must be injected hypodermically to relieve the pain. Tracheotomy may be necessary if respiration is much impeded. Later, demulcents should be given.

Post-mortem Appearances.—In cases fatal within twenty-four hours, the effects of the acid are strikingly marked. There may be streaks and spots of a yellow or brown colour about the angles of the mouth, chin, and neck. The mucous membrane of the tongue, mouth, and œsophagus is of a yellowish, brown, or dark grey colour, and is corroded, softened, and detached in places; but occasionally the œsophagus escapes in a remarkable manner. Prof. Dixon Mann met with a case in a child in whose stomach there was a perforation as large as a shilling, with blackened and corroded edges, yet neither the mouth nor œsophagus showed the least trace of corrosion. The stomach may be collapsed or distended with gas. It usually contains a brown or almost black grumous liquid, consisting chiefly of mucus and altered blood. The entire mucous membrane may be brown or black in colour, softened and corroded; in places it is completely stripped off, and then the underlying tissues are seen to be intensely inflamed. Sometimes the blackening and corrosion occur in patches. If perforation has occurred, the acid may have attacked the adjacent viscera, but the peritoneum over the stomach may be inflamed without perforation. Similar appearances may be found in the duodenum if death were not immediate. The larynx and, occasionally, the air-passages and lungs may be stained and corroded.

If the patient live for a few days after taking the acid, the above appearances are modified by inflammatory reaction. In cases fatal after the lapse of a few months, the stomach may be found to be contracted, the walls thickened, and the inner surface ulcerated, cicatrised, and more or less devoid of mucous membrane; and the œsophagus may exhibit one or more strictures.

Tests.—On dark cloth sulphuric acid produces brownish-red stains, and these may be seen about the clothing of a person who has been poisoned.

Barium chloride produces a white precipitate insoluble in hydrochloric acid.

Nitric Acid, HNO_3.

Nitric acid, or *aqua fortis*, is largely employed for manufacturing purposes. In 1903 it caused one accidental and nine suicidal deaths, and one death by murder.

Fatal Dose and Period.—A boy died in thirty-six hours after taking two drachms. A man recovered from the effects of half an ounce. Death usually occurs in from eighteen to twenty-four hours. Of thirty-six cases, twenty-six were fatal.

Symptoms.—These on the whole resemble the symptoms of sulphuric acid poisoning, commencing with severe pain and violent vomiting, and being followed by collapse. Several points of difference have, however, to be noted. The staining of the lips and skin is of a more distinctly yellow colour, and the vomited material is yellow, unless much mixed with altered blood, when it is of a dirty brown colour. The teeth are stained yellow, and the enamel may be destroyed. Gas is readily evolved from organic matter in contact with strong nitric acid, and the distension of the stomach is therefore more marked than in the case of sulphuric acid poisoning. This tends to increase the dyspnœa, and makes the abdomen, if possible, even more exquisitely tender. Owing to the fuming character of the acid, the air-passages are more likely to be attacked, and bronchitis, congestion of the lungs, and pneumonia may follow. Inhalation of the fumes alone without drinking any of the acid may be fatal. Persons who have endeavoured to wipe up large quantities of nitric acid, which have been accidentally spilt, have subsequently died with symptoms of asphyxia. In some of these cases, the symptoms have not appeared until several hours after the fumes have been inhaled, and death has then taken place rapidly. Death may ensue from secondary complications after the lapse of several months.

Treatment.—As for sulphuric acid poisoning.

Post-mortem Appearances.—If death has occurred soon after the acid has been taken, the lips and chin exhibit spots and streaks of a yellow or brown colour. The interior of the mouth and the tongue are similarly stained, the mucous membrane is eroded in places, and the epithelium is destroyed. The œsophagus is thrown into longitudinal folds, and the mucous membrane is yellow, softened, and inflamed. The stomach is usually distended with gas. The interior is stained and corroded, and the lining detached in places. Perforation is not so frequent as with sulphuric acid, and blackening is not so marked. The duodenum exhibits similar features. The larynx is often intensely inflamed, and the lungs may be congested.

Tests.—On dark cloth, the strong acid forms yellowish-brown stains.

If a crystal of ferrous sulphate be dissolved in the acid (or solution of a nitrate) and a little strong sulphuric acid poured gently down the side of the test-tube, a brown ring is formed at the junction of the liquids. This test is valueless in the presence of organic matter.

Neutralise the acid with caustic soda, evaporate to dryness, add a crystal of brucine and a drop of strong sulphuric acid. A bright red colour is produced.

Hydrochloric Acid, HCl.

This acid, also known as spirit of salt and muriatic acid, is very largely employed in commerce. It is a favourite suicidal poison, and in 1903 was responsible for forty-five deaths of this nature and ten accidental deaths.

Fatal Dose and Period.—A teaspoonful was fatal to a girl of fifteen; recovery has followed the taking of one and a half ounces of the strong acid. Death usually occurs in from eighteen to twenty-four hours.

Symptoms.—The corrosive action is not so marked, and the lips and face are not stained, otherwise the symptoms resemble those of nitric acid poisoning.

Treatment.—As for sulphuric acid poisoning.

Post-mortem Appearances.—These are more like the appearances of sulphuric than nitric acid poisoning, owing to the absence of yellow staining, but the signs of corrosion are not so marked, and perforation of the stomach is less frequent. The mucous membranes are inflamed, and may be reddened, or stained a dirty white or grey colour, and blackened in places where blood has been extravasated.

Tests.—Reddish stains are produced by the acid on most kinds of cloth.

Silver nitrate gives a white precipitate insoluble in nitric acid but soluble in ammonia.

Acetic Acid, CH_3COOH.

During the ten years ending 1903, twenty-one deaths were certified as due to acetic acid poisoning—thirteen accidental, and eight suicidal. Glacial acetic acid acts as a corrosive, producing corresponding signs and symptoms. Owing to the volatility of the acid, the respiratory mucous membranes are generally severely irritated, and, in some cases, death is due to asphyxia from acute laryngitis. One teaspoonful has proved fatal to a child. The dilute acid is merely irritant.

Tests.—Acetic acid is readily recognised by its smell. If warmed with alcohol and sulphuric acid, the fruity odour of ethyl acetate is evolved.

Oxalic Acid, $(COOH)_2$.

Oxalic acid forms colourless, transparent, prismatic crystals resembling zinc or magnesium sulphate. It is employed by workers in leather, brass-polishers, dyers, and straw-hat makers. Potassium binoxalate, known as salts of sorrel or lemon, is used for taking stains out of linen. Oxalic acid is one of the poisons most frequently selected by suicides, being responsible for eighty-nine deaths of this character in 1903. Accidental poisoning sometimes occurs

from mistaking the acid for Epsom salts, and, in rare cases, eating sorrel leaves, which contain salts of oxalic acid, has proved fatal; seven deaths were due to accident in 1903, and one to murder.

Fatal Dose and Period.—Sixty grains killed a boy of sixteen in eight hours. Recovery has occurred after half an ounce had been taken. Death sometimes occurs within a few minutes, and, if a large dose has been taken, usually within an hour; but, in some cases, life has been prolonged for several days. More than half the cases are fatal.

Symptoms.—Oxalic acid has two distinct toxic actions, (1) local, as a corrosive, (2) remote, after absorption, on the nervous system. The preponderance of the symptoms due to one or other of these actions depends upon the concentration of the acid and the amount that is taken. When a large quantity of the solid crystals or strong solution is swallowed, an intensely sour acid taste is felt in the mouth, and burning pain in the gullet and stomach. Severe vomiting occurs at once or in a few minutes, the ejected material consisting of greenish-brown or nearly black mucus and altered blood. The abdomen is extremely tender, and the individual lies doubled up. If life is prolonged for an hour or two there may be diarrhœa and tenesmus. Symptoms of collapse appear; the pulse is small and frequent, the skin cold and clammy, and the respiration laboured. Convulsions, delirium, and coma may precede death.

When the diluted acid is taken, the irritant symptoms are proportionally less marked. Vomiting may be delayed for some hours (seven in one case) or may not occur at all. The nervous symptoms are more prominent. There may be tingling or numbness in the extremities, twitching of the muscles of the face, trismus, general tonic or clonic convulsions, and aphonia which may persist for some days after recovery. If the stomach is empty and the poison is, therefore, readily absorbed, death may occur with great rapidity from depression of the heart.

Treatment.—Chalk, whiting, or ceiling plaster convert oxalic acid into the almost insoluble calcium salt. Alkalies and their carbonates are of no avail as the salts they form are very soluble. The stomach-pump should not, if possible, be employed, but it may be used with extreme caution in a case in which vomiting has not occurred. Apomorphine is too depressing, and other emetics would probably not act. Stimulants may be required, and a full dose of castor oil should be given.

Post-mortem Appearances.—If the concentrated acid has been taken, the mucous membrane of the mouth is white (or occasionally brownish), softened, and easily detached. The interior surface of the œsophagus is thrown into longitudinal folds and is more or less corroded. The stomach contains a brown grumous fluid. Its mucous membrane may be white, or reddened and inflamed, or, sometimes, almost as black as in sulphuric acid poisoning. In places the muscular wall is exposed, but complete perforation is rare. The duodenum may exhibit similar features.

Tests.—When heated in a porcelain dish the crystals are completely dissipated.

Calcium chloride gives a white precipitate with oxalic acid and oxalates, insoluble in acetic, soluble in hydrochloric acid.

Silver nitrate gives a precipitate soluble in nitric acid and in ammonia.

Potassium Binoxalate, C_2O_4KH.

Half an ounce of this salt has been fatal in eight minutes. The symptoms are much the same as those produced by the acid. Similar treatment is called for, but the stomach-pump may be used as the corrosive action is not so great. The tests are the same as for oxalic acid.

Phenol or Carbolic Acid, C_6H_5OH.

This substance is very largely employed for disinfecting purposes, and is a constituent of many disinfecting fluids and powders. Since the middle of 1900 it has been placed in Part II. of the Schedule, but it is still responsible for more deaths than any other poison. In 1903 there were 141 suicidal and 20 accidental deaths from taking carbolic acid. When pure, it consists of long, colourless prisms which become slightly brownish on exposure to air. The addition of a small amount of water converts it into an oily-looking fluid, which has been administered by the mouth or as an enema in mistake for castor oil.

Fatal Dose and Period.—One drachm has proved fatal in twelve hours; a girl of seventeen recovered after taking six ounces of crude carbolic acid. Death usually occurs within three or four hours; but it has taken place within three minutes, and has been delayed for sixty hours.

Symptoms.—Like oxalic acid, carbolic acid acts locally as a corrosive, and remotely as a depressant to the nervous system. When a strong solution of the acid is swallowed, a hot, burning sensation is felt in the mouth, gullet, and stomach, and the angles of the mouth are whitened. Severe pain and vomiting are present in some cases, but, owing to the local anæsthetic action on the gastric mucous membrane, these are often entirely absent. The poison is quickly absorbed and begins to affect the nervous system. Faintness and vertigo are rapidly succeeded by coma and collapse. The pulse is rapid and feeble, the lips cyanosed, the breathing laboured and stertorous, the temperature subnormal, perhaps as low as 94°, and the pupils usually contracted. The urine is often dark green in colour. Sometimes convulsions and trismus occur before death.

Toxic symptoms, sometimes terminating in death, have also followed the use of carbolic acid as an enema or vaginal douche, or on the dressings of a wound. Chronic absorption in the last case is frequently first indicated by the greenish colour of the urine, an appearance which acts as a warning signal.

Treatment.—A soft stomach-tube may be used with caution. After removing the contents, the stomach should be washed out with a solution of magnesium or sodium sulphate, which converts

the poison into a harmless sulphocarbolate. Emetics, including apomorphine, are apt to fail. Stimulants, ether or brandy per rectum or subcutaneously, must be freely given. White of egg and milk are of value.

Post-mortem Appearances.—Where the strong acid has been in contact with the mucous membranes, white or yellowish wrinkled patches, perhaps surrounded by a zone of inflammatory redness, are produced. The gastric mucous membrane is white or brownish and markedly corrugated. It is usually not deeply eroded, but sometimes is as completely destroyed as by a mineral acid. The air passages may be injected, and the lungs congested; engorgement of the right side of the heart and other signs of asphyxia may be marked.

Tests.—The smell of carbolic acid is strong and characteristic. It may be detected about the mouth of a person who has been poisoned, or on opening the stomach.

Phenol is not an acid in the chemical sense of the term, and does not redden litmus. It is readily distilled off from organic matter, and bromine water added in excess to the distillate gives a yellowish-white precipitate.

On warming an aqueous solution with bleaching powder and a few drops of ammonia, a blue colour is produced.

Ferric chloride gives a purple colour with carbolic acid.

Creosote.

This is a mixture of cresol, guaiacol, and other phenols, obtained by the distillation of coal tar. During the ten years ending 1903, it was responsible for 13 deaths—4 accidental and 9 suicidal. Creosote is largely employed in the treatment of phthisis, and, by gradually increasing the dose, a marked degree of tolerance for it can be acquired.

Fatal Dose and Period.—An infant died in sixteen hours, after taking from 24 to 30 drops of creosote. Three 6-drop doses taken in milk proved fatal to a woman of fifty-two in five days.

Symptoms.—Like carbolic acid, creosote acts directly upon the gastric mucous membrane as an escharotic, producing pain and vomiting, and, after absorption, upon the nervous system, causing coma with stertorous breathing, cyanosis, abolition of reflexes, and, in infants, convulsions.

Treatment.—As for carbolic acid poisoning.

Post-mortem Appearances.—The mucous membranes are inflamed, grey or red in colour, and eroded in patches. The kidneys may be congested.

Chromic Acid, H_2CrO_4.

Chromic acid is employed for charging electric batteries. It is a powerful corrosive when taken internally, and has also proved fatal when applied externally to papillary growths.

Corrosive Alkalies—Caustic Potash and Soda.

These substances are met with in the solid form as deliquescent white sticks. Concentrated solutions have a characteristic soapy feel. Though easily procurable, they are not common poisons; only one death (accidental) was caused by caustic potash in 1903, and none by caustic soda.

Fatal Dose and Period.—Forty grains of caustic potash have proved fatal. Death has occurred in three hours. Twenty-four hours is the average period in acute cases, but death may take place from secondary complications after the lapse of weeks or months.

Symptoms.—Burning pain in the mouth and stomach; violent vomiting, the ejected material being stained brown by altered blood and containing shreds of mucous membrane; colicky pain in the abdomen; diarrhœa; and collapse. If recovery follow the first effects, death may occur later from inanition, owing to stricture of the œsophagus or destruction of the gastric mucous membrane.

Treatment.—Vinegar or lemon-juice should be given to neutralise the alkali. The stomach-pump should not be used. Morphia, hypodermic injections of brandy or ether, and demulcent drinks are required.

Post-mortem Appearances.—The mucous membranes are softened, inflamed, and corroded in places. The colour may be chiefly red, or brown, or sometimes almost black.

Tests.—The reaction with litmus is strongly alkaline. Absence of effervescence with an acid distinguishes them from the alkaline carbonates. The tests for potassium and sodium may be made.

Potassium Carbonate.

Potassium carbonate is the chief constituent of pearl-ash and soap-lees. The symptoms and effects of these substances are much the same as those produced by caustic potash and soda, but the corrosive action is not so marked.

Ammonia, NH_4HO.

A strong solution of ammonia is sold as spirits of hartshorn. Of fatal cases of poisoning by ammonia in 1903, ten were accidental and six suicidal. Death has followed inhalation of the vapour alone when a large quantity of the solution has been spilt. Forty drops of Scrubb's cloudy ammonia given by mistake for fluid magnesia to a girl four years old caused great dyspnœa, sloughing of the palate, fauces and buccal mucous membrane, partial unconsciousness, and a rise of temperature to 104° F. at the end of twelve hours. Recovery followed gradually (*Lancet*, June 10, 1905).

Fatal Dose and Period.—One and a half teaspoonfuls of a concentrated solution have proved rapidly fatal. Death has occurred within four minutes, but does not usually take place for several hours or days. Secondary effects may be fatal after many months.

Symptoms.—These comprise burning pain in the mouth, œsophagus and stomach, violent vomiting, intense thirst, dyspnœa, cyanosis, and aphonia or hoarseness from inhalation of the vapour, followed by collapse. Death from inhaling the fumes alone may take place rapidly from asphyxia, or, after an interval, from broncho-pneumonia.

Treatment.—As for poisoning by caustic potash.

Post-mortem Appearances.—The mucous membrane of the mouth, œsophagus, and stomach is intensely reddened and congested, and in places corroded. The air passages are inflamed and sometimes covered with a false membrane. The lungs may be congested. Stricture of the œsophagus and scarring of the wall of the stomach may be found in cases only fatal after an interval.

Tests.—The odour and marked alkalinity.

CHAPTER XXI.

IRRITANT POISONS (METALS AND NON-METALS).

CONTENTS.—Arsenic—Antimony—Tin—Mercury—Lead—Copper—Bismuth—Zinc—Iron—Barium—Silver—Potassium—Phosphorus—Iodine.

Arsenic.

Statistics.—On the average, neglecting years of exceptional epidemics, arsenic causes about four deaths per annum from accident and negligence. From time to time, however, poisoning, either acute or chronic, occurs on a large scale from the unsuspected presence of arsenic in food. The influence on the mortality, of contamination by arsenic of certain beers, during the years 1900 and 1901, is shown by the following figures :—

Deaths from Arsenical Poisoning by Accident and Negligence.

1898	1899	1900	1901	1902	1903
3	3	56	76	2	4

Suicidal deaths are about five per annum. In the past, arsenic has figured prominently in many sensational murder trials, but during recent years its use has not been very frequent. Two murders by the administration of arsenic were recorded in England and Wales from 1883 to 1892, but none from 1894 to 1903.

Occurrence of Arsenic —White arsenic, arsenious acid, or arsenious oxide, As_2O_3, is the most largely used compound of arsenic. It is met with in commerce in the form of white cakes, or white gritty powder; but, when sold in amounts less than ten pounds, it must (with certain exceptions) be mixed with soot or indigo, and it then forms a dark grey or bluish powder. It is used for a great variety of purposes in the arts. *Liquor arsenicalis*, or Fowler's solution, contains 1 per cent. of arsenious acid, and the *liquor arsenici hydrochlor.* is of the same strength. Donovan's solution contains 1 per cent. of arsenious iodide.

Arsenic acid, H_3AsO_4, is employed in the manufacture of magenta and other aniline dyes. Sodium and iron arsenates are used in medicine.

Copper arsenite, $CuHAsO_3$, or Scheele's green, and a compound of copper arsenite and acetate known as Schweinfurt or emerald green, are occasionally used as pigments in cheap wall papers, &c.

Arsenic trisulphide, As_2S_3, or orpiment, is used as a pigment in King's yellow.

Arseniuretted hydrogen, AsH_3, or arsine, is an intensely poisonous, colourless gas, with a peculiar disagreeable smell. It has caused

toxic effects when generated in the laboratory, and has proved fatal to workmen employed in treating silver-lead containing arsenic, with hydrochloric acid.

Arsenic in Food.—White arsenic has been accidentally mixed with food under the impression that it was flour. Five persons were so poisoned in 1891. Fatal results have followed the use of arsenical pigments to colour blanc-mange, Bath buns, and confectionery, but such accidents are rare now. The arsenic in the beer which was responsible for the recent epidemic of arsenical poisoning in the north of England was proved to have been derived ultimately from arsenical iron pyrites from which sulphuric acid had been manufactured. The sulphuric acid had been employed for converting starch into dextrose, and dextrose into invert sugar; and the sugars in their turn had been used in brewing. The samples of beer which were analysed, contained from one-twentieth to one or two grains of arsenic per gallon. It was estimated that at least 6,000 persons had been affected.

Arsenic in Wall-papers, Fabrics, &c.—Arsenical pigments are not so frequently employed for colouring wall-papers as they were at one time, but their use has not wholly ceased. Brown, as well as green, papers may contain the poison. It is probable that the arsenic enters the system as a fine dust, and is also inhaled in the form of volatile compounds generated by the action of *Penicillium glaucum*, and other moulds on the wall-paper. Poisoning has also followed the use of arsenic for colouring children's toys, artificial flowers, stockings, and other articles of attire.

Arsenic in Weed-killers, Fly-papers, Sheep-dip, Rat-paste, &c.—Poisoning from these sources is usually accidental. In 1891 five persons were poisoned, one fatally, by drinking gooseberry wine from a cask which had previously contained weed-killer. In 1884 two women were convicted of the murder of John Flannagan by the administration of arsenic, a solution of which they had prepared by soaking fly-paper in water. Eight persons, four of whom died, were poisoned in 1874 by drinking water which had accidentally become contaminated with sheep-dip.

Arsenic in Substances for External Application.—Poisoning has followed the application of quack nostrums to cancerous growths. Violet powder containing arsenic poisoned a number of infants, two fatally, who had been dusted with it. Certain soaps and cosmetics contain arsenic, and are resorted to on account of the brilliancy they impart to the complexion. In several homicidal cases the purchase or possession of arsenic has been explained by the assertion that it was intended for cosmetic purposes. This defence was set up in the trial of Madeline Smith in 1857, and also in the trial of Florence Maybrick in 1889. The latter had obtained arsenic by soaking fly-papers.

Fatal Dose and Period.—Two grains have proved fatal to a woman. Death usually occurs within twenty-four hours, but may take place in two hours, or be delayed for several days. About half the cases are fatal.

Symptoms—Acute Poisoning.—Usually the symptoms commence within an hour of taking the poison, but in exceptional cases they may not appear for several hours. The individual experiences a feeling of nausea and faintness, soon followed by severe burning pain in the stomach, and violent and persistent vomiting. The ejected material consists at first of the contents of the stomach, perhaps stained black or blue if commercial arsenic has been taken, and then of slimy mucous stained with blood and bile, or of a whitish fluid which has been compared to rice-water. Severe diarrhœa and tenesmus with pain in the rectum follow, the motions being thin and streaked with blood. Intense thirst and burning pain in the throat are experienced. Painful cramps in the legs are frequent. Signs of collapse develop; the skin is cold and clammy, and the pulse feeble and irregular. Respiration is laboured owing to the painful condition of the abdomen and stomach. Tetanic convulsions, spasms, paralysis, or coma may supervene before death.

In exceptional cases, profound depression of the nerve centres occurs, while the signs of gastro-intestinal irritation are subordinate, or even absent. Rapid and severe collapse is followed by deep coma and death in a few hours, without either vomiting or purging having occurred.

Poisoning by Arseniuretted Hydrogen exhibits certain additional features. Whatever the manner in which arsenic is taken into the system, it is excreted into the stomach, and then sets up gastro-intestinal irritation, but when inhaled in the form of a gas it acts also as a direct poison to the red blood-corpuscles, producing jaundice, congestion of the kidneys, hæmoglobinuria, anæmia, and profound nervous depression.

Chronic Poisoning.—The milder symptoms are occasionally seen when a person is taking arsenic under medical advice. Suffusion of the conjunctivæ, puffiness beneath the eyelids, and dryness of the throat are often the first indications, and may be followed by loss of appetite, headache, nausea or vomiting, and mild diarrhœa. Long-continued absorption of the poison leads to malnutrition, gastro-intestinal catarrh, skin lesions such as herpes, erythematous, vesicular or papular eruptions, erythro-melalgia (a condition in which the feet and hands are red, swollen, and exquisitely tender), keratosis (a thickening of the epidermis, especially of the soles and palms), raggedness of the finger-nails, and pigmentation (particularly about the axillæ, abdomen, scrotum, folds of the thighs and knees). Multiple neuritis develops, characterised by hyperæsthesia and other disorders of sensation, and motor weakness or paralysis, often commencing in the lower extremities, and occasioning the "steppage" gait. Laryngitis and bronchitis are generally present. Loss of memory and hallucinations may occur. Progressive emaciation may terminate in death from exhaustion, pneumonia, or phthisis; or frequently death occurs from dilatation of the heart accompanied with general œdema, ascites, &c.

Symptoms of chronic poisoning may also be manifested during convalescence after taking a single big dose of arsenic. When

arsenic has been administered criminally in several large, but not immediately fatal, doses, the clinical picture is one of acute and chronic poisoning combined.

Treatment.—The stomach should be repeatedly washed out, or if the tube is not at hand, emetics given (preferably not tartar emetic). Doses of freshly-precipitated ferric hydrate, made by adding sodium carbonate to *tinct. ferri perchlor.* and filtering through a handkerchief, should be frequently administered, and may be also placed in the water used for washing out the stomach. Demulcent drinks should be given later. Morphia may be required for the pain.

Chronic poisoning calls for general alterative and tonic treatment.

Arsenical poisoning contracted in a factory or workshop is notifiable (*v.* p. 166).

Post-mortem Appearances.—Arsenic exerts a marked action in retarding decomposition, a fact which has often been noticed when the bodies of persons criminally poisoned have been exhumed. The corpse of John Flannagan, which was disinterred in 1884 after 37½ months' burial, was remarkably well preserved, the face being readily identifiable. The effects of the poison are most striking when a large dose has been taken, and the symptoms have been prolonged. The mucous membrane of the stomach is intensely reddened and inflamed, usually in patches, or streaks coinciding with the rugæ, particularly towards the cardiac end, but sometimes involving the entire surface. It is covered with tenacious mucus stained with blood and bile, but, in the centres of the inflamed patches, there may be gritty particles of arsenic or white or yellowish spots of paste-like material consisting of coagulated lymph and arsenic. Punctate ecchymoses and submucous hæmorrhages are often present, and occasionally ulceration of the surface. In rare cases there may be perforation. Of the intestines, as a rule, only the duodenum and rectum are inflamed, but sometimes the canal is affected throughout. Inflammation of the stomach is equally present if the poison has entered the system through the skin, vaginal mucous membrane, or lungs. Fatty degeneration of the liver and kidneys may be observed in cases which have not been immediately fatal, and particularly after poisoning by arseniuretted hydrogen.

Methods of Detection.—When the arsenic is present in solution in bulk, the following tests may be applied :—

Ammonio-nitrate of silver gives a yellow precipitate, soluble in excess of ammonia.

Ammonio-sulphate of copper gives a bright green (Scheele's green) precipitate, soluble in excess of ammonia.

Sulphuretted hydrogen, in the presence of hydrochloric acid, gives a yellow precipitate, soluble in excess of ammonia.

For toxicological purposes, there are two tests of great value, inasmuch as they enable minute quantities of arsenic to be detected. These are :—

(1) **Reinsch's Test.**—This depends upon the deposition of arsenic upon copper. The first step is to ascertain that the reagents are absolutely free from arsenic by boiling some pieces of bright

copper foil with some water and about one-quarter of the same volume of strong hydrochloric acid. If, at the end of half an hour, the copper is undimmed, the test may be proceeded with. The solution is poured off, and the suspected substance, whether vomited material, stomach-contents, urine (which may previously be evaporated to one-sixth its volume), beer, or solid particles picked out of the mucous membrane, is placed in the dish and boiled with water and one-quarter of the same volume of strong hydrochloric acid. At the end of half an hour the strip of copper is removed, and, if stained, is dried with filter paper and heated (over a spirit lamp by preference) at the end of a clean sublimation tube. Four metals are deposited on copper by this process. They may be distinguished by the colour of the stain, and the appearance of the sublimate when examined under the microscope, as follows :—

	Stain.	Sublimate.
Arsenic,. .	Steel grey, or with very small amounts of As, purplish.	Octahedral and tetrahedral crystals.
Antimony, .	Greyish-purple.	White amorphous powder.
Mercury, .	Silvery.	Black globules, looking like a charge of small shot.
Silver, . .	Silvery.	None formed. The copper is unchanged on heating.

Marsh's Test.—The student must be familiar with the details of this for examination purposes, but for laboratory work Reinsch's test is quite sufficient, and can be performed more quickly and easily. Marsh's test depends upon the fact that when arsenic is in contact with nascent hydrogen, arseniuretted hydrogen is evolved. Antimony so treated yields antimoniuretted hydrogen ; hence the test affords a method of identifying either metal. The apparatus employed consists of a Woulfe's bottle or flask, through the cork of which passes a thistle funnel for introducing sulphuric acid and then the suspected substance, and a glass tube bent at right angles and drawn out to a fine point at the free extremity. Hydrogen is generated by the action of sulphuric acid on zinc placed in the flask, and, as the evolution is slow when the metal is pure, a few drops of platinic chloride may be added. After waiting until all the air in the flask has been displaced by hydrogen, the flame of a Bunsen burner is allowed to play on the horizontal tube for half an hour, and if at the end of that time there is no deposit in the tube, the purity of the reagents is established. The solution suspected to contain arsenic

or antimony is now introduced into the flask in small amounts through the thistle funnel, the horizontal tube still being heated. The gas is decomposed by the heat, and a stain of metallic arsenic or antimony gradually develops in the tube. When this is quite distinct, the flame is withdrawn, and the gas which issues from the pointed extremity is ignited. Several pieces of cold porcelain are now held in the flame until stains are formed upon them. These stains may be differentiated by the following appearances and tests:—

Arsenic.	Antimony.
In the Tube.	
The stain is deposited some little distance beyond the flame.	The stain is deposited close to, and on both sides of, the flame.
The colour is nut-brown where the stain is thin, but lustrous black where thick.	The stain is grey where thin, but has a bright metallic lustre where thick.
On removing the tube and heating with the flame of a spirit lamp, the stain is readily volatilised, and is re-deposited as octahedral and tetrahedral crystals of arsenious oxide.	On heating in air the stain moves slowly, and undergoes but little change, or re-sublimes in an amorphous form.
On passing sulphuretted hydrogen through the tube and driving the now greyish film towards the gas by means of a flame, the light yellow arsenious sulphide is produced.	On passing H_2S through the heated tube, the orange-coloured antimony sulphide is produced.
On the Porcelain.	
Chloride of lime (bleaching powder) solution rapidly dissolves the stain.	Chloride of lime solution has no effect.
Yellow ammonium sulphide break up the film, but only dissolves a small portion.	Yellow ammonium sulphide completely dissolves the stain. On evaporation, an orange-coloured spot of ammonium sulphide is left.
If the stain be dissolved in a drop of nitric acid, evaporated to dryness, and silver nitrate added, the brick-red silver arseniate is formed.	The stain is soluble in nitric acid, but a brick-red colour is not given with silver nitrate after drying.

Antimony.

Only two salts of antimony are at all commonly met with—viz., antimony potassium tartrate, $KSbOC_4H_4O_6$, or tartar emetic, a white crystalline powder used in medicine; and antimony chloride, $SbCl_3$, a heavy yellowish liquid. Both accidental and suicidal poisoning by

compounds of antimony are infrequent, but, homicidally, tartar emetic has been employed on several occasions. The details of the most recent, the Klosowski case, are given on p. 191.

Fatal Dose and Period.—Three-quarters of a grain of tartar emetic have been fatal to a child, and two grains (under exceptional circumstances) to an adult woman. Fifteen grains killed a young man in six hours, and ten grains a boy in eight hours. In fatal cases, death usually occurs within twenty-four hours, but may be delayed for several days. Recovery has followed the taking of as much as an ounce of tartar emetic owing to the prompt emesis produced.

Symptoms.—When tartar emetic is swallowed, a strong metallic taste is perceived in the mouth, followed in a short time by burning pain in the stomach, and sensations of heat and constriction in the throat. Incessant vomiting occurs, the ejected material becoming bile-stained, and, finally, perhaps tinged with blood. Profuse diarrhœa follows. Great thirst may be complained of, but swallowing may be difficult. The pulse becomes rapid and feeble, and the skin cold and clammy. The urine may be scanty and blood-tinged, or suppressed. Painful spasms often affect the stomach and limbs. In rare cases a pustular rash appears on the skin. Death may be preceded by coma or delirium.

In exceptional cases, the poison acts as a narcotic. Vomiting may be slight or absent; profound collapse with cyanosis and dyspnœa being followed by coma and death.

Chronic poisoning by the frequent administration of small doses produces symptoms closely resembling gastro-intestinal catarrh, followed by great muscular weakness, extreme emaciation, and death from exhaustion. Such cases are almost always criminal.

Antimony Chloride acts as a powerful corrosive, producing violent grumous vomiting, erosion of the lips and tongue, &c. In addition, there may be symptoms of narcotic poisoning.

Treatment.—Tannin acts as an antidote to antimony by forming an insoluble compound with it. The stomach should be well washed out with a dilute solution of tannic acid, even if profuse vomiting has occurred. Strong tea or coffee may be used if tannic acid is not at hand. Later, demulcent drinks should be given. Stimulants and morphia may be required.

Post-mortem Appearances.—The mucous membranes of the stomach, and, to a less extent, of the duodenum, are reddened and inflamed and covered with a white or yellowish slimy mucus. If decomposition has commenced, this may be of an orange colour owing to formation of the sulphide by the H_2S generated. Sometimes the surface is eroded, and there may be ulceration and hæmorrhage in the large intestine. Antimony chloride produces blackening and extensive destruction of the mucous membranes of the mouth, œsophagus, and stomach.

Tests.—Tartar emetic, heated in a reduction tube, is charred.

A solution is faintly acid, and gives a precipitate with dilute hydrochloric acid soluble in excess.

Reinsch's and Marsh's tests (*v.* "Arsenic").

Tin.

Poisoning by tin and its compounds is rare. Cases have been recorded after eating tinned fruits, but some of these were probably instances of ptomaine poisoning. The symptoms are those of gastro-intestinal irritation. In one case partial paralysis of the legs, anæsthesia, ataxia, and albuminuria followed the wearing of silk stockings which had been impregnated with stannic chloride to increase the weight.

Mercury.

Compounds of mercury accounted for 32 accidental and 52 suicidal deaths in England and Wales during the ten years ending 1903. Chronic poisoning is sometimes seen in those working with the metal or its salts. The following are the forms in which it is met with:—

Metallic Mercury.—This is not an acute poison, but salivation and other constitutional effects may follow its ingestion, or absorption through the skin. Acute symptoms have occasionally been observed to follow the taking of *hyararg. c̄ cret.* Probably in these cases the mercury has become oxidised after long keeping.

Mercurous Chloride, Hg_2Cl_2, or **Calomel,** is not usually an active poison, but doses of 15, 8, and 6 grains have been followed by fatal results (*Guy* and *Ferrier*). It is possible that in these cases the drug was contaminated with corrosive sublimate. Calomel is contained in Steedman's teething powders (*Hutchison*).

Mercuric Chloride, $HgCl_2$, or **Corrosive Sublimate.**—This salt is sometimes used for preserving furs and feathers from moth. A dilute solution is largely employed for surgical purposes. Severe poisoning, in some cases fatal, has followed its use as an enema or a vaginal or uterine douche (*v.* p. 110). Death has been caused by the external application of corrosive sublimate in the treatment of skin diseases.

Other compounds of mercury which are used in commerce or medicine and occasionally cause death are—mercuric oxide and the red ointment containing the same, mercuric sulphide or cinnabar, ammoniated mercury and white precipitate ointment, basic mercuric sulphate or turpeth mineral, red iodide of mercury and its ointment, nitrates, and cyanides of mercury.

Fatal Dose and Period.—Three grains of corrosive sublimate have proved fatal to an adult; but recovery has followed the taking of much larger doses, in one case 370 grains! Death may occur within a few hours, or be delayed for several days. Sugden (*Brit. Med. Journ.*, April 8, 1905) records a case in which a "headache powder" containing, through some unexplained error, two and a-half grains of corrosive sublimate, caused the death of a lady, aged twenty-three, in twenty-two days.

Symptoms—Acute Poisoning.—When a large dose of one of the more active poisons, such as the perchloride or nitrate, is taken,

a metallic taste is perceived, and an intense, burning pain is quickly felt in the mouth, throat, and stomach. Violent vomiting of white or blood-stained stringy mucus follows. The tongue and fauces are whitened. The voice is hoarse and breathing difficult owing to swelling of the larynx, and there may even be fatal œdema of the glottis. Colicky pains in the abdomen are followed by profuse diarrhœa and tenesmus, the stools being thin, and latterly consisting chiefly of bloody mucus. The pulse is small and frequent, the skin cold and clammy, and the temperature subnormal. The urine may be scanty, blood-stained, and albuminous, or may be completely suppressed. In protracted cases, salivation, stomatitis, and fœtor of the breath may appear. Death occurs from collapse, sometimes preceded by convulsions and unconsciousness.

Chronic Poisoning.—The milder symptoms, fœtor of the breath, soreness of the gums, and salivation are not infrequently exhibited by persons who are taking mercury under medical advice. In workers in mercury, instrument-makers, &c., these may pass on to ulceration and gangrene of the cheeks and tongue, necrosis of the jaw, gastro-intestinal symptoms, anæmia, emaciation, and tremors known as "mercurial palsy," usually commencing in the face or upper limbs, and then extending to the legs. Delirium and mania occasionally follow. Mercurial poisoning in factories is now notifiable, and severe symptoms are not often seen.

Treatment.—Probably violent vomiting is already present, particularly if corrosive sublimate has been taken. If not, the tube should be passed with caution, or an emetic given. Albuminous substances, such as raw white of egg mixed with water, or, failing that, milk, should be freely administered, as they precipitate the albuminate of mercury. This substance is insoluble in water, but is gradually digested and absorbed if left in the stomach. It should therefore be removed by further vomiting or use of the tube. Opium and stimulants may be necessary.

Post-mortem Appearances.—When corrosive sublimate has been taken, the mucous membranes of the mouth and œsophagus are inflamed, softened, corroded in places, and of a white or slaty-blue colour. The lining membrane of the stomach may be swollen, partially destroyed, and white, or sometimes intensely red in colour, with submucous hæmorrhages. The whole of the intestine may be inflamed, but sometimes only the duodenum, cæcum, and rectum are affected. The kidneys are frequently congested.

Tests.—Most salts of mercury volatilise without leaving any residue when heated on platinum foil. Reinsch's test (*v.* p. 214).

Mercurous Salts.—Hydrochloric acid produces a white precipitate which is blackened by ammonia; potassium iodide, a green precipitate; potassium hydrate, a black precipitate; and stannous chloride, in excess, a white precipitate which becomes grey.

Mercuric Salts.—Potassium iodide produces a red precipitate, soluble in excess; potassium hydrate, a yellow precipitate; and stannous chloride, a white or grey precipitate.

Lead.

During the ten years from 1894 to 1903, 1,190 deaths in England and Wales were certified as due to lead poisoning. Of these, 2 were suicidal, 39 accidental or negligent, and 1,149 industrial. Lead and its salts are used for a great variety of purposes in the arts, and chronic poisoning is frequent among those who are habitually exposed to their influence, particularly workers in lead, plumbers, painters, file-makers, glaziers, smelters, type setters and founders, potters, and gasfitters. In 1899, 1,258 cases of lead poisoning in factories and workshops were notified, but in 1904 the number was only 597. Accidentally, chronic poisoning arises from drinking water, beer, or, particularly, acid cider, which has been standing in leaden pipes; using saucepans soldered with lead or covered with lead glaze; occupying a room which has been newly painted; the use of tin-foil containing lead for wrapping up tea, chocolate, &c.; drinking wine from bottles which have been cleaned with shot; using hair-dyes, hair-restorers, and cosmetics containing lead; and taking lead pills for the purpose of procuring abortion. Acute poisoning on a large scale has followed the accidental admixture of lead acetate with flour, and lead oxide with beer, and the colouring of confectionery with lead chromate.

The compounds of lead which are commonly met with are—the red oxide of lead, or red lead, Pb_3O_4; lead acetate, $Pb(COOCH_3)_2$, or sugar of lead; and basic lead carbonate, $2PbCO_3 . Pb(OH)_2$, or white lead. Lead acetate is contained in Mrs. Allen's hair restorer (*Hutchison*).

Fatal Dose and Period—Acute Poisoning.—One and a half ounces of lead acetate have proved fatal in three days. **Chronic Poisoning.**—The amount of lead actually taken cannot be determined. Water containing $\frac{1}{100}$ of a grain per gallon has caused toxic symptoms; and very severe effects have followed the taking of abortifacient pills, each containing ·0005 grain of lead.

Symptoms—Acute Poisoning.—Large doses of acetate of lead produce burning sensation in the mouth and throat; pain in the stomach, and vomiting after an interval; obstinate constipation as a rule, but sometimes diarrhœa; great thirst; diminution or suppression of urine; colic; and collapse. In protracted cases, painful spasms, anæsthesia, paralysis, convulsions, and coma may precede death.

Sub-acute Poisoning.—This is an extremely fatal form, occasionally seen among workers in lead, especially young women between 18 and 25, in which acute nervous symptoms develop after a short exposure to the influence. Headache is commonly first complained of, and is followed after a few hours by acute neuritis, epileptiform convulsions, and coma. Death often occurs within three days. Recovery may leave total blindness from neuro-retinitis and retinal hæmorrhages. Hemiplegia has been observed to develop after three days' exposure to the poison. There is also a sub-acute form, in which gastro-intestinal symptoms are prominent. Vomiting,

colic, constipation followed by diarrhœa, melæna, and albuminuria may terminate fatally in a few weeks.

Chronic Poisoning, also known as painter's colic and plumbism, is so common an affection that it is considered fully in books on clinical medicine. It is sufficient here to recapitulate the symptoms, which are—obstinate constipation; colic; anæmia, with a dull earthy hue of the skin known as the saturnine cachexia; a blue line on the gums from the deposition of lead sulphide, and sometimes ulceration and retraction of the gums; lead palsy, which may be generalised, but is more frequently limited to certain groups of muscles, particularly those supplied by the musculo-spiral nerve, producing the characteristic "wrist-drop," and sometimes to the brachial group, or to the muscles of the hand, or to the extensors of the toes and peroneal muscles giving rise to the "steppage-gait"; tremor occasionally in the affected muscles; arthralgia in a few cases; and cerebral symptoms, such as optic neuritis, epilepsy, and insanity. Arterio-sclerosis and gout are frequently associated with chronic lead poisoning. The marked influence of lead in bringing about abortion in pregnant women has been described on p. 109. There is also evidence that, as with syphilis, plumbism in the husband alone, at the time of conception, may lead to abortion.

Treatment—Acute Poisoning.—Stomach-pump or emetic, followed by the administration of sodium or magnesium sulphate, which converts the lead into the insoluble lead sulphate; and, later, a brisk purge. **Chronic Poisoning.**—According to the symptoms.

Post-mortem Appearances—Acute Poisoning.—The mucous membranes of the stomach and intestines are softened, inflamed, and occasionally eroded. **Chronic Poisoning.**—Interstitial nephritis and cirrhosis of the liver are often present.

Tests.—Sulphuretted hydrogen produces a precipitate, black in strong solutions, brown in dilute. Clear drinking water, containing one-tenth of a grain per gallon, is very distinctly coloured by this test.

Potassium bichromate gives a yellow precipitate, or turbidity in dilute solutions. One-tenth of a grain of lead per gallon in drinking water gives a turbidity immediately; and one-fiftieth of a grain after half an hour.

Potassium iodide gives a yellow precipitate, soluble in boiling water, from which, on cooling, the iodide crystallises out in bright yellow scales.

Sulphuric acid produces a white precipitate.

Copper.

Metallic copper is an inert substance, but all the salts—the commonest of which are the sulphate, nitrate, and chloride—are poisonous in large doses. Compounds of copper are largely employed for colouring bottled peas, pickles, &c., but in the amounts used for these purposes do not seem to be injurious. Acute poisoning by copper is rare. Occasionally, irritant symptoms have

followed the use of copper vessels for culinary purposes, if they have been allowed to become corroded by fruit juices, fatty acids, or vinegar. When kept clean and bright, their employment is free from objection. The existence of chronic copper poisoning among persons working with the metal is doubtful. Certainly, no effects comparable with those produced by lead are seen. In cases in which chronic poisoning by copper has apparently occurred, the symptoms may have been really due to arsenic or lead.

Fatal Dose.—This has not been determined. Amounts of less than half an ounce are very unlikely to be fatal.

Symptoms.—When a large dose has been taken, these are pain in the stomach, violent vomiting and purging, and collapse. In fatal cases, convulsions, coma, and paralysis may precede death. Jaundice and hæmoglobinuria are often observed.

Treatment.—Emetic or stomach-tube if free vomiting has not occurred, followed by white of egg or milk.

Post-mortem Appearances.—The mucous membranes of the stomach and intestines are swollen, inflamed, perhaps superficially eroded, and stained green or blue by the poison.

Tests.—Ammonia in excess produces a deep blue colouration; and potassium ferrocyanide a chocolate-coloured precipitate.

If a clean needle be suspended in an acidulated solution containing copper, the metal is deposited upon it, and may be dissolved off by ammonia, to which it imparts a blue colour. This is a delicate test, and can be conveniently applied to vomited material, pickles, &c.

Bismuth.

A few cases of acute irritant poisoning by bismuth have been recorded, but it is probable that the symptoms were really due to arsenic, with which, at one time, many samples of bismuth were contaminated.

Zinc.

Only two salts of zinc are of common occurrence—viz., the sulphate and chloride. Accidental poisoning by the sulphate is rare, but poisoning by the chloride is not very uncommon, 8 accidental and 7 suicidal deaths having occurred from 1894 to 1903.

Zinc Sulphate, $ZnSO_4$, has been taken by mistake for Epsom salts. It is only likely to be fatal in quantities of over an ounce, and then acts as a gastro-intestinal irritant.

Zinc Chloride, $ZnCl_2$, forms a greyish-white, soft, wax-like mass. It is the chief constituent of Burnett's disinfectant fluid. The solid substance, or a concentrated solution, acts as a powerful corrosive, causing burning pain in the mouth, throat, and stomach, violent vomiting, the ejected material containing blood and shreds of mucous membrane, purging, and collapse. Death may occur immediately, or, after an interval, from secondary effects. Zinc chloride also acts as an escharotic when applied externally. It is sometimes worked into cloths for the purpose of increasing their

weight, and may then give rise to severe dermatitis. Post-mortem, the mucous membranes are acutely inflamed and corroded. Carbonates, white of egg, and demulcents may be given; the stomach-tube is inadmissible.

Chronic Poisoning is occasionally seen among zinc-smelters, &c. The symptoms resemble those of plumbism.

A solution containing zinc gives a white precipitate with ammonium sulphide or sulphuretted hydrogen, soluble in acids; a white precipitate with potassium ferrocyanide; and a white precipitate with ammonia or potash, soluble in excess.

Iron.

Ferrous Sulphate, $FeSO_4$, and **Ferric Chloride,** Fe_2Cl_6, are irritant poisons in large dozes, and have on rare occasions caused death. They have both been given for the purpose of procuring abortion.

Barium.

Salts of barium have been taken by mistake for saline purgatives, and suicidally in the form of rat-poison. About 100 grains of barium chloride killed an adult woman in fifteen hours. One ounce has proved fatal in an hour. The poison has a local irritant action on the stomach and intestines, producing vomiting, diarrhœa, and tenesmus, and, after absorption, acts on the nervous system. Its influence on the heart resembles that of digitalis, the beats becoming slow and forcible. Salivation, dyspnœa, convulsions, or paralysis may occur before death. Sodium or magnesium sulphate acts as an antidote by forming the insoluble barium sulphate. The poison is recognised by the white precipitate with sulphuric acid, and the green flame-colour.

Silver.

Silver Nitrate, $AgNO_3$, is a powerful corrosive in the solid form. Fatal poisoning has followed the accidental swallowing of a piece of the solid stick, which was being used to cauterise the tonsils. Chronic poisoning has been seen after the long-continued use of silver nitrate medicinally. A blue line appears on the gums, and greyish-blue or black pigmentation in the skin, a condition known as argyria. In severe cases, paralysis may follow. Sodium chloride precipitates the insoluble silver chloride, thus acting as an antidote, and a test.

Potassium.

Potassium Bromide, KBr.—Accidental deaths from poisoning by this salt were reported in 1896, 1897, and 1899. Very large doses kill by depression of the heart. The symptoms of chronic poisoning, or **bromism**, are, a papular or acneiform rash, diminution of cutaneous sensibility, conjunctivitis, bronchial irritation, and general depression.

Potassium Iodide, KI.—In rare cases, acute symptoms have followed the administration of medicinal doses of potassium iodide. Probably the persons so affected possessed unusual susceptibility to the influence of the drug. Chronic poisoning, or **iodism**, causes conjunctivitis, nasal and bronchial catarrh, and erythematous or pustular eruptions.

Potassium Nitrate, KNO_3, or saltpetre, has occasionally been taken in mistake for Epsom salts. A dose of an ounce or more acts as a gastro-intestinal irritant, producing vomiting and purging followed by collapse.

Potassium Chlorate, $KClO_3$.—An ounce of this salt has caused death in six days. It acts as a gastro-intestinal irritant, producing pain in the stomach and vomiting, and has also a specific action on the blood, disintegrating the red corpuscles and forming methæmoglobin in the plasma. From this action follow cyanosis, jaundice, and diminution of the urine—which contains hæmo- and methæmoglobin, albumen, and tube-casts—or perhaps anuria. Post-mortem, there may be inflammation and softening of the gastric mucous membrane; the kidneys exhibit nephritis; and the blood is chocolate-coloured and gives the spectrum of methæmoglobin.

Potassium Bichromate, $K_2Cr_2O_7$, is the most frequent of the potassium salts to cause death. During the ten years ending 1903, 28 suicidal and 11 accidental cases of fatal poisoning by it were recorded. In the arts, potassium bichromate is used for charging electric batteries, dyeing, calico-printing, &c. Chronic poisoning is sometimes seen in those engaged in manufacturing the salt, and in the manufacture of aniline black dyes.

Fatal Dose and Period.—Two drachms killed a woman in four hours.

Symptoms—Acute Poisoning.—Pain in the stomach followed by vomiting, purging, painful cramps in some cases, and collapse. **Chronic Poisoning.**—Eczematous eruptions, and deep ulcers known by the workmen as "chrome-holes," and nasal catarrh followed by ulceration and destruction of the septum, are the commonest symptoms.

Treatment.—The stomach should be washed out with water containing calcined magnesia or chalk in suspension. Demulcents, opium, and stimulants may be required later.

Tests.—Potassium bichromate has a markedly acid reaction. Lead acetate gives a yellow precipitate; and silver nitrate a red precipitate in neutral solutions. H_2S changes the colour of a solution to green, and sometimes gives a precipitate of sulphur.

Potassium Permanganate, $KMnO_4$, is largely used as a disinfectant for drains and water-closets. The solid substance or a strong solution is a powerful corrosive, producing corresponding symptoms and post-mortem appearances. In one case, death occurred in thirty-five minutes after a handful of the crystals had been taken in a tumbler of beer.

Other poisonous salts of potassium, considered elsewhere, are the **hydrate**, the **cyanide**, and the **oxalate**.

Phosphorus.

Phosphorus exists in two allotropic modifications: yellow phosphorus, a wax-like substance; and red phosphorus, which is harder and heavier. Only the former is poisonous, but commercial red phosphorus may be toxic owing to the presence of small quantities of the yellow variety. **Acute Poisoning** by phosphorus arises from the taking of rat-paste, or, among children, from sucking the heads of lucifer matches. Of 71 accidental deaths which occurred from 1894 to 1903, 53 were of children below five years of age. During the same period the suicidal deaths were 80—20 males and 60 females; the disproportion between the sexes, which was first noticed many years ago, appears to be becoming more marked. Rat-pastes contain from 1 to 2 per cent. of phosphorus, and the heads of lucifer matches from 14 to 17 per cent. (*Wynter Blyth*).

Chronic Poisoning is occasionally seen among workers in match-factories. Fatal cases are now rare, owing to the greater use of red phosphorus, and better sanitation and care of the employés. One death was registered in 1902, but none in 1901 and 1903.

Phosphorus poisoning is notifiable under the Factory and Workshops Act, 1901 (*v.* p. 166).

Fatal Dose and Period.—A case is recorded of a lunatic who died after taking a dose of one-eighth of a grain, but this must be regarded as very exceptional. One and a half grains have proved fatal in twelve days, and two grains in eight days. Usually the symptoms extend over several days, but, in rare cases, death has occurred in a few hours.

Symptoms—Acute Poisoning.—When a large dose of the poison is swallowed, a garlic-like taste, and odour in the breath are perceived. Pain in the stomach and throat; vomiting, the ejected material being perhaps blood-stained and luminous in the dark; and diarrhœa in about one-third of the cases, may follow after an interval of from a quarter of an hour to several hours. In many cases, the symptoms of gastro-intestinal irritation are mild, or even absent, but, exceptionally, they are severe and progressive. Delirium, convulsions, and coma may be followed by collapse and death within twenty-four hours.

Usually, however, the initial symptoms of irritant poisoning abate, and for a space of two or three days, or perhaps longer, the individual feels comparatively well; and those not familiar with the effects of the poison may imagine that all danger is past. Then, most frequently on the third day, but sometimes not for a week or two, jaundice appears, first in the sclera, but soon spreading over the whole body and becoming very marked. Vomiting and diarrhœa now return, and are accompanied by headache, sleeplessness, great thirst, enlargement of the liver, abdominal distention, and scanty high-coloured urine, containing albumen and bile. The patient passes into the "typhoid" state, coma or muttering delirium occurs, and death takes place within a week.

In about one-tenth of the cases, hæmorrhages occur during the

second stage, constituting the **hæmorrhagic form**. There may be epistaxis, melæna, hæmatemesis, purpura, and in women menorrhagia. The clinical picture now closely resembles that presented by acute yellow atrophy of the liver, but in the latter affection the liver is diminished in size, and leucin and tyrosin are found in the urine. In rare cases of phosphorus poisoning, however, these bodies may be present, and the liver may be shrunken.

In a few cases, disorders of the nerve centres are very marked, the **nervous form**. From the first there may be painful cramps, great prostration, and stupor, followed by jaundice as in other cases, acute delirium, convulsions, trismus, coma, and death.

Chronic Poisoning.—This appears to be due to the inhalation of gaseous oxidation products of phosphorus rather than to the element itself. The chief symptom is periostitis of the lower jaw, followed by necrosis of the bone, or "phossy jaw," as the workmen term it. It only affects those who have retracted gums or carious teeth.

Treatment.—The stomach should be thoroughly washed out with the tube. Antidotes which are recommended by various authorities are old French oil of turpentine, sanitas, hydrogen peroxide, and potassium permanganate. No oily or fatty matter should be given, as it increases the solubility of phosphorus. The later treatment is purely symptomatic.

Post-mortem Appearances.—The mucous membrane of the stomach may be swollen, inflamed, and superficially eroded in places, and there may be small hæmorrhages beneath it, particularly in cases which have been fatal within twenty-four hours. In more protracted cases the striking feature is fatty degeneration in all the viscera. The liver is usually enlarged, but, in exceptional cases, is normal in size, or even shrunken. It is intensely fatty, soft, greasy, and of a yellow colour either uniform or mottled. The heart, kidneys, gastric mucous membrane, and voluntary muscles show similar changes.

Methods of Detection.—On opening the abdomen a garlic-like odour may be perceived, and the viscera and their contents, like the vomit, may be luminous in the dark.

Very small quantities of phosphorus in organic material may be detected by Mitscherlich's method. The suspected material is distilled with a little sulphuric acid in a flask connected with an ordinary condensing tube, the free end of which dips under a solution of silver nitrate. The experiment is performed in the dark, or the condenser is surrounded with a box with blackened sides pierced with holes for looking through. If phosphorus is present a luminous ring appears in the tube, and a black precipitate of metallic silver in the solution. The presence of turpentine, alcohol, ether, and certain other volatile bodies, interferes with the luminosity, but does not prevent the formation of the black precipitate.

Iodine.

This substance has been taken with fatal result both suicidally and accidentally. It was at one time extensively used for surgical

purposes, and death has followed its injection into an ovarian cyst. One drachm of the tincture has proved fatal. The solid scales and a concentrated solution are powerful irritants producing pain, vomiting, purging, and collapse. The lips and chin of the individual may be stained yellow, and the vomited material may be of the same colour, or blue if much starchy material was present in the stomach. Exceptionally, gastro-intestinal symptoms are absent or subordinate, and death is caused by paralysis of the nerve-centres. Donaldson-Sim (*Lancet*, March 25, 1905) records the case of a man who, while in hospital, drank four ounces of liniment of iodine. He was anæsthetised, and his stomach was thoroughly washed out at once. No dyspnœa, vomiting, or purging occurred, and the condition seemed quite satisfactory. In an hour's time, however, the pulse became feeble, the extremities cold and blue, and the face cyanosed; and, in spite of treatment, death took place about four hours after the poison had been taken.

Post-mortem.—The mucous membranes are stained yellow or brown, inflamed, and sometimes corroded. The treatment recommended, after using the stomach-tube, is the administration of starchy food, such as arrowroot, corn-flour, &c.

As with potassium iodide and iodoform, chronic poisoning, or iodism, may follow the excessive use of iodine, whether taken internally or applied as an ointment or liniment externally.

CHAPTER XXII.

GASEOUS POISONS.

CONTENTS.—Carbon monoxide in coal-gas, water-gas, &c.—Carbon dioxide—Sulphuretted hydrogen and sewer-gas—Carbon bisulphide—Chlorine—Chloroform—Ether—Nitrous oxide—Ethyl chloride and somnoform.

Carbon Monoxide, CO.

Carbon Monoxide is a colourless inodorous gas which burns with a pale blue flame. It has a direct toxic action, besides being non-respirable. Poisoning by pure carbon monoxide is very rare, the gas inhaled usually consisting of a mixture of CO with CO_2 and air. The sources of carbon monoxide, and conditions under which poisoning occurs, are as follows:—

Coal-gas.—This contains about 6 per cent. of carbon monoxide. Accidental poisoning, considering the enormous use of coal-gas, is rare, owing to the fact that the smell produced by the presence of other hydrocarbons leads to the prompt detection of an escape. Persons, however, may be overcome during sleep, and wholesale poisoning has followed the percolation of the gas through the ground from a broken gas-main into a house. In one such case the leak was 86 yards distant from the house. The gas undergoes a process of filtration in passing through the earth, which removes or reduces the smell. Sixteen deaths from accidental inhalation of coal-gas occurred in 1903. Suicide is occasionally effected by turning on the gas after closing the doors and windows of the room; ten cases occurred in 1903.

Water-gas.—This illuminant, which is made by passing steam and air over incandescent coke, contains from 20 to 40 per cent. of carbon monoxide. It is more largely used in America than in England. The absence of smell, which prevents ready detection of an escape, renders the gas highly dangerous, and numerous accidents have followed its use.

Charcoal-stoves, Geysers, Lime-kilns, Blaize-heaps, &c.—Mixtures of CO and CO_2 in varying proportions are evolved from these sources. In France, inhalation of the fumes of burning charcoal is a favourite method of committing suicide, but, in this country, it is rare.

Conflagrations.—Deaths in burning buildings are usually due to the carbon monoxide and dioxide in the smoke.

Explosions.—Gunpowder, dynamite, gun-cotton, and other substances generate carbon monoxide on explosion. The disaster at the Crarae Quarries in 1886, affords a good instance of the way in which accidents may occur. Blasting operations on an unusually large scale were to take place, and a number of persons

assembled to witness the sight. Immediately after the explosion, many of them rushed forward to see the effects, and were rapidly overcome by the gases which had been generated; some fell as suddenly as if they had been shot, and six died before they could be removed.

Mine Gases.—A mixture of CO and CO_2, known as "choke-damp," is present after a fire or explosion in a mine, but carbon monoxide may also collect in ill-ventilated collieries from the decomposition of coal.

Fatal Dose and Period.—It is impossible to determine the actual amount of the gas which must be inhaled to cause death. Breathing a mixture containing ·2 per cent. of carbon monoxide produces severe toxic symptoms, and a mixture containing 1 per cent. is likely to prove fatal. Death occurs rapidly when a person is left unaided in an atmosphere containing much of the gas. If removed from its influence, life may be prolonged for several hours or days.

Symptoms and Effects.—The toxic action of carbon monoxide is due to the fact that the gas unites with hæmoglobin, forming a stable compound known as carboxyhæmoglobin. This prevents the blood from performing its function as an oxygen carrier, and death accordingly occurs from asphyxia. Experiments on rabbits have shown that death follows when 30 per cent. of the hæmoglobin has been changed.

When air containing much of the gas is breathed, sensations of buzzing in the ears, headache, giddiness, and nausea are quickly experienced. The individual feels completely prostrated and powerless to help himself, and, though perhaps aware that he is being poisoned, may be quite unable to make an effort to escape or shout for assistance. Vomiting sometimes occurs. Drowsiness, gradually passing into deep coma, follows. The face is cyanosed; the lips often covered with froth; the pupils dilated and insensitive; the conjunctivæ injected; the pulse weak and fluttering; the skin cold and clammy; the respiration slow and shallow; the temperature sub-normal; and the sphincters relaxed. Convulsions may precede death. The state of coma may last for several days before terminating fatally. Wynter Blyth mentions the case of a person who was comatose for eight days, and died on the twelfth day after inhalation. Consciousness returned, but was again succeeded by coma. Delirium has been observed in a few cases. Nervous symptoms are occasionally manifested after recovery has occurred from the immediate effects of the gas. Dementia may persist for months, and in one case a man still showed signs of mental weakness after an interval of two years.

Chronic Poisoning by carbon monoxide is sometimes exhibited by those employed about gas-works, furnaces, &c. Anæmia, neuralgia, and malnutrition are followed by symptoms of peripheral neuritis, and possibly mental derangement.

Treatment.—The individual should be taken into the open air, and artificial respiration adopted; if procurable, pure oxygen should

be given. The body heat must be maintained, and subcutaneous injections of ether administered. Successful results have followed venesection and transfusion of defibrinated human blood. Saline injections are of little value.

Post-mortem Appearances. — Putrefaction is often delayed. The external appearances are very characteristic. The whole body may be of a rosy red colour, or there may be bright red, irregular patches about the face, chest, abdomen, and thighs, and the sugillations on the dependent parts are of an unusually reddish tint. Internally, the striking feature is the bright cherry-red colour of the blood throughout due to the presence of carboxyhæmoglobin. Sometimes, however, this phenomenon is not seen after poisoning by coal-gas. The air-passages often contain froth, and the lungs may be congested.

Methods of Detection.—If suspected to be present in a room or cellar, carbon monoxide may be detected by examining spectroscopically the blood of a mouse which has been made to breathe the air for some time, or a sample of blood through which a large volume of the air has been aspirated. The spectrum of carboxyhæmoglobin exhibits two bands between D and E, distinguishable from the bands produced by oxyhæmoglobin by the fact that no change takes place on the addition of ammonium sulphide. Another point of difference is that the bands are slightly nearer the violet end of the spectrum, but this is only appreciable when the two spectra are viewed one above the other. The blood of a person who has been poisoned by the gas usually shows the spectra of carboxy- and oxyhæmoglobin superimposed. Carbon monoxide may be detected in the blood for days or even weeks after death by this method. Haldane has devised a calorimetric method of estimating the degree of saturation of blood with the gas.

Carbon Dioxide, CO_2.

This gas, also known as carbonic acid gas, is colourless and odourless under the circumstances in which it is usually met with—namely, mixed with air; the pure gas has, however, a slightly pungent effect on the nostrils and an acid taste. Carbon dioxide is considerably heavier than air, and consequently tends to accumulate at the bottoms of mine shafts, wells, cellars, &c. It is also generated during fermentation, and may be responsible for fatal accidents in the cleaning of brewers' vats and in similar occupations. Gases evolved by conflagrations, explosions, lime-burning, &c., contain varying proportions of CO_2; coal-gas only contains about ·5 per cent. Carbon dioxide does not support combustion, and a candle is extinguished in an atmosphere containing 16 per cent. of the gas, but the fact that the candle does burn is no indication of safety, for a mixture containing only 10 per cent. of CO_2 occasions serious symptoms, and ultimately death, if the individual continues to breathe it.

Fatal Dose and Period.—The amount of CO_2 absorbed depends

upon the proportion of the gas present and the length of time it is inhaled. An atmosphere containing 20 per cent. is likely to prove quickly fatal, and 2 per cent. is injurious if breathed for some time. Serious effects are more likely to follow when the carbon dioxide is generated at the expense of the oxygen present, either by combustion or respiration, than when it is simply added to the atmosphere.

Symptoms.—Carbon dioxide produces asphyxia by preventing the excretion of CO_2 from the lungs, but it has, in addition, a direct narcotic action upon the nervous system. When an atmosphere consisting almost entirely of carbon dioxide, such as may exist at the bottom of an old well, is breathed, coma rapidly supervenes, and is soon followed by death. If the gas is diluted with air, giddiness, ringing in the ears, and drowsiness gradually passing into insensibility, are experienced, and the individual eventually dies from asphyxia. Constant inhalation of small amounts of carbon dioxide in badly-ventilated rooms produces malnutrition and anæmia.

Treatment.—Plenty of fresh air, or oxygen if at hand, artificial respiration, and stimulants are required.

Post-mortem Appearances.—These are essentially the same as in death from asphyxia by obstruction of respiration (*v.* p. 19).

Tests.—A candle is extinguished by mixtures containing more than 15 or 16 per cent. of the gas.

Lime-water gives an immediate white precipitate when poured into a jar containing the gas.

Sulphuretted Hydrogen, H_2S, and Sewer-Gas.

It is convenient to consider these together, since sewer-gas derives its toxic action, in most cases, chiefly from the sulphuretted hydrogen it contains.

Poisoning by H_2S, pure or mixed with air, occurs occasionally in manufactories and chemical laboratories.

Sewer-Gas has a variable composition depending upon the nature of the sewage and the degree of ventilation. The gases usually present are sulphuretted hydrogen, ammonium sulphide, carbon dioxide, marsh gas, nitrogen, oxygen usually in smaller proportion than in atmospheric air, and fœtid organic matter; carbon monoxide may be present owing to the escape of coal-gas from the mains into the sewers. Men working in sewers may be killed by the poisonous action of the gas, or they may be rendered unconscious and then drowned by falling into the sewage.

Fatal Dose and Period.—Sulphuretted hydrogen is extremely poisonous. A mixture containing ·02 per cent. produces alarming symptoms if breathed for half an hour; ·08 per cent. is dangerous to human life; and ·15 per cent. is rapidly fatal. Death occurs quickly if the individual continues to inhale the gas, but, if he is removed from the influence, may take place after several hours.

Symptoms and Effects.—The precise mode of action of sulphuretted hydrogen has not been determined with certainty. Probably the gas produces asphyxia by acting as a direct blood poison, and

has also a paralysing effect on the central nervous system. When an atmosphere containing a large percentage is breathed, symptoms of asphyxia and heart-failure appear immediately, and are soon followed by death. If the individual is rescued before life is extinct, the symptoms may persist for several hours or days before terminating fatally. A man who was overcome by the gas in a manhole, at East Ham, in 1895, was comatose when brought to the surface, and remained so until death which took place in eighteen hours. His symptoms were slow and stertorous respiration; constantly recurring clonic spasms of the arms and legs until three hours before death; conjunctivitis; absence of corneal reflex; temperature 102° F.; and involuntary passage of urine. Œdema of the lungs appeared before death. Four other persons who had been rendered insensible were drowned by falling into the sewage. Recovery from the first effects of the poison is, as a rule, permanent; but in some cases the symptoms reappear after an interval. A student at Lille who opened an apparatus for generating sulphuretted hydrogen in a chemical laboratory immediately fell to the ground insensible, but quickly recovered in the fresh air. Another student who was standing some yards away also fell heavily, but apparently fully recovered in the courtyard, and was able to walk about for an hour. Coma, however, reappeared, and he died in thirty-six hours without having regained consciousness.

When much diluted, sulphuretted hydrogen produces conjunctivitis, nasal catarrh, cough, and dyspnœa from irritation of the respiratory mucous membranes, headache, palpitation, and faintness, followed by severer symptoms if the inhalation is continued.

Chronic Poisoning by the penetration of sewer-gas into a house gives rise to anæmia, diarrhœa, sore-throat, &c. It is not quite clear how far these symptoms are due to sulphuretted hydrogen and how far to fœtid organic matter.

Treatment.—Pure air or inhalation of oxygen; artificial respiration; stimulants; and maintenance of bodily heat.

Post-mortem Appearances.—Putrefaction occurs rapidly. The internal signs are chiefly those of asphyxia, but the blood is exceptionally dark—sometimes almost black. This is due to the presence of sulph-hæmoglobin, a compound the spectrum of which resembles that of methæmoglobin, but is distinguished by the fact that the band near the red end between C and D does not disappear on the addition of a reducing agent. Sulph-hæmoglobin is not invariably present in the blood after poisoning by sulphuretted hydrogen.

Tests.—H_2S is readily detected by its offensive odour. This may be noticed on opening the body of a person who has been poisoned.

A piece of filter-paper, moistened with a solution of lead acetate and held in the gas, is rapidly blackened.

Carbon Bisulphide, CS_2.

This substance is a highly volatile, colourless liquid. Impure commercial specimens have a penetrating offensive odour. Poison-

ing by the liquid is rare, but chronic poisoning by inhaling the vapour is not uncommon in india-rubber and gutta-percha factories. The symptoms exhibited are headache, giddiness, dyspepsia, vomiting, and colicky pains, followed after an interval by tingling, numbness, paralysis, and other indications of peripheral neuritis. Delirium, hallucinations, and affections of the special senses are sometimes observed.

Chlorine.

This gas is met with in chemical works, and factories for the preparation of bleaching powder. It causes severe irritation of the conjunctival and respiratory mucous membranes, leading to nasal catarrh, cough, and dyspnœa. A fatal termination is rare. Chronic poisoning produces anæmia, dyspepsia, and chronic bronchitis.

Gaseous Anæsthetics—Chloroform, $CHCl_3$.

The great majority of deaths from chloroform poisoning occur during inhalation of the gas. A few are caused by drinking the liquid, usually with suicidal intent. In 1903 there were 97 deaths from chloroform, and 33 from anæsthetics, "kind not stated," but probably nearly all chloroform or A.C.E., during their administration for surgical purposes. These figures seem large, but are really only a very small fraction of the total number of administrations, and it must be remembered that many of the individuals were moribund when placed upon the table. Three cases of suicide occurred. Chloroform is rarely employed by murderers. Experiments have shown that it is extremely difficult to anæsthetise a sleeping person without awakening him.

Fatal Dose and Period.—A boy of four who swallowed a drachm of chloroform died in three hours. In an adult seven drachms have caused death. Recovery has taken place after four ounces have been swallowed. The symptoms may last for several hours or days.

Symptoms.—The effects of chloroform inhalation are well known to medical students. When the liquid is swallowed, it acts as an irritant to the stomach, and may cause sufficient vomiting to prevent further toxic effects. After absorption through the gastric mucous membrane, it produces the same effects as when inhaled. Diarrhœa, jaundice, and abdominal pain may continue for some days after consciousness is regained, and death may occur ultimately from heart-failure and œdema of the lungs.

Treatment.—The stomach should be well washed out with the stomach-pump; stimulants given; and artificial respiration adopted.

Post-mortem Appearances.—These are not characteristic after death from inhalation; signs of syncope are sometimes present, or, less frequently, signs of asphyxia. When the liquid has been swallowed, the mucous membrane of the stomach is reddened and inflamed, and occasionally eroded.

Methods of Detection.—Small amounts of chloroform may be detected in organic matter—*e.g.*, a portion of a lung—by finely

mincing the material, and gently heating it, with a little sodium bicarbonate solution, in a flask connected with a hard glass tube bent twice at right angles. The straight part of the tube is heated to redness in the middle by a Bunsen flame. The chloroform vapour is decomposed by the heat, and, at the free end of the tube, chlorine is recognised by its turning starch paper moistened with potassium iodide blue, and hydrochloric acid by the reddening of litmus paper, and by the precipitate formed when the gas is passed through a solution of silver nitrate.

After gently distilling off from an organic mixture, a part of the distillate is warmed with a few drops of aniline and alcoholic caustic potash. If chloroform is present, the offensive odour of phenyl-isocyanide is perceived. Another part of the distillate warmed with strong caustic potash and β-naphthol becomes blue if it contains chloroform.

Ether, $(C_2H_5)_2O$.

Ether is generally considered a safer anæsthetic than chloroform, but it is liable to cause irritation of the respiratory mucous membrane. Nine deaths were occasioned by its use for operative purposes in 1903.

Nitrous Oxide, N_2O.

Nitrous oxide, or laughing gas, on rare occasions causes death—about once in 30,000 administrations (*Taylor*). Five fatalities during operations were recorded in 1903.

Ethyl Chloride, C_2H_5Cl, and Somnoform.

Ethyl chloride is generally considered to be intermediate between ether and nitrous oxide in point of safety. On several occasions its use as an anæsthetic has caused death (see *Med. Rev.*, 1900, p. 619, and 1903, p. 375). The following instance is recorded in the *Brit. Med. Journ.* of July 8, 1905:—Six cubic centimetres of ethyl chloride were administered to a stout and alcoholic married woman who was suffering from cellulitis of the arm. After anæsthesia had been induced and the mask removed, spasmodic twitching of the head and eyes to the right was noticed, but passed off quickly as consciousness re-approached. The mask was then re-applied, but no more ethyl chloride was given. After a few seconds, breathing suddenly ceased, and the pulse became imperceptible. Artificial respiration was resorted to for half an hour, but was of no avail. Post-mortem, all the viscera were found to be markedly pale, the heart was empty, the left ventricle very thin-walled, the liver large and fatty, and both kidneys cirrhotic.

Dr. M'Cardie, in a recent general review of the subject, has given an account of seven deaths which have occurred during the administration of ethyl chloride. These (and the above) are, so far as he can ascertain, all that have taken place since Lotheisen,

in 1898, first made routine use of the drug as a general anæsthetic. In all of these cases the individuals were suffering from serious pathological lesions. Dr. M'Cardie estimates the death-rate to be about 1 in 10,000 administrations, but he points out that it is impossible to collect accurate statistics. He considers the danger to be chiefly on the side of respiration which fails before circulation. A fact of considerable importance to the medical jurist is indicated in the following remark:—"From a medico-legal point of view ethyl chloride (and ethyl bromide) is the only drug with which it would be reasonably possible to bring about the remarkably quick loss of consciousness alleged to have been caused by the close and forcible application of a handkerchief or cloth over the mouth, and so far as I know it has not yet been suggested that these drugs have been thus used. In any case, the handkerchief would need to be large and fairly thickly folded, to be saturated with the drug, and so firmly applied as to exclude all air."*

Somnoform consists of ethyl chloride 60 per cent., methyl chloride 35 per cent., and ethyl bromide 5 per cent., the last being the dangerous constituent. It has been responsible for a considerably larger number of deaths than pure ethyl chloride (see *Brit. Med. Journ.*, June 17, 1905).

* Ethyl chloride as a general anæsthetic, *Lancet*, Oct. 7, 1905.

CHAPTER XXIII.

POISONOUS CARBON COMPOUNDS.

CONTENTS —Alcohol—Fusel oil and amyl alcohol—Formaline—Paraldehyde—Chloral hydrate—Sulphonal—Iodoform—Hydrocyanic acid and its salts—Organic nitrites—Petroleum and paraffin—Coal-tar naphtha and benzene—Aniline—Nitro-benzene—Dinitro-benzene—Salicylic acid—Pyrogallic acid—Picric acid—Acetanilide, phenazone, phenacetin, and exalgin.

Alcohol, C_2H_5HO.

EIGHTY-SEVEN deaths from poisoning by alcohol were registered in England and Wales, during the ten years ending 1903, under the heading "accident and negligence," and four under suicide. If deaths from chronic alcoholism and delirium tremens were included, alcohol would be the poison most responsible for loss of life. Accidents happen through persons undertaking to drink a large quantity of intoxicating liquor for a bet; or by repeatedly filling the glass of a person who is already drunk, for a joke; or, by mistake, drinking or giving to a child a quantity of raw spirit; or when an intemperate person suddenly finds an unlimited amount of spirit at his disposal, as, for instance, by the breaking of a cask of whisky in the street.

Symptoms.—The early symptoms—those of drunkenness—are well known. The severer effects have already been dealt with under the headings of "Coma," p. 21, and "Alcoholic insanity," p. 137. Chronic alcoholism belongs to the domain of clinical medicine.

Treatment.—Free lavage with the stomach-tube, or, if this is not at hand, administration of an emetic. The body heat should be maintained, but cold affusions may be applied to the head. Hot strong coffee is valuable later.

Post-mortem Appearances.—When a quantity of strong spirit is taken, the stomach may be so inflamed as to suggest corrosive poisoning. Taylor describes the case of a child who died twelve hours after taking four ounces of brandy. The mucous membrane was intensely reddened, softened, and, in places, actually detached; beneath it were patches of extravasated blood. In other instances, signs of inflammation were less marked, or absent. The brain and meninges are usually congested; the lungs œdematous; and the right side of the heart distended with dark fluid blood.

Tests.—The odour of alcohol may be perceived on opening the stomach. The contents of the viscus should be distilled at a gentle heat, and the distillate tested.

Warm with a little caustic potash and some particles of iodine.

On cooling, the smell of iodoform is perceived, and yellow crystals separate out. Under the microscope these are hexagonal plates.

Add a little sulphuric acid, and a few drops of potassium bichromate solution. The colour changes from brown to green, and the smell of aldehyde is perceived.

Warm with solid sodium acetate and strong sulphuric acid; the fruity odour of ethyl acetate develops.

Fusel Oil and Amyl Alcohol, $C_5H_{11}OH$.

Fusel oil is a mixture of the higher homologues of ethyl alcohol; amyl alcohol is prepared from it. These substances are rare poisons. The symptoms they give rise to are headache, giddiness, impairment of muscular power or sensation, coma, and collapse.

Formaline.

This substance, which is employed as a preservative and disinfectant, consists of a 40 per cent. solution of formaldehyde, H.CHO. The vapour is very irritating to the eyes and throat. Cases of poisoning are rare. The symptoms observed are pain in the stomach, vomiting of blood-stained material, tenesmus, and collapse.

Paraldehyde, $(CH_3CHO)_3$.

Two ounces of this hypnotic have caused death. Vomiting, giddiness, and coma are the symptoms. One case of paraldehyde habit has been recorded. The drug is easily recognised by its nauseous taste and odour, which may be detected in the breath and urine.

Chloral Hydrate, $CCl_3CH(OH)_2$.

Chloral hydrate is a white crystalline substance, freely soluble in water, and possessing a characteristic odour and taste. From 1894 to 1903 it was responsible for 96 deaths in England and Wales—81 accidental, and 15 suicidal.

Fatal Dose and Period.—Twenty grains have caused the death of an adult; ten grains the death of a woman of seventy; and three grains the death of a child of one year. Recovery has occurred after more than an ounce has been taken. Death may occur rapidly, or the symptoms may extend over several hours.

Symptoms and Effects.—Chloral hydrate, in addition to being a powerful hypnotic, has a direct depressant action on the heart, hence its administration to persons suffering from heart-disease is accompanied with danger. In the great majority of cases, after a toxic dose of chloral is taken, the individual soon passes into a state of drowsiness or sleep, from which he can at first be aroused, but which gradually deepens into a condition of profound coma. Exceptionally, this is preceded by a period of delirious excitement with flushed face and quick bounding pulse. When the coma is

established, the pulse is weak and irregular, but may be either slow or rapid; the respiration is laboured and slow, hence the individual becomes cyanosed; the skin is cold and covered with perspiration; the pupils are generally contracted, but may dilate before death; the temperature is subnormal; and the reflexes are abolished. Death occurs from heart-failure. In exceptional cases, death from cardiac paralysis occurs within a few minutes after the drug has been taken.

Chronic Poisoning is seen in those who are addicted to the chloral habit, which develops from taking the drug for insomnia. The symptoms are dyspepsia, erythematous and urticarial eruptions, impairment of muscular power, cardiac and respiratory weakness producing a tendency to fainting, and mental disturbance. A slightly larger dose than usual may be fatal.

Treatment.—The stomach-tube should be used, or an emetic given. The bodily heat should be maintained by means of hot blankets and bottles. Efforts should be made to arouse the patient by shouting, slapping, or stimulating him with the Faradic current, but he should be kept in the recumbent position. Artificial respiration may be necessary. Strychnine should be injected subcutaneously, and hot strong coffee per rectum.

Post-mortem Appearances.—These are not characteristic.

Tests.—If organic material containing chloral be distilled with caustic potash, chloroform passes over and may be recognised by the usual tests.

In simple solution, when chloral is warmed with silver nitrate and a drop of ammonia, a silver mirror is deposited on the sides of the test-tube.

Warmed with a few drops of ammonium sulphide, a brownish-yellow colour, and, usually, a yellow precipitate is formed.

Fehling's solution is reduced.

Sulphonal, $(CH_3)_2C(SO_2C_2H_5)_2$.

This is a crystalline substance sparingly soluble in water. It is largely taken for the purpose of procuring sleep, without medical advice having been sought, and a good many accidents have happened in consequence. Seven deaths were registered as accidental, and one as suicidal, from 1894 to 1903.

Fatal Dose.—Thirty grains (Glaister). Recovery has followed the taking of three ounces.

Symptoms.—In acute poisoning these are vomiting; pain in the abdomen; ataxia; hæmatoporphyrinuria and albuminuria; convulsions; and coma. Death occurs from cardiac failure. The sulphonal "habit" is characterised by gastro-intestinal irritation; erythematous rashes; hæmatoporphyrin in the urine; cardiac weakness; and mental symptoms.

Treatment.—Wash out the stomach, and give stimulants.

Iodoform, CHI_3.

Severe toxic effects—in a few cases terminating fatally—have followed the use of iodoform on surgical dressings, or for irrigating abscess cavities. The symptoms which have been noticed are, gastro-intestinal irritation, fever, erythematous eruptions, melancholia or delirium, coma, and collapse.

Hydrocyanic Acid, HCN, and its Compounds.

Hydrocyanic, or prussic, acid and the cyanides form a group which comes fourth in order of frequency of the poisons chosen for committing suicide, being selected for this purpose ten times as frequently by men as by women. Accidental poisoning is much less common. Murder by the administration of cyanides is now rare, only one case having occurred during the ten years ending 1903, but from 1883 to 1892 fourteen persons were murdered in this manner. The following are the forms and circumstances in which these substances occur :—

Hydrocyanic Acid.—The pure acid is not met with outside the laboratory. The pharmacopœial solution should contain 2 per cent. of HCN, but it becomes weaker with keeping ; it is a faintly acid liquid with an almond-like odour. Scheele's acid contains about 4 or 5 per cent.

Oil of Bitter Almonds.—The crude oil, prepared from the pulp of bitter almonds, consists chiefly of benzaldehyde with from 5 to 14 per cent. of hydrocyanic acid. After this has been separated off, the refined essence is sold as a flavouring agent. Almond flavour, or essence of peach kernels, consists of one part of oil of bitter almonds in about eight of rectified spirit.

Vegetable Seeds, &c.—The bitter almond, the kernels of the cherry, plum, and peach, the pips of the apple, the leaves of the cherry-laurel, and parts of other plants, mostly belonging to the *Rosaceæ*, contain various proportions of amygdalin, a glucoside, which, on fermentation, yields hydrocyanic acid. *Aqua lauro-cerasi* should contain ·1 per cent. of HCN, but the strength varies. Toxic effects have followed the eating of bitter almonds. At least one attempt has been made to attribute the symptoms of homicidal poisoning by prussic acid to the eating of fruit.

Potassium Cyanide.—This salt forms a deliquescent, white, crystalline mass with a strong odour of hydrocyanic acid. It is freely soluble in water, and has a marked alkaline reaction. Cyanides are employed in photography, gold and silver electro-plating, gold extraction, and other processes.

Mercury and Silver Cyanides have, in a few instances, caused death.

Fatal Dose and Period.—Half a drachm of the pharmacopœial acid, one teaspoonful of oil of bitter almonds containing 3·4 per cent. of HCN, and five grains of potassium cyanide appear to be the smallest

amounts which have caused death. Recovery has occurred after half an ounce of the *acid hydrocyan. dil.* has been taken. Prussic acid is one of the most rapidly fatal poisons known. A single drop of the pure acid introduced into the eye of a rabbit kills it within from thirty to sixty seconds. In human beings, death usually occurs within a few minutes, but, in exceptional cases, has been delayed for more than an hour. If life is prolonged for half an hour, there is good hope of recovery.

Symptoms.—When a large dose is taken, the symptoms commence almost immediately. The individual may be able to open a door and shout for assistance, or cork and hide a bottle, but often he is rendered helpless before he has had time to do even this. Sometimes he utters a piercing shriek before losing consciousness and falling to the ground. Respiration is difficult, and is characterised by short inspiration and prolonged efforts at expiration; the countenance becomes cyanosed, and the lips may be covered with froth; the eyes are glistening and staring, and the pupils are usually dilated. The skin is cold and clammy, and the pulse almost imperceptible. Vomiting generally occurs, and there may be passage of the urine and fæces. Violent clonic and tonic convulsions may appear, and are followed by complete muscular relaxation. The respiration becomes gasping, stertorous, and gradually slower and slower until death takes place.

Poisoning has followed the application of hydrocyanic acid as an anodyne to the skin, and the inhalation of the vapour of the pure acid. The chemist Scheele lost his life in this way through the accidental breaking of a flask.

The symptoms of poisoning by **potassium cyanide** are very similar, but do not occur in quite such rapid succession. If a strong solution has been taken, there may be signs of corrosion about the mouth and lips.

Treatment.—The stomach should be promptly emptied either by the tube or an emetic. Respiration should be stimulated by inhalations of ammonia, and dashing cold water over the face; artificial respiration may be required. Subcutaneous injections of ether, brandy per rectum or by the mouth, and faradization over the region of the heart, phrenics, and diaphragm are also called for. Injection of atropine has been recommended, not so much as an antidote, as a respiratory stimulant.

Post-mortem Appearances.—The face and extremities are cyanosed; the eyes are glistening; the pupils dilated; the mouth sometimes covered with froth; the jaws firmly closed; and the hands clenched. Internally, after prussic acid poisoning, the signs are often remarkably negative, but, when potassium cyanide has been taken, the mucous membrane of the stomach may be bright red, inflamed, softened, and even sometimes eroded.

Methods of Detection.—An almond-like odour may be perceived on opening the body. Hydrocyanic acid may be separated off from the contents of a stomach or other organic material by distillation with tartaric acid.

Warm with ferrous sulphate, and a few drops of caustic potash, then add ferric chloride and hydrochloric acid in excess. A Prussian blue precipitate is formed.

Silver nitrate gives a white precipitate insoluble in nitric acid. This test may be applied to hydrocyanic acid in organic material (a single crushed apple-pip, for instance) by placing a drop of silver nitrate in a watch-glass, and inverting it over the solution to be tested. After standing, the drop becomes milky, and, when dry, leaves a white deposit which, on microscopical examination, is found to consist of acicular crystals. If potassium cyanide is being tested for, a little sulphuric acid must be first added to liberate the HCN.

Evaporate to dryness with ammonium sulphide, and to residue add ferric chloride and dilute hydrochloric acid. A blood-red colour forms. This test may also be performed by allowing a drop of ammonium sulphide on a watch-glass to evaporate to dryness over the suspected solution, and then adding ferric chloride.

Organic Nitrites.

Nitroglycerine, dynamite, spiritus ætheris nitrosi, and **amyl nitrite** have all been taken with fatal results, either suicidally or by accident. The symptoms are flushing of the face, rapid and violent beating of the heart, headache, giddiness, vomiting, paralysis, unconsciousness, dyspnœa, and collapse. Death is due to depression of the cardiac and respiratory centres, and also to interference with the oxygen-carrying function of the blood, owing to the formation of methæmoglobin. Post-mortem, there may be signs of asphyxia, and chocolate-coloration of the blood. The treatment includes maintenance of the recumbent posture, artificial respiration, and oxygen inhalations. Ergotin and adrenalin are possible antidotes.

Petroleum and Paraffin.

Petroleum is a mixture of paraffins of the series $C_n H_{2n+2}$ occurring as natural oil springs in various parts of the world. Crude paraffin is a similar product obtained by the distillation of oil-shale. Petroleum ether, gasoline, light petroleum, cleaning oil, kerosene, and other substances are prepared from the crude oil by fractional distillation. These oils are largely used for cleaning, lubricating, and illuminating purposes, and as solvents for resins, caoutchouc, &c. Twenty-four accidental and three suicidal cases of poisoning by paraffin occurred from 1894 to 1903.

Fatal Dose and Period.—It is impossible to assign any fatal dose to paraffin as the compositions of different samples vary. The crude oil is more toxic than the refined products. Death, except in infants, only occurs when large quantities have been taken, but even as much as a pint has only caused temporary effects. In fatal cases, the symptoms do not, as a rule, extend over more than a few hours, but in one instance death occurred from gastro-enteritis twenty days after the poison had been taken.

Symptoms.—These include abdominal pain, vomiting, laboured respiration, cyanosis, coma, and collapse.

Treatment.—Lavage of the stomach, administration of stimulants, and artificial respiration if necessary.

Post-mortem Appearances.—These are not characteristic.

Methods of Detection.—The oil will be recognised by its smell in the contents of the stomach or vomited material, and will probably be present in sufficient amount to burn when a light is applied to it.

Coal-Tar Naphtha; and Benzene, C_6H_6.

Coal-tar naphtha is a complex mixture from which benzene or benzole, solvent naphtha, and other compounds are prepared. Three ounces of coal-tar naphtha produced in a boy of twelve dilirium, vomiting, stertor, dyspnœa, and insensibility, followed by collapse and death in three hours. A child of five, who had taken two or three ounces of coal-tar naphtha, recovered from the immediate effects, but died in eleven days from acute bronchitis. An ounce of benzene caused unconsciousness, cyanosis, diarrhœa, vomiting, and death in twelve hours from heart-failure. Inhalation of the vapour of benzene has also proved fatal.

Treatment.—The stomach should be washed out, and brandy, atropine, and inhalations of ammonia given.

Post-mortem Appearances.—Signs of death from asphyxia are usually present. The stomach is frequently normal, but inflammation of the mucous membrane has been observed. The lungs may be congested.

Tests.—The odour of benzene may be recognised in the vomit or contents of the stomach; and the latter may burn when a light is applied.

Aniline, $C_6H_5NH_2$.

Aniline is an oily fluid, colourless when pure, but gradually turning brown on exposure to air. Six drachms of aniline have caused death when swallowed. Poisoning has also followed the absorption of aniline through the unbroken skin. On one occasion a number of infants in a workhouse exhibited toxic symptoms owing to the absorption of aniline from the marking ink employed to stamp the name of the institution on their diapers. St. Clair Thompson records the case of a man who exhibited toxic symptoms after an aural application consisting partly of aniline. Inhalation of aniline vapour has also caused death.

Symptoms of chronic poisoning by aniline and by chromic acid are sometimes displayed by those who are engaged in the preparation of aniline black dyes in which aniline oil and potassium chromate are employed.*

Symptoms.—These may appear within a few minutes, or may be delayed for an hour or more. When a large dose has been taken, the effects are giddiness, vomiting, slow and laboured res-

* For recent regulations concerning such factories, see *Lancet*, Dec. 2, 1905.

piration, and drowsiness passing into coma. The temperature is subnormal, the pulse weak and irregular, and the skin cold and clammy. A very characteristic feature of aniline poisoning is the development of a dusky blue colour, which may be observed about the tips of the fingers and toes, the lips, ears, gums, and palate. This appearance is probably due to the formation of a coloured compound of aniline in the blood. It is not cyanosis from difficult respiration, for it may be observed in cases in which there is no dyspnœa; and in mild poisoning, as, for instance, when aniline has been absorbed from clothing, it may be the only symptom present, the individual perhaps feeling perfectly well, and being quite unaware of his abnormal appearance.

Treatment.—Evacuation of the contents of the stomach; stimulants; artificial respiration; and, in severe cases, venesection and transfusion of defibrinated human blood.

Post-mortem Appearances.—Signs of death from asphyxia may be present. The blood may be very dark in colour and show the spectrum of methæmoglobin.

Test.—If aniline be warmed with chloroform and alcoholic caustic potash, the disagreeable odour of phenyl isocyanide is perceived.

Nitro-Benzene, $C_6H_5NO_2$.

Nitro-benzene, or "oil of mirbane," a pale yellow liquid with a smell like that of bitter almonds, is used in the preparation of perfumes and flavouring agents. It is excessively poisonous, twenty drops having proved fatal. Cutaneous absorption alone may cause death. In one case, a man aged twenty-two applied a liquid blacking containing nitro-benzene to the cloth tan uppers of a pair of shoes before going to a dance. At 12.30 he was taken ill, became collapsed and cyanosed, and died at 4.45 a.m. His feet were found to be deeply stained with the blacking (*Med. Rev.*, 1904, p. 706). The vapour is also highly dangerous. A case is recorded in which a man spilt some nitro-benzene over his clothes and continued to inhale the fumes for a considerable time. He became comatose in four hours, and died five hours later. Accidents have happened from mistaking the drug for oil of bitter almonds. Two sips of nitro-benzene, taken in mistake for whisky, caused the death of a man in eight hours.*

Symptoms.—These are not unlike prussic acid poisoning, with the difference that the onset is frequently delayed for several hours after the drug has been taken. Giddiness, vomiting, and drowsiness are succeeded, sometimes very suddenly, by profound coma with shallow respiration, weak irregular pulse, and cold clammy skin. As with aniline poisoning, the lips, nails, tongue, and even occasionally the whole body, may be of a blue or purple colour. This is often an early symptom, and may be observed before the individual is seriously ill.

Treatment and **Post-mortem Appearances.**—The same as in aniline poisoning.

* *Lancet*, Jan. 13, 1906.

Dinitro-Benzene, $C_6H_4(NO_2)_2$.

This is a solid substance, used in the manufacture of roburite and other explosives. The symptoms of acute poisoning resemble those produced by nitro-benzene. Chronic poisoning occurs from handling the substance, or inhaling small particles in the air. The symptoms are headache, dyspepsia, blueness of the lips, tenderness and enlargement of the liver, dark colour of the urine, and indications of peripheral neuritis.

Salicylic Acid, $C_6H_4OH.COOH$.

Three drachms of oil of wintergreen, equivalent to 139 grains of salicylic acid, have proved fatal to a child of three years. Salicylic acid and sodium salicylate occasionally produce toxic effects when given repeatedly in medicinal doses. Warning signs are headache, deafness, and ringing in the ears. In cases of acute poisoning, the early symptoms are followed by delirium, vomiting, weak irregular pulse, epistaxis, hæmaturia, and other hæmorrhages. Very large doses kill by depression of either the cardiac or respiratory centre.

Pyrogallic Acid, $C_6H_3(OH)_3$.

This is a white, crystalline substance used for purposes of photography. It has been taken both suicidally and accidentally. A quarter of an ounce of a solution of pyrogallic acid has proved fatal to an adult; and death has followed its external application as an ointment in the treatment of psoriasis. Pyrogallic acid acts as a corrosive upon the mucous membranes with which it comes in contact, and also has a hæmolytic action on the blood-corpuscles, liberating hæmoglobin into the plasma. The **Symptoms** are pain in the stomach, vomiting, dyspnœa, diarrhœa, subnormal temperature, hæmoglobinuria, blueness of the lips and ears, and coma. They may persist for several days before terminating fatally.

Post-mortem, the stomach is congested or corroded, and may even be perforated. The kidneys are swollen and intensely congested.

Picric Acid, $C_6H_2OH(NO_2)_3$.

This substance also has a destructive action on the red corpuscles, leading to hæmoglobinuria and jaundice; other symptoms are vomiting, diarrhœa, and delirium. Toxic effects have followed the application of picric acid as a dressing to a burn or scald.

Acetanilide, Phenazone, Phenacetin, and Exalgin.

Acetanilide, or antifebrin, is sold as "Headache" or "Daisy" powders, containing from four to ten grains. One of these caused the death of an adult woman in one hour. Fatal poisoning has followed

the external application of acetanilide to a raw surface. Ten grains of phenazone or antipyrin have produced very severe symptoms. Fifteen grains of phenacetin killed a girl of seventeen in a few hours. Five grains of exalgin produced unconsciousness lasting for three hours in a woman of thirty, who was suffering from severe asthma. In another case, seventeen and a half grains produced coma and convulsions. Many of the deaths which were ascribed to influenza during the earlier epidemics of that disease, were really due to poisoning by antipyrin, the dangerous properties of which had not at that time been fully realised.

The toxic effects caused by these bodies include blueness of the lips and cheeks, profuse sweating, weak irregular pulse, shallow breathing, subnormal temperature, suppression of the urine, urticarial eruptions, delirium, convulsions, and coma. Strychnine, ether, alcohol, and oxygen inhalations should be given.

CHAPTER XXIV.

POISONS OF VEGETABLE ORIGIN.

CONTENTS.—Opium and morphine—Belladonna and atropine—Stramonium—Hyoscyamus—Solanum nigrum, dulcamara, and tuberosum—Camphor—Cocaine—Cannabis Indica—Nux vomica and strychnine—Cicuta virosa—Œnanthe crocata—Cocculus Indicus—Calabar bean—Curare—Gelsemium—Conium maculatum—Tobacco—Lobelia—Monk's-hood and aconitine—Veratrine—Digitalis—Hellebore—Yew—Pennyroyal—Savin—Tansy—Ergot—Turpentine—Male fern—Santonin—Colchicum—Laburnum—Castor-oil seeds—Colocynth, elaterium, and croton oil—Arum, bryony, chelidonium, daphne mezereon, holly, wild hyacinth, privet, ranunculus—Fungi.

Opium and Morphine.

OPIUM is the juice obtained from the unripe capsules of the white poppy, *Papaver somniferum*, inspissated by evaporation. In commerce, it is met with in rounded or irregular cakes or lumps of a reddish or dark brown colour, covered with chaffy seeds of a species of rumex, or with poppy leaves, and containing from 5 to 20 per cent. of morphine. The B.P. directs that the non-standardised official preparations of opium shall be made from samples containing from 9·5 to 10·5 per cent. of morphine. There are at least eighteen other alkaloids in opium, the most important of which are codeine and narcotine.

The following are the more frequently encountered official and non-official preparations of opium and morphine, with the amounts they contain:—

	Strength.
Extractum Opii,	Standardised, 20 per cent. morphine.
Pil. Saponis Co.,	1 of opium in 5.
Pil. Plumbi c̄ Opio,	1 ,, 8.
Pulv. Opii Co.,	1 ,, 10.
Pulv. Ipecac. Co. (Dover's powd.),	1 ,, 10.
Ung. Gallæ c̄ Opio,	1 ,, 13⅓.
Tinct. Opii (Laudanum),	Standardised, ·75 per cent. morphine.
Ext. Opii Liq.,	,, ,, ,,
Pulv. Ipecac. c̄ Scilla,	1 of opium in 20.
Pulv. Kino Co.,	1 ,, 20.
Linimentum Opii,	50 per cent. of Tinct. Opii.
Pulv. Cret. Aromat. c̄ Opio,	1 of opium in 40.
Suppositoria Plumbi Co.,	1 grain of opium in each.
Liq. Morph. Hydrochlor.,	1 per cent. morph. hydrochlor.
,, Acet.,	1 ,, ,, acet.
,, Tart.,	1 ,, ,, tart.
Inj. Morph. Hypoderm.,	5 ,, ,, ,,

	Strength.
Suppositoria Morph.,	¼ grain morph. hydrochlor in each.
Tinct. Chloroformi et Morphinæ Co. (Imitation Chlorodyne),	10 ♏ contain morphine hydrochloride $\frac{1}{11}$ gr.; acid. hydrocyan. dil., ½ ♏; chloroform, ¾ ♏.
Tinct. Opii. Ammoniata,	1 grain of opium in 96 ♏.
Tinct. Camph. Co. (Paregoric),	1 grain of opium in 240 ♏.
Black Drop,	About 4 times the strength of Tinct. Opii.
Nepenthe,	Same as Tinct. Opii.
Battley's Solution,	1·5 per cent. morphine.
Godfrey's Cordial,	1 to 1½ grains of opium in 1 fl.-ounce.
Atkinson's Infant Preserver,	3 ♏ of Tinct. Opii in 1 fl.-ounce.
Dalby's Carminative,	2½ ♏ of Tinct. Opii in 1 fl.-ounce.
Syrup of Poppies,	Small and uncertain.

Many cough, diarrhœa, and sedative stomachic mixtures contain opium.

Statistics.—Opium is the second most common poison to be taken suicidally; and the third most common to be taken accidentally. The practice of giving infants "soothing syrups" containing opium has been not infrequently followed by fatal results. During the ten years ending 1903, 1,537 deaths in England and Wales were certified as due to opium poisoning, and 150 to chlorodyne poisoning, which is practically opium poisoning, for the amount of hydrocyanic acid present is comparatively small. These were distributed as follows:—

	Accident. (Including Morphia Habit.)		Suicide.	
	Males.	Females.	Males.	Females.
Opium and morphine,	551	363	432	189
Chlorodyne,	66	36	36	12
	617	399	468	201
	1,016		669	

In addition, there were two murders by the administration of opium, and eight deaths of infants were certified as due to "soothing syrups."

Fatal Dose and Period.—Infants are extremely susceptible to the influence of opium, one or two drops of the tincture having on several occasions proved fatal. Among adults, four grains of opium, two drachms of tinct. opii, and one grain of morphine hydrochloride have caused death, but recovery has occurred after very much larger

doses have been taken—*e.g.*, eight ounces of laudanum and fifty-one grains of morphine hydrochloride respectively. Kidney disease, by preventing the excretion of the poison increases the risk. Victims of the opium habit can take enormous doses with impunity. In fatal cases, the average duration of the symptoms is from six to nine hours; but, exceptionally, death has occurred within an hour, or been delayed for more than a day.

Symptoms—Acute Poisoning.—As a rule, the symptoms commence within an hour after the poison has been taken, but they may appear within a few minutes after a hypodermic injection of morphia, and in children; or, on the other hand, they may be delayed for several hours if opium has been taken in a solid form, especially on a full stomach. Usually, the first effect of the drug is to produce a mild degree of excitement or animation, with quickening of the pulse and flushing of the face, a feature often seen after medicinal doses, but which may be of very brief duration, or completely absent when a toxic amount has been taken. In a short time this condition is succeeded by headache, giddiness, diminution of sensibility, and somnolence gradually passing into a state of stupor, from which, at first, the individual may be momentarily aroused by a strong stimulus. In this stage, the face is flushed or cyanosed, the skin warm, the pulse small and quick, the breathing hurried, and both pupils minutely contracted. Vomiting sometimes occurs. When fully established, the coma is profound. The breathing is now slow and stertorous. The lips and extremities are livid. The skin is cold, pale, and bathed in sweat. The pulse is slow and compressible, or, sometimes, rapid and feeble. The reflexes are abolished, and the muscles are completely relaxed. In a few cases, erythematous or urticarial eruptions appear. The breathing becomes slower and shallower, and may be of the Cheyne-Stokes type; convulsions are occasionally seen, more frequently in children than in adults; the pupils may dilate just before the end; and, finally, death occurs from asphyxia.

Recovery may take place even though the patient is apparently at the point of death, and nausea and vomiting may then occur for the first time.

In some cases, partial recovery occurs under treatment, the individual perhaps becoming sufficiently conscious to recognise those about him, and to give an account of the circumstances under which the poison was taken. Then coma again supervenes and is followed by death.

The diagnosis of opium poisoning from other states of coma is given on p. 20.

Chronic Opium Poisoning, Morphinism, or Morphia Habit.—In this country, as a rule, the practice of taking morphia is initiated by the use of the drug for the purpose of relieving pain, and is more prevalent among women than among men. Hypodermic administration is frequently resorted to. The degree of tolerance acquired is sometimes remarkable, perhaps over 100 grains of opium being taken daily. As the effects of a dose wear off, lassitude and

mental depression occur, and the individual accordingly seeks relief by further resort to the drug. Nausea, vomiting, sallowness of the complexion, itching, sleeplessness, loss of appetite, and emaciation follow. The temper becomes irritable, and the moral faculties degenerate. Lying and stealing are resorted to for obtaining the drug, and, in other matters, depravity may be displayed. The habit may continue for months or years, but, if persisted in, a condition of extreme asthenia eventually develops, symptoms of peripheral neuritis may appear, and, finally, the individual dies from exhaustion.

Treatment.—The stomach should be well washed out, first with water, and then with a solution of potassium permanganate containing about 10 or 15 grains to the pint. This tends to oxidise and destroy any morphine which may be remaining in the viscus. Emetics are apt to fail, but, in the absence of the tube, mustard and warm water may be administered. A depressing emetic, such as tartar emetic, should be avoided. Continuous efforts should be made to arouse the patient by the faradic current, dashing cold water in the face, &c., and in mild cases walking him about, but the latter should not be done if he is comatose. Artificial respiration is required when the coma is profound, and should be maintained until life is extinct. Stimulants, such as strychnine, ether, and hot strong coffee per rectum are called for. The value of atropine as an antidote has been disputed, but in some cases its use has been remarkably successful. It should be given hypodermically in doses of $\frac{1}{20}$ to $\frac{1}{40}$ of a grain.

Chronic Morphia Poisoning calls chiefly for moral treatment combined with gradual reduction of the dose.

Post-mortem Appearances.—Signs of death from asphyxia are usually present. The meninges are frequently congested, and there may be serous effusion beneath them and into the ventricles.

Tests for salts of morphine—*In solution.*—Strong nitric acid gives a straw-like colour to dilute solutions, orange-red to strong. Iodic acid gives a yellow colour. Phospho-molybdic acid a yellow precipitate, turned deep blue by ammonia.

In the solid state.—Sulpho-molybdic acid gives a reddish-purple colouration, which ultimately changes to blue.

Belladonna and Atropine.

Atropa belladonna or the **Deadly Nightshade** (nat. ord. *Solanaceæ*) is indigenous in Britain, but is not very common. It grows in waste, shady spots to a height of two or three feet, and flowers from June to August. The leaves are oval, pointed, entire, and arranged in pairs, each pair consisting of a large and a small leaf; the flower is of a reddish-purple and bell-shaped; the fruit is a black berry resembling a cherry; and the seeds are very small, rough, and kidney-shaped. All parts of the plant are poisonous. Atropine is an alkaloid prepared from the leaves and root of the plant.

On the average, about three suicidal, and seven accidental deaths from belladonna and atropine poisoning occur annually, in England

and Wales. Children are occasionally poisoned by eating the berries. The liniment and "eye-drops" are sometimes swallowed with fatal results. In a few cases death has been caused by the external application of belladonna, or by its use as an enema. Dr. Spurgin records the case of two children, aged respectively 10 and $3\frac{1}{2}$ years, who displayed very severe symptoms after the application to the eyes of a solution of atropine containing four grains to the ounce. Careful enquiry established the fact that in neither case did the guttæ drop or trickle into the mouth (*Lancet*, Sept. 20, 1905).

Fatal Dose and Period.—Half a grain of atropine has caused death. A teaspoonful of belladonna liniment has been fatal to an elderly woman. Three of the berries have killed an infant of nine months, and fourteen have been fatal to an old man. In fatal cases death usually occurs within twenty-four hours.

Symptoms.—Usually within half an hour of taking a poisonous dose of belladonna, the individual complains of dryness of the mouth and throat, which may become so great as to render swallowing difficult or impossible. The mucous membrane becomes red and painful, and the voice hoarse. The pupils rapidly dilate to an extreme degree, and, owing to paralysis of accommodation, vision becomes indistinct, and there may be diplopia. Giddiness is experienced, and the individual staggers when he walks. The pulse-rate is markedly increased, and may be 150 per minute. The conjunctivæ are conjested; the skin is dry; and, in a large number of cases, a bright red scarlatiniform rash appears over the greater part of the body. The temperature is somewhat raised, and the breathing is hurried. Vomiting occasionally occurs. The urine may be scanty or retained, although there is constant desire to micturate, but sometimes there is incontinence from paralysis of the sphincter. By this time the individual is in a state of acute delirium. He talks loudly and incessantly, or displays uncontrollable laughter. He is restless, and can with difficulty be kept in bed. His speech is thick and incoherent. Hallucinations are common, and he may endeavour to seize spectral figures in the air. He may become possessed of one idea, and continually repeat certain movements or utterances. In one case a tailor sat for four hours moving his hands and arms as if sewing. Sometimes the delirium is violent. Twitching of the muscles or general convulsions occur in some instances, and there may be numbness of the fingers. In fatal cases, periods of drowsiness or stupor interrupt the delirium; but eventually the coma becomes profound, the face livid, the skin cold, and death occurs from heart-failure and exhaustion. If recovery takes place, it may be some days before the pupils regain their normal size.

Treatment.—The stomach should be washed out, or, in the absence of the tube, emetics given, followed by the administration of tannic acid or strong boiled tea. One-third to half a grain of pilocarpine or of morphia should be injected subcutaneously. Stimulants are required, and artificial respiration if coma supervenes.

Post-mortem Appearances.—These are not characteristic. Sometimes signs of asphyxia are present. If the berries have been

eaten, the stomach may be irritated and stained by the juice, and portions of the pulp or seeds may be found.

Tests.—The chemical tests are not reliable. If a drop of the filtered vomit or contents of the stomach be dropped into the eye of an animal, dilatation of the pupil occurs.

Stramonium.

Datura stramonium or the **Thorn-apple** (*Solanaceæ*) is occasionally found growing in waste-places, dung-hills, &c. It has large white sweet-scented flowers. Daturine, the active principle, is an alkaloid isomeric with atropine. Neither poisoning by the plant itself, nor by the official preparations from it, is at all common in this country, but in India other species of datura have been largely used for criminal purposes. The symptoms closely resemble those of poisoning by belladonna, and the same treatment may be adopted.

Hyoscyamus.

Hyoscyamus niger or **Henbane** (*Solanaceæ*) is a fairly common plant, found growing in waste-places and by the sea-shore. The flowers are yellow, and the leaves are sessile, unequally cut at the sides, and half embracing the stem. It contains two alkaloids, hyoscyamine and hyoscine, isomeric with atropine. Cases of poisoning are rare. An interesting example is recorded by Dr. Given (*Lancet*, 1904) which occurred through a chemist reading ·08 gr. of hyoscine hydrobromate as "gramme" instead of "grain." Thus the patient took fifteen times as much of the drug as was intended. Very severe symptoms were caused, but recovery occurred. The symptoms, in the main, resemble those of atropine poisoning, but, owing to the presence of small quantities of hyoscine, which is a cerebral sedative, there is less tendency to acute delirium.

Solanum.

Solanum nigrum, the **Garden** or **Common Nightshade**, has small white flowers and berries which are black when ripe. The latter have been eaten by children, and have caused vomiting, purging, and convulsions, followed by death.

Solanum dulcamara, **Woody Nightshade** or **Bittersweet**, is a common plant with attractive purple flowers, and bright red berries, which have occasionally proved fatal to children.

Solanum tuberosum is the familiar potato. The berries have on several occasions proved fatal. The active principle in this, and the two preceding plants, is an alkaloid called **solanine**. Besides being present in the berries it has also been found in the "eyes," the peel, and unsound portions of the tuber, all of which have occasionally caused toxic symptoms. Sound, mature potatoes very rarely contain solanine in poisonous amount. Some remarkable cases of poisoning on a large scale by potatoes have been recorded among soldiers in Continental garrisons. The various **symptoms**

observed in five epidemics are thus described by Prof. Dixon Mann: —"Frontal headache, colicky pains in the stomach and bowels, vomiting, diarrhœa, tenderness of the abdomen, shivering, sweating, depression, slight stupor, oral and visual disturbances, congestion followed by pallor of the face, blueness of the lips, widely dilated pupils, initial acceleration with subsequent retardation of the pulse, elevation of the temperature, syncope, and convulsions. All the 716 men thus attacked recovered. The potatoes which acted in this untoward way presented no abnormal appearance."

Camphor.

Poisoning by camphor or by camphorated oil is not very rare. Seventeen deaths were recorded from 1894 to 1903, three of which were suicidal. Solid camphor is largely used for preserving furs, &c., from moth, and is sometimes eaten by children.

Fatal Dose.—Twenty grains have killed an adult. But recovery has occurred after very much larger doses, even in children.

Symptoms.—Giddiness and headache, the first symptoms, are followed, after a variable time, by burning pain in the throat and stomach; great excitement or incoherent delirium; vomiting; purging; convulsions, especially in children; dilatation of the pupils; great thirst; numbness or tingling of the extremities; thready pulse; difficult or stertorous respiration; lividity of the lips; and drowsiness passing into coma. In fatal cases, death occurs from collapse in from seven to thirty-six hours.

Treatment.—Stomach-tube or emetic followed by stimulants.

Post-mortem Appearances.—The stomach may be inflamed, and the odour of camphor perceptible.

Cocaine.

This is an alkaloid prepared from the *Erythroxylon coca*, a South American plant, the leaves of which are largely chewed by the inhabitants of Chili and Peru on account of the intoxicating and exhilarating properties they possess. In this country, the cocaine habit is by no means rare, the drug being usually administered hypodermically. Sometimes it is taken as snuff or in the form of a nasal spray. Cocaine is extensively used for surgical purposes as a local anæsthetic, and acute symptoms are not infrequently seen after its use, though death under these circumstances is rare. During the ten years ending 1903, fourteen accidental and eight suicidal deaths from poisoning by cocaine were recorded in England and Wales.

Fatal Dose.—Two-thirds of a grain, injected subcutaneously, killed a woman of seventy-one in five hours; and twenty minims of a 4 per cent. solution, injected into the urethra, produced immediate convulsions followed by death.

Symptoms—Acute Poisoning.—When a poisonous dose has been taken by the mouth or injected, giddiness and faintness

appear within a few minutes. Nausea and vomiting may occur. The pulse becomes extremely weak and may be so rapid as to be uncountable. Swallowing and articulation are difficult. The breathing is shallow and gasping, the face pale, the lips cyanosed, and the pupils widely dilated. Profuse perspiration occurs. In some cases unconsciousness rapidly supervenes; in others there is restlessness and delirium. Twitching of the muscles or general convulsions are frequently observed. Death occurs from paralysis of respiration and may take place within forty minutes (or in some recorded cases only a few minutes) from the time of taking the poison. If recovery occurs, there may be retention of urine; anæsthesia of the mouth and nostrils; and diminished cutaneous sensibility for some hours.

Chronic Poisoning.—The physical symptoms are dyspepsia; constipation; sleeplessness; wasting; rapid pulse; attacks of dyspnœa and palpitation; fainting; impotence, but with perhaps increased sexual excitability; itching of the skin; albuminuria in some cases; muscular twitchings; spasms; and even epileptiform convulsions which may prove fatal. Mentally, the condition varies. Immediately after a full dose there is exaltation and loquacity, but, as the effect of the drug wears off, the individual becomes gloomy and depressed. Hallucinations are common. The itching of the skin may give rise to the belief that small insects, "cocaine-bugs," are creeping over it (Magnan's symptom). The writer has met with a case in a school-boy, who was one day found plucking tufts of hair from his head, and burning them in the flame of a candle, under the impression that they were cotton-wool. He had been given a prescription containing cocaine for toothache some months before, and had continued, quite innocently, to obtain a fresh supply of the medicine whenever he felt pain. If the habit is long persisted in, melancholia or a maniacal condition may develop.

Treatment.—Evacuation of the stomach by the tube or by emetics. Administration of stimulants, particularly ether hypodermically. Inhalation of nitrite of amyl has been recommended. Chloroform for convulsions; and artificial respiration if necessary.

Tests.—The chemical tests are not very satisfactory. If a solution be cautiously tasted, it is found to be bitter, and in a few minutes produces numbness of the tongue. A few drops placed in the eye cause dilatation of the pupil.

Cannabis Indica.

Cannabis Indica or Indian Hemp is employed in the preparation of haschish and bhang. The extract is used for medicinal purposes. Cases of poisoning are very rare in this country. A large dose produces delirium followed by insensibility.

Nux Vomica and Strychnine.

Strychnos Nux Vomica (nat. ord. *Loganiaceæ*) grows in various parts of India and Ceylon. The disc-shaped seeds, covered with

fine grey silky hairs, are familiar objects. They may also be met with in commerce as a brown powder. The bark is known as "false Angostura bark." The seeds of another species, *S. ignatii*, are called the "beans of St. Ignatius," and contain rather more strychnine.

Strychnine, the alkaloid prepared from these plants, is a white powder, very insoluble in water. The salts most frequently met with are, the sulphate, the hydrochloride, the nitrate and acetate, all of which are moderately soluble in water. Most "vermin-killers" consist of starch mixed with from four to twenty per cent. of strychnine, and coloured with Prussian blue, carmine, soot, or ultramarine. They are responsible for a considerable number of suicidal, and a few accidental deaths. Strychnine is present in Easton's Syrup, and Fellowes' "Compound Syrup of Hypophosphites." In 1904 a child died from eating ten pills each containing the equivalent of a drachm of Easton's Syrup, and in 1896 a man committed suicide by taking the same preparation. Strychnine, in spite of its intensely bitter taste, is a poison frequently selected by murderers. Three hundred and nine deaths from poisoning by strychnine, nux vomica, and vermin-killers, in England and Wales, during the ten years ending 1903, were distributed as follows:—

	Accident.		Suicide.	
	Males.	Females.	Males.	Females.
Strychnine and nux vomica,	43	24	87	92
Vermin-killers, . . .	1	2	26	34
Totals, ...	44	26	113	126
	70		239	

In addition, there were six cases of murder and one of manslaughter.

Fatal Dose and Period.—One-thirtieth of a grain was fatal to a child between two and three years of age, in four hours. An adult has been killed by half a grain. Recovery, when vomiting has been promptly procured, has followed the taking of more than twenty grains. In fatal cases, death usually occurs within two hours; exceptionally, it may take place within a few minutes, or may be delayed for five or six hours.

Symptoms.—When a poisonous dose of strychnine is swallowed, an intensely bitter taste is perceived. The symptoms usually commence within four or five minutes, but they may be delayed for twenty minutes, or, in rare cases, longer. Restlessness, apprehen-

sion, and a feeling of impending suffocation are rapidly succeeded by twitching of the muscles and jerking of the head, which, often quite suddenly, pass into general convulsions, at first clonic, and then tonic. The hands are clenched, the limbs are thrown out, the head is jerked violently backwards, and the whole body becomes rigid. The contraction of the muscles of the back is often so great as to produce an arching of the body, so that it rests only on the head and heels, a condition known as opisthotonus. Rarely the curve is lateral or forwards. The muscles of the abdomen are tightly stretched, and are as hard as a board. The pulse is rapid, and respiration is difficult owing to the rigidity of the muscles of the chest. The aspect of the face is ghastly. The angles of the mouth are drawn down into the *risus sardonicus*, the lips are livid, the eyes wild and staring, and the pupils dilated. The jaws are clenched, but often the masseters are the last muscles to be affected. After the spasm has persisted for from a half to two minutes, the muscles completely relax, the cyanosis passes off, the pulse-rate diminishes, and the individual sinks back exhausted, and bathed in sweat. The remission, however, is but short. In a few minutes the convulsions recur, and are again followed by relaxation. Any attempt to pass the tube, or even a slighter stimulus, such as a touch, a footstep, or a bright light, is sufficient to bring on the convulsions. During the intervals the patient lies in a state of extreme terror, and he may cry out wildly as he feels the paroxysm approaching. In an unfavourable case the remissions become shorter, and the convulsions progressively more violent, perhaps even jerking the individual out of bed. Death occurs from asphyxia during a spasm, or from exhaustion during a period of relaxation. Consciousness is generally maintained until the end. In a case which is going to recover, the remissions become longer, and the convulsions gradually less severe.

Strychnine poisoning presents considerable resemblance to tetanus, but, in the latter affection, the convulsions come on more slowly and after a period of ill-health, with premonitory symptoms of stiffness and soreness in the muscles of the jaws and neck. Tonic spasm of the muscles of the jaws (lock-jaw) occurs before the convulsions become generalised, muscular relaxation between the convulsive attacks is never complete; and the duration of the symptoms is longer, usually more than twenty-four hours. The resemblance between the two conditions has served as a defence to a charge of murder, notably in the trial of Palmer in 1856.

Treatment.—Chloroform should be administered at once, the tube then introduced, and the stomach well washed out. Some recommend lavage with a dilute solution of potassium permanganate. If the tube is not at hand, an emetic may be given. A drachm of potassium bromide in water may be given every half hour, and from thirty to sixty grains of chloral hydrate administered per rectum, but chloroform inhalation should be maintained as long as there is any tendency for the convulsions to recur.

Dr. A. E. Russell,* as the result of experiments on animals,

* *Lancet*, Sept. 23, 1905.

strongly suggests the advisability of injecting cocaine or eucaine into the spinal theca of man in cases of strychnine poisoning. This causes temporary physiological "section" of the posterior roots, and in animals controls the strychnine convulsions.

Post-mortem Appearances.—Signs of death from asphyxia may be present.

Tests.—Intense bitterness is perceived if a solution containing strychnine or the solid substance is cautiously tasted.

If a few particles of potassium bichromate or manganese dioxide be added to solid strychnine, or to the residue of a solution which has been evaporated to dryness in a porcelain dish, and the mixture be stirred with a glass rod moistened with strong sulphuric acid, a vivid purple colour, which gradually changes to red, is produced.

Cicuta Virosa.

This is the **Water Hemlock** or **Cowbane**, a common British plant belonging to the *Umbelliferæ*. It grows to a height of three or four feet on the banks of streams or ditches. The stem, which is hollow and furrowed, has been mistaken for celery; and the root for parsnip. In 1901 a number of boys, who were camping-out in the Island of Cumbrae, ate portions of the plant in the belief that it was parsnip. Twenty-four of them displayed severe symptoms of poisoning, and one died. The **symptoms** are giddiness; dryness of the throat; dilatation of the pupils; pain in the stomach; vomiting; delirium in some cases; and violent tetanic convulsions with foaming at the mouth and dyspnœa. In the fatal case mentioned above, the convulsions persisted almost without intermission for five and a half hours before death, the body being rigid, and the back arched.

Œnanthe Crocata

or the **Water Dropwort** is also one of the *Umbelliferæ*, found growing to a height of from two to five feet in moist places. The large fusiform tuberose roots have occasionally been eaten by mistake for an edible vegetable. The **symptoms**, which come on quickly, are violent convulsions with blood-stained froth at the mouth and nostrils; unconsciousness or delirium; and dyspnœa with stertor and cyanosis. Death may take place within a few minutes from asphyxia. In other cases death has occurred after the lapse of several days with symptoms of gastro-enteritis.

Cocculus Indicus.

This is a hard dark berry, which, being readily identifiable, is sometimes shown to students at examinations. It has been used to increase the intoxicating power of beer, but cases of poisoning are extremely rare. **Picrotoxin**, the active principle, is employed in medicine as a parasiticide. The **symptoms** produced by a poisonous dose are gastro-intestinal irritation, unconsciousness, and tetanic convulsions.

Calabar Bean.

This is another pharmaceutical specimen which the student must be prepared to recognise, though instances of poisoning by it are very uncommon. In 1864, forty-six children in Liverpool were poisoned by eating some of the beans which had been thrown out of a ship, but only one died. The active principle, **physostigmine** or **eserine**, is employed in ophthalmic practice. The **symptoms** of poisoning are giddiness; vomiting; muscular weakness or paralysis; contraction of the pupil usually, but sometimes dilatation; feeble irregular pulse; and unconsciousness.

Curare.

An extract of this resinous substance, which is probably obtained from a species of *Strychnos*, is used by the natives of South America as an arrow-poison. It is almost unknown as a poison among human beings, but, at the trial, in 1905, of Tullio Murri and his accomplices for the murder of Count Bonmartini, it was shown that an attempt had been made to commit the crime by the forcible administration of curare. The student will be familiar with the effects of the poison from physiological experiments.

Gelsemium.

Gelsemium sempervirens is the **yellow** or **Carolina Jasmine**. A few cases of fatal poisoning by accidentally taking overdoses of the medical preparations are recorded. The **symptoms** produced are giddiness; dilatation of the pupils; diplopia and ptosis; extreme muscular weakness or paralysis; depression of the heart; unconsciousness; and convulsions.

Conium Maculatum.

This is the **Common** or **Spotted Hemlock** (nat. ord. *Umbelliferæ*). It is a familiar English plant, growing to a height of from two to four feet, and having a smooth round dark green stem with purple spots. The leaves have on several occasions been eaten by mistake for parsley, and a decoction of them has been administered homicidally. The medicinal preparations have also been responsible for accidental and homicidal deaths. The active principle is **conine**.

The chief action of conine is to paralyse the motor nerves, beginning at the periphery, and gradually ascending to the spinal cord. Hence the **symptoms** of poisoning are weakness of the limbs, followed by paralysis; dilatation of the pupils and ptosis; and dyspnœa and cyanosis from respiratory paralysis. Death occurs from asphyxia, consciousness being usually maintained until near the end. If the plant has been eaten there may be signs of gastro-intestinal irritation. Delirium, coma, and slight convulsions have occasionally been observed. The **treatment** is lavage of the stomach, artificial respiration, and administration of stimulants.

Tobacco.

The tobacco plant, *Nicotiana tabacum* (nat. ord. *Solanaceæ*), is occasionally met with in this country as a garden flower. Fatal poisoning by tobacco or nicotine is not very rare. During the ten years ending 1903, three cases of suicidal and six of accidental death were reported in England and Wales. Swallowing a "quid" of tobacco has caused death, and the same result has followed the addition, in a sportive spirit, of pipe-juice or snuff to the beer of a drunken person. Absorption of nicotine by the rectum may be sufficient to cause death. Children have been killed by ignorant persons injecting into the rectum a decoction of tobacco as a vermifuge; and very severe symptoms were exhibited by a prisoner who had concealed an ounce of tobacco in his rectum. Smoking strong tobacco has proved fatal to a boy. Certain insecticides used in horticulture contain large quantities of nicotine.

Pure nicotine is an intensely virulent poison, rapidly causing death by paralysis of the cardiac and respiratory centres. In 1851, Count Bocarmé murdered his brother-in-law by forcibly administering nicotine, death ensuing in five minutes. The **symptoms** of tobacco poisoning are giddiness; vomiting; pallor of the skin and sweating; faintness; feeble irregular pulse; muscular weakness; cramps; and unconsciousness. In some cases, delirium and convulsions occur. Death has occurred in twenty minutes after the administration of an enema consisting of a decoction of tobacco, but the symptoms may last for several hours. The **treatment**, after emptying the stomach by the tube or an emetic, is to give stimulants and tannic acid or strong tea. Artificial respiration may be necessary.

Lobelia.

(Nat. ord. *Lobeliaceæ*.) Poisoning by this plant is now very rare in England, but it was at one time frequently prescribed by quacks, often with fatal result. In 1884, a woman, to whom the drug had been admini-tered by a herbalist for the purpose of procuring abortion, died in forty minutes. The poison acts as a gastro-intestinal irritant and nervous depressant.

Monk's-Hood and Aconitine.

Aconitum napellus, **Monk's-hood** or **Wolfsbane**, is a familiar garden flower belonging to the *Ranunculaceæ*. It grows to a height of two or three feet, and has a raceme of deep blue flowers in August and September. The leaves are 3-5-partite, and the segments are deeply cut. The root has, on several occasions, been mistaken for horse-radish, and eaten with fatal result, although the resemblance between the two is not very marked. The root of monk's-hood is conical; is brown externally, white internally when freshly cut, but becoming pink on exposure to air; gives off a number of curly rootlets; has soft scrapings; and imparts a tingling, numbing sensation to the lips and tongue when tasted. The root of horse-radish is cylindrical; is yellowish-white externally, white

internally, remaining so on exposure to air; gives off straight rootlets; has tough stringy scrapings; and has a hot pungent taste.

Monk's-hood contains several active principles, of which the most important is the alkaloid, **aconitine**. Commercial samples of aconitine contain varying amounts of the pure alkaloid, and consequently differ very widely in their toxicity. The German preparation is far weaker than either the English or the French. Fatal poisoning has occurred owing to the substitution by the dispenser of a stronger aconitine than that prescribed. In one fatal case, the preparation actually employed was estimated to be 170 times more powerful than that intended to be used. The deaths from aconite poisoning in England and Wales, from 1894 to 1903, were 48, of which 27 were accidental, and 21 suicidal. In 7 of these a liniment of aconite and belladonna was taken.

Fatal Dose and Period.—Aconitine is one of the most virulent poisons known. One-fifteenth of a grain has proved fatal to a man in five hours. One drachm of the tincture has caused death, and about sixty grains of the root a like result. Death usually occurs within four or five hours. In exceptional cases, it has taken place in three-quarters of an hour; and has been delayed for twenty hours.

Symptoms.—Within a few minutes of taking a poisonous dose of aconite, a severe burning, tingling, and numbing sensation is felt in the mouth and lips, followed by salivation, burning pain in the throat, and perhaps difficulty in swallowing. In from half an hour to an hour, intense abdominal pain develops, and severe vomiting occurs. In some cases, there is also purging. The tingling and numbing sensation now spreads over the entire skin. Great muscular weakness, with heaviness of the limbs, occurs. Spasmodic twitchings, or painful cramps, affect the limbs, and there may be severe general convulsions. The cardiac and respiratory centres become profoundly depressed. The pulse is weak and irregular; the skin cold and clammy; the lips livid; and the breathing laboured and gasping. The pupils may alternately dilate and contract more than once, and vision may be lost during the periods of dilatation. Power of speech may be lost. Delirium occurs in some cases, and there may be stupor, but often consciousness is retained until the end. Death occurs from syncope or asphyxia.

Treatment.—After washing out the stomach or giving an emetic, 20 minims of tinct. digitalis should be injected subcutaneously, and repeated in an hour if the symptoms are still severe. Strong coffee or brandy may be given by the mouth or rectum. Artificial respiration may be necessary. The recumbent posture should be maintained.

Post-mortem Appearances.—These are not characteristic. There may be signs of asphyxia and irritation of the stomach.

Tests.—The chemical reactions are not reliable. The taste is very characteristic, and the lethal effects may be tested by administering a small dose to an animal.

Veratrine.

Veratrine is an alkaloid, or mixture of alkaloids, prepared from sabadilla or cevadilla, the dried ripe seeds of *Schœnocaulum officinale* (nat. ord. *Colchicaceæ*). It is a constituent of certain nursery pomades employed for killing pediculi (*v.* p. 185). It acts as severe gastro-intestinal irritant and nervous depressant. Death occurs from syncope, due to depression of the cardiac centres, and to the direct action of the poison on the heart muscle. Cases of poisoning by veratrine are rare.

Digitalis.

Digitalis purpurea is the common **Foxglove** (nat. ord. *Scrophulariaceæ*). The leaves are ovate, subacute, crenate, somewhat rugose, and downy, especially on the under surface. The seeds are very small, light brown in colour, and pitted. The plant contains several active principles, of which digitoxin, digitalin, and digitalein are the most poisonous. Commercial digitalin consists of a mixture of these and other substances in varying proportions, and accordingly the effects produced by different samples vary. Fatal poisoning by digitalis, which is not very common, is usually accidental, but a case of suicide was recorded in 1894.

Fatal Dose.—Nine drachms of the tinct. digitalis and thirty-eight grains of the leaves have respectively caused death. The fatal dose of digitalin has not been determined.

Symptoms.—These may not appear for an hour or more after the poison has been swallowed. The first effects are those of gastro-intestinal irritation. There is severe vomiting, colicky pains in the abdomen, and purging. Then follows the specific action of digitalis on the heart. The pulse becomes weak, irregular, and remarkably slow; it is often below forty per minute, and a rate as low as twenty-five has been recorded. Giddiness; muscular weakness; faintness; noises in the ears; dilatation of the pupil with disturbance of vision; and cold sweats on the skin, occur. Respiration is slow and sighing. Hiccough may be present. The urine is frequently suppressed. Mild delirium, with hallucinations, is observed in some cases; in others, there is drowsiness or stupor. Death may occur suddenly from heart-failure, or, more slowly, from asphyxia, sometimes preceded by convulsions. The symptoms may extend over several days, and sudden death may occur after the patient is apparently convalescent, if a muscular effort, such as getting out of bed, or even sitting up, is made.

Digitalis is a cumulative poison, and may suddenly give rise to acute symptoms after an individual has been taking medicinal doses for some days.

Treatment.—If profuse vomiting has not occurred, the stomach should be washed out, or an emetic given, followed by strong tea or tannin. Brandy or hot coffee may be administered per rectum, and external warmth applied. The recumbent posture should be maintained until the pulse is normal.

Post-mortem Appearances.—There may be signs of irritation in the stomach.

Tests.—The chemical tests are not satisfactory. The suspected extract may be injected into a frog, and the effect on the heart-beat watched.

Hellebore.

Two species of this plant—viz., *Helleborus viridis* and *H. fœtidus* (nat. ord. *Ranunculaceæ*), are found in England. *H. niger* is not a British plant. The powdered root or a decoction of the leaves of the latter is sometimes employed by ignorant persons as a vermifuge, and has been taken to produce abortion. Instances of fatal poisoning are rare. The symptoms are those of gastro-intestinal irritation, and profound cardiac depression.

Yew.

This is a common British tree. The berries have on several occasions proved fatal to children, and the leaves, or a decoction of them, have caused death when taken either as a vermifuge or an abortifacient. The **symptoms** are abdominal pain; giddiness; vomiting; purging; collapse; convulsions; and coma or delirium in some cases. There is no specific action on the uterus. Death may occur within a few hours.

Pennyroyal.

An essence or oil of this rather infrequent British plant (*Mentha pulegium*) is a popular emmenagogue. It acts as a powerful irritant, and may give rise to delirium, unconsciousness, and tetanic convulsions. If abortion takes place, it is owing to the severity of the general symptoms, but death may occur without expulsion of the uterine contents.

Savin.

This is the *Juniperus sabina*. Nearly all the cases of poisoning have been due to its use as an abortifacient. It is a strong irritant, producing vomiting and purging followed by coma and collapse. Death may take place without abortion having occurred.

Tansy.

The common *Tanacetum vulgare* has a reputation similar to that of the above. It may cause death in a few hours preceded by unconsciousness and convulsions.

Ergot.

Ergot, or *Claviceps purpurea*, is a fungus which grows in the ovary of many species of grasses, particularly the common rye, but also wheat, barley, and oats. It gradually replaces the grain, and

when fully developed forms a firm, compact mass of hyphæ, or sclerotium, of a deep purple colour, slightly curved, and longer than the original grain. It contains several active principles, of which the extract, ergotin, is a mixture.

Ergot possesses to a marked degree the power of stimulating the uterus, and is largely used by obstetricians to ensure efficient contraction of that organ after labour. Nevertheless, its action as an abortifacient is extremely uncertain. Ergot is also used as a hæmostatic.

Most of the cases of acute poisoning by ergot have occurred in women, as the result of efforts to procure abortion; but severe symptoms have occasionally followed medicinal doses, probably of a preparation of unusual strength.

Fatal Dose.—This has not been determined.

Symptoms — Acute Poisoning. — These comprise giddiness; vomiting; colicky pain; purging in some cases; great thirst; weak rapid pulse; disturbance of vision; muscular weakness; painful cramps; coma or delirium; and convulsions. Exceptionally, hæmatemesis, hæmaturia, and jaundice have been observed.

Chronic Poisoning arises from eating bread which has been made from flour containing ergot. It is practically unknown in this country now, but appears occasionally in epidemic form among the Russian peasants. The symptoms, at first, are those of irritant poisoning—viz., vomiting, diarrhœa, and abdominal pain accompanied by itching, tingling, or numbness of the skin, and dimness of vision or loss of hearing. The later symptoms present two types—the *gangrenous*, in which dry gangrene of the toes, fingers, ears, nose, or even the arms, feet, or legs occurs; and the *spasmodic*, in which painful cramps affect the limbs and are followed by tonic contractions, perhaps terminating in general convulsions. Delirium or mania may occur. Both sets of symptoms may be present in the same individual.

Treatment.—Symptomatic, after emptying the stomach. Inhalation of nitrite of amyl has been recommended.

Post-mortem Appearances.—There may be signs of irritation of the stomach. Exceptionally, with jaundice there may be fatty changes in the liver and kidneys.

Tests.—The spectrum of a solution containing ergot shows a band in the green, and a broader, more distinct band in the blue. The chemical tests are not reliable.

Turpentine.

A few cases of poisoning by this oil are recorded, chiefly among children. A teaspoonful has killed an infant of five months; and four ounces an adult in twelve hours. The **symptoms** are giddiness; vomiting; diarrhœa; strangury; convulsive movements; and coma. The **treatment** is evacuation of the stomach contents, followed by demulcents, and castor oil if diarrhœa has not occurred.

Male Fern.

The rhizome of male fern or *Aspidium filix mas* is used as an anthelmintic, and has occasionally given rise to severe and even fatal effects. The **symptoms** are vomiting and purging, followed by delirium, coma, and collapse. Freyer records the case of a child who died in five hours after taking about 120 grains of extract of filix mas with castor oil. Three weeks previously she had taken twice the quantity, but without castor oil. *A propos* of this case Prof. Dixon Mann writes, "The toxic properties of the extract of male fern are augmented by the presence of additional oil to that contained in the extract itself; . . . it is advisable, therefore, not only to avoid giving a mixture of the extract with castor oil, but also to give some other laxative than oil, if one is subsequently needed."

Santonin.

This is the active principle of *Artemisia maritima* or **Wormwood**, a plant which grows on the sea-shores of the British Isles. It is used as an anthelmintic for round-worm. Less than two grains proved fatal to a child between five and six years of age in fifteen hours. The **symptoms** are giddiness; vomiting; yellow vision which may last for several hours; dyspnœa; convulsions; coma; and collapse. **Chronic poisoning** by wormwood is seen among absinthe drinkers.

Colchicum.

The seeds and corm of the *Colchicum autumnale* (nat. ord. *Colchicaceæ*) are used in medicine. The chief active principles are colchicine and veratrine. Colchicum is present in "Gloria Tonic" and "Blair's Gout Pills" (*Hutchison*). Nearly all the cases of poisoning have been accidental. Three and a half drachms of *vinum colchici* caused death in four days; and twenty-eight of Blair's Pills killed a man of fifty in four and a half days. The **symptoms**, which may not appear for an hour or two after the poison has been taken, are abdominal pain; severe vomiting; profuse diarrhœa with passage of blood; laboured respiration and cyanosis; depression of the heart; muscular twitchings or general convulsions; followed by death from collapse. Consciousness is generally maintained, but stupor has been observed. The **treatment** is on general principles, but strong tea or tannic acid may be given.

Laburnum.

The seeds, leaves, and root of *Cytisus laburnum* (nat. ord. *Labiatæ*) have occasionally been eaten by children with fatal result. The symptoms, which may be delayed for an hour or more, are vomiting; purging; epigastric pain; shivering; giddiness; extreme weakness of pulse; subnormal temperature (93·6° F. in one case); dilatation of the pupils; drowsiness passing into coma; and muscular twitchings or occasionally general convulsions. Exceptionally, profound nervous depression occurs with little or no vomiting.

Castor-Oil Seeds.

Castor oil itself is innocuous, but the seeds contain an active principle which has, on several occasions, caused fatal poisoning. A man who had taken two seeds died on the sixth day. Gullan records a case in which a single seed produced a condition of great collapse (*Brit. Med. Journ.*, May 6, 1905). The **symptoms** are acute epigastric pain; violent and incessant vomiting; purging with sanguineous stools (but sometimes obstinate constipation); followed by collapse.

Colocynth—Elaterium—Croton Oil—Aloes.

These drastic purgatives have in a few instances caused intense gastro-intestinal irritation followed by death, when taken in quantities in excess of the medicinal doses. An interesting case of poisoning by Beecham's Pills, which, according to Hutchison, consist of aloes, soap, and ginger, is recorded by Dr. Staple in *The Lancet* of June 10, 1905. A woman aged thirty-two, who was "a few days over her time," took four pills on May 10 and seven on May 11. Diarrhœa, vomiting, and symptoms of peritonitis appeared and she died on May 18. The autopsy showed acute peritonitis and enteritis. At the inquest, a verdict of death from taking the pills was returned.

Arum maculatum (Cuckoo Pint)—**White Bryony—Black Bryony—Chelidonium** (Celandine)—**Daphne mezereon —Holly—Wild Hyacinth—Privet—Ranunculus.**

These and other British plants act chiefly as gastro-intestinal irritants, and in cases of severe poisoning may cause death from collapse.

Fungi.

Agaricus campestris, the **common mushroom**, is not poisonous when fresh, but, if decomposed, may give rise to severe symptoms, sometimes followed by death. A considerable amount of fat and albumen is present in the tissue, and probably ptomaines are developed by the decomposition of these. The chief toad-stools which contain toxic principles are:—

Amanita phalloides.—This has frequently been mistaken for the common mushroom to which it bears a considerable resemblance. It may be distinguished by the facts that the stem is hollow, and is inserted into a bulb at the base; and the gills are white, while those of *A. campestris* are purplish-black, or, in young specimens, a delicate pink which darkens on exposure to air. It will peel almost as well as the mushroom. A toxalbumen known as **phallin** has been extracted from the fungus.

Amanita muscaria is the fly-fungus. It is about the same size and shape as the mushroom, but the pileus (the top) is of a bright

red colour studded with raised white spots. It contains a poisonous alkaloid, **muscarine**, which has also been isolated from the next two fungi.

Russula integra seu *emetica* has a smooth, red pileus, and thick, fragile lamellæ.

Boletus luridus.—This fungus also resembles the mushroom, but the pileus is easily detached, revealing the hymenophore which consists of a series of tubes having red openings. The fleshy tissue quickly turns blue when broken and exposed to air.

Symptoms.—These may appear soon after the fungus has been eaten, but are usually delayed for six or eight hours, and even in some cases thirty hours or more. They are by no means constant in character. In most cases signs of acute gastro-intestinal irritation are present. There is violent vomiting, colicky pains in the abdomen, and profuse diarrhœa, the stools being rice-watery and perhaps containing blood. Great thirst, laboured respiration, cyanosis, quick feeble pulse, and collapse follow. The clinical picture in this type is not unlike that of arsenical poisoning.

In other cases, there are nervous symptoms in addition to those of an irritant character, particularly if *Amanita muscaria* has been taken. They comprise headache; giddiness; illusions of the senses —*e.g.*, blue vision; delirium; dilatation of the pupil; slow pulse; trismus; muscular twitchings; violent tetanic convulsions; and coma. They may precede the signs of gastro-intestinal irritation.

Exceptionally, the nervous symptoms alone occur; and in some cases the poison acts purely as a narcotic.

Death may take place within a few hours; but usually the symptoms extend over a day, and sometimes two or three days.

Treatment.—The stomach should be emptied by an emetic. Sir Thomas Stevenson writes, "The stomach-pump and tube are perhaps of little service, seeing how persistently the particles of fungi adhere to the walls of the gastro-intestinal canal. Atropine appears to be a direct antidote to muscarine; and digitalis appears to be so in a less degree. Atropine should therefore be given in small doses in cases of poisoning by *Amanita muscaria;* and failing this some preparation of digitalis." Castor oil may be administered to clear the bowels. Opium may be required for persistent diarrhœa, but should not be given in addition to atropine.

Post-mortem Appearances.—There may be intense inflammation of the gastric mucous membrane with superficial erosion. Fatty degeneration of the liver, kidneys, and heart is frequently found. Subserous ecchymoses beneath the pleura and pericardium have been observed.

CHAPTER XXV.

POISONS OF ANIMAL ORIGIN.

CONTENTS.—Cantharides—Ptomaine poisoning by meat, fish, milk, cheese, and ice-cream—Stings of insects, &c.—Snake-venom.

Cantharides.

Cantharis vesicatoria or **Spanish Fly** is a beetle about three-quarters of an inch in length, with wing-cases, head, and legs, of a bright metallic, coppery-green colour. It is also met with as a greyish-brown powder, readily identified by the presence of shining green particles. The medical preparations, which are practically only used as counter-irritants, may give rise to toxic symptoms from cutaneous absorption, particularly in those suffering from kidney disease. The active principle is **cantharidin.**

Deaths from accidental poisoning by cantharides were recorded in 1894 and 1900. Such cases usually arise from swallowing preparations intended for external application. Criminally, cantharides is administered for two purposes, either as an abortifacient or as an aphrodisiac. Abortion frequently occurs owing to the severity of the general symptoms, and reflex stimulation of the uterus by irritation of the bladder. There does not appear to be any direct action on the uterus. The popular belief that cantharides increases the sexual desires is not always borne out in cases of poisoning, nor has the administration under medical advice of small doses for impotence been attended with marked success.

Fatal Dose and Period.—Twenty-four grains of the powder taken in two doses, caused abortion in a young woman, followed by death in four days. An ounce of the tincture killed a boy of seventeen, in fourteen days.

Symptoms.—Soon after a poisonous dose of cantharides has been taken, an intense, burning pain is felt in the mouth and throat, and quickly extends to the stomach. Salivation; pain and difficulty in swallowing; severe vomiting of blood-stained material, with shreds of mucus; and great thirst follow. Purging generally occurs, and the stools may contain blood. There is great general depression, and in some cases the individual dies from collapse before the more characteristic symptoms appear. In most cases, however, the specific effects of cantharides on the genito-urinary system are seen. There is pain in the loins and severe strangury, the small quantity of urine passed containing albumen and blood. Violent priapism, increased sexual desire, seminal emissions, and swelling and inflammation of the genital organs in either sex, frequently, but not invariably, occur. Delirium, tetanic convulsions, and coma may precede death.

Treatment.—Lavage of the stomach, followed by demulcents, such as barley-water, but not fatty or oily substances, as they tend to

dissolve out the cantharidin. Hot sitz-baths, fomentations, and the application of leeches about the neck of the bladder may relieve the pain, but morphia is usually required. Stimulants are necessary in collapse.

Post-mortem Appearances.—The mucous membrane of the stomach is intensely inflamed, and in places eroded or detached. The upper part of the intestine, and in some cases the entire canal, is also inflamed. If the powder has been taken, small green particles may be found in the folds of the mucous membrane. The kidneys are swollen, red, and highly congested; under the microscope, they show signs of acute nephritis. The mucous membranes of the ureters, bladder, and urethra are inflamed.

Ptomaines and other Toxic Substances in Animal Food.

The Registrar-General's figures show that from 1894 to 1903, 556 deaths in England and Wales were certified as due to ptomaine or food poisoning. The annual mortality from this cause appears to be increasing, for 183 of the deaths were registered in the years 1902 and 1903, and only 52 in 1894 and 1895. Probably the true explanation of this is better diagnosis.

Food may become unfit for human consumption in several ways, *e.g.*:—

(*a*) The animal may have been infected with parasites, such as *Trichina spiralis*, *Tænia*, *&c.*; or may have been suffering from disease—for instance, carcinoma or tuberculosis; or may simply contain micro-organisms derived from the surroundings, as in the case of oysters and typhoid bacteria.

(*b*) The animal may have eaten poisonous food.

(*c*) The food may become contaminated with extraneous micro-organisms—*e.g.*, milk and diphtheria bacilli.

(*d*) Tinned meat may dissolve off metallic poisons from the vessel or solder. This has already been considered.

(*e*) The food may contain ptomaines. This is by far the commonest source of poisoning by food, and is the form which chiefly concerns the toxicologist. Ptomaines are animal alkaloids, which are generated by bacterial activity in decomposing albuminous material, or by physiological processes in living organisms. Dr. Luff mentions eleven ptomaines which have been isolated from putrid flesh, and ten which have been extracted from the secretions of living creatures, or from fresh animal tissue. Cases of poisoning usually arise from ptomaines generated by putrefaction, and it is of the greatest importance to realise that the degree of decomposition need not be sufficient to affect the appearance of the food, or to be appreciable either to the taste or smell. Indeed, meat in an advanced stage of putrefaction may be innocuous. This is shown by an oft-quoted experiment made by Klein. Some mice were fed upon portions of a meat-pie, which had proved poisonous to human beings, and they died. After keeping the pie for a few days, a strong odour of decomposition developed, but it was no longer injurious to mice.

An instance of the formation of ptomaines in living organisms is seen in mussels which are growing in stagnant or sewage-contaminated water. Under these circumstances, a body known as **mytilotoxin** develops, and may occasion severe or fatal poisoning among those who eat the shellfish.

The following are the chief varieties of food which give rise to ptomaine poisoning, and the symptoms they produce :—

Meat.—Swine-flesh in one form or another is *par excellence* the kind of meat which is likely to become affected. Numerous instances of poisoning have been observed after the ingestion of boiled, baked, or salted pork, pork-pie, ham, brawn made from pigs' heads, bacon, potted pigs' tongues, and sausages. In other cases, beef-pie, corned beef, roast beef, veal-pie, tinned ox-tongue, chicken-broth, and mutton have been responsible. Frequently the poisoning assumes an epidemic character in consequence of a number of persons partaking of the tainted food at a banquet, or purchasing it at the same shop. At Welbeck, in 1880, seventy-two persons were affected by eating cold boiled ham, and four died. And again at Oldham, in 1898, fifty-two persons were poisoned, four fatally, by veal-pies.

The symptoms may come on within a few hours of taking the food, or may be delayed for one or two days or more. The onset is generally sudden, and may be marked by a rigor, followed by vomiting, abdominal pain or colic, profuse offensive diarrhœa, rise of temperature to 101° to 104° F., intense frontal headache, pain in the back and limbs, great thirst, and cutaneous eruptions. Nervous symptoms may appear, such as dilatation of the pupil, disturbance of vision, painful cramps or muscular twitchings, drowsiness, and occasionally coma. In other cases, the signs of gastro-enteritis are followed by subnormal temperature, cold clammy skin, shallow respiration, feeble pulse, and collapse.

Fish.—Of these, mackerel is the most likely to give rise to poisoning, owing to the readiness with which it undergoes decomposition. Toxic symptoms have also followed the eating of ray, "fresh" and salted herring, salted cod, preserved anchovies, crabs, lobsters, mussels, cockles, oysters, and other shellfish.

The symptoms, in most cases, are those of irritant poisoning, but in some instances the effects produced by mussels have been of a purely neurotic type. Profound coma with abolition of reflexes, slow gasping respiration, and cyanosis may be followed by death in a few hours without either vomiting or purging having occurred. Urticarial eruptions are frequently seen in poisoning by shellfish.

Milk and Cheese.—Under certain circumstances, a ptomaine known as **tyrotoxicon** may develop, in either of these foods, and perhaps give rise to wholesale poisoning. It has also been found in ice-cream. The symptoms observed are those of gastro-enteritis, followed by collapse. With milk as a carrier of micro-organisms of zymotic diseases, we are not here concerned.

Treatment.—This must be purely symptomatic, as no direct antidote is known to ptomaines. A purgative may be administered,

and the stomach washed out, in the absence of free diarrhœa and vomiting.

Post-mortem Appearances.—These comprise inflammation of the stomach and intestines with hæmorrhages into the mucous membrane; enlargement of the spleen, and congestion of the liver, kidneys, lungs, and meninges.

Stings of Insects, &c.

Deaths from the stings of insects are by no means rare, 59 instances having been recorded in England and Wales from 1894 to 1903. Wasps and bees are responsible for most of the cases, but the stings of ants, dragon-flies, horse-flies, sand-flies, gnats, certain caterpillars, and jelly-fish sometimes produce severe symptoms. In 1901, at Chepstow, a young lady was stung on the face by a bee, and died in ten minutes. In another case, a lady of twenty-three was stung on the angle of the jaw. Rapid swelling of the neck and tongue occurred, followed by agonising pain in the chest and abdomen, insensibility, and death in a quarter of an hour. The local symptoms are, an intense swelling in the neighbourhood of the part stung, together with the appearance of a scarlatiniform or urticarial eruption. When the sting is on the tongue, or in its vicinity, the swelling may be sufficient to cause death by asphyxia. The general symptoms are those of syncope, and, in some cases, tetanic spasms sufficient to cause death.

The **treatment** is to extract the sting if still present, and apply ammonia or sodium bicarbonate. The application of bruised dock leaves is an old-fashioned remedy which may afford relief.

Snake-bites.

The common adder (*Viper berus*) is the only venomous British snake. The effects of its bite, though severe, are not often fatal. The symptoms are extensive swelling and pain of the parts around the wound, followed by giddiness, faintness, vomiting, diarrhœa, and collapse. In some cases, febrile symptoms appear.

APPENDIX.

Patent and Proprietary Drugs.

In a case of suspected poisoning by a patent or proprietary preparation, it is important, both from the positive and negative standpoints, to be able to ascertain readily the composition of the drug. The following valuable list * of the ingredients in the more commonly occurring preparations has been compiled by Dr. Robert Hutchison, and is reproduced by permission. Dr. Hutchison writes :—"I wish it to be clearly understood that my analyses make no pretence to perfect accuracy. The analysis of many of these preparations, particularly such as are of vegetable origin, is often a very difficult matter, and it has been found impossible to give quantitative results. I believe, however, that I have succeeded in representing the active constituents in most, if not in all, cases."

Approximate Ingredients of Various Patent and Proprietary Preparations.

Aperient and Liver Pills.

Beecham's Pills.—Aloes, ginger, and soap.

Baillie's Pills.—Aloes, colocynth, oil of cloves, and soap.

Bile Beans.—Cascara, rhubarb, liquorice, and oil of peppermint, coated with gelatin.

Cockle's Pills and Barclay's Pills.—Aloes, colocynth, and rhubarb.

Carter's Little Liver Pills.—Podophyllin (one-eighth grain) and aloes soc. (one-third grain) in each pill.

Dixon's Pills,—Taraxacum, podophyllin, jalap, and soap.

Holloway's Pills.—Aloes, rhubarb, saffron, Glauber's salts, and pepper.

Page Woodcock's Wind Pills.—Aloes, oleum carui, and soap.

Scott's Pills.—Aloin and cascara with a soap basis.

Whelpton's Pills.—Rhubarb, aloes, ginger, pulv. ipecac., and soap.

Saline Aperients.

Eno's Fruit Salt.—Bicarb. soda, tartaric acid, and citric acid.

Lamplough's Pyretic Saline. — Citric acid with bicarbonate of potassium and sodium.

Abbey's Salt.—Tartaric acid with bicarbonate of sodium, sulphate of magnesium, and sugar.

Cough Mixtures and Lozenges.

Congreve's Elixir.—Balsams of peru and tolu, styrax, Virginian prune, squills, aromatic sulphuric acid, rectified spirit, sugar, cochineal.

Keating's Cough Lozenges.— Ipecac. lactucaria, squill, liquorice, tragacanth, and sugar.

* *Patent Foods and Patent Medicines*, 1904.

Owbridge's Lung Tonic.—Balsam of tolu, oil of aniseed, and oil of cloves.

Balsam of Aniseed.—Contains aniseed and other ingredients.

Preparations for Gout and Rheumatism.

Eade's Pills.—Salicylate of sodium, guaiacum, and aloes.

Gloria Tonic.—Colchicum, guaiacum resin, and iodide of sodium.

Blair's Gout Pills.—The active ingredient is colchicum.

Preparations for Headache and Neuralgia.

Antikamnia.—Bicarb. of sodium, antifebrin, and (?) caffeine.

Bromidia.—Bromide of potassium, chloral, hyoscyamus, cannabis indica, oil of aniseed, syrup, and water.

Bunter's Nervine.—Creasote, chloroform, camphor, balsam of tolu, and alcohol.

Kaputine.—Antifebrin and sugar (coloured).

Kay's Tic Pills—Sulphate of iron, quinine, and soap.

Zox Powders.—Pure antifebrin.

Preparations for Asthma.

Crevoisier's.—Belladonna, foxglove, stramonium, sage and nitrate of potassium in equal parts.

Hair's Cure.—Iodide of potassium and tar water.

Plant's Cigarettes.—Leaves of stramonium, lobelia, and green tea.

Tucker's Cure.—Atropine, cocaine, hyponitrous acid, and various balsamic extracts, administered by means of an aeriser.

Cosmetic Applications.

Mrs. Allen's Hair Restorer.—Acetate of lead, milk of sulphur, scented with oil of cinnamon.

Tatcho.—Purified oil of paraffin and essential oil of lemon.

Koko.—Borax, glycerine, and rose water.

Harlene.—Glycerine, alcohol, ammonia, and oil of cassia.

Mexican Hair Restorer.—Acetate of lead, precipitated sulphur, glycerine, and water.

Remedies for Obesity.

Trilene Tablets.—Sugar and a vegetable constituent of unknown nature.

Grey's Specific.—Contains 47·2 per cent. of free sulphur and a bitter (? gentian).

Mrs. Frost's Anti-obesity Remedy.—The active ingredient is extract of *Fucus vesiculosus.*

Russell's Anti-corpulent Cure.—Citric acid (20 grains to half an ounce), glycerine, and water. The Pink Tablet = saccharine.

Miscellaneous Preparations.

Buer's Piles Cure.—Ointment: Gall and hamamelis with lanoline basis. Powder: Precipitated sulphur and carbonate of magnesium.

Californian Syrup of Figs.—Senna (active constituent), syrup of figs, and cinnamon.

Doane's (Back-ache) Pills.—1. White-coated aperient (dinner pills): Podophyllin, aloin, rhubarb, and peppermint. 2. Brown-coated (back-ache pills): Oil of juniper and a resinous constituent (? copaiba).

Glykaline.—Glycerine, rectified spirit, and a trace of iodide of potash.

Essence de Riggles.—Ol. menth. pip. dissolved in rectified spirit.

Guy's Tonic.—Phosphoric acid, tinct. cochineal, inf. of gentian, and chloroform water.

Dalby's Carminative.—Pulv. Rhei, magnes. carb., glycerine, sugar, ol. menth. pip. and ol. anethi, and a small quantity of laudanum.

Chlorodyne. — Chloroform, ether, hydrocyanic acid, morphine, cannabis indica, capsicum, peppermint, and treacle.

Clarke's Blood Mixture.—The active constituent is iodide of potassium (about 6 grains to the ounce).

Oxien.—Powdered sugar and starch and ol. gaultheriæ.

Ozerine.— Bromide of potassium and iodide of ammonia with chloroform water.

Pink Pills.—Sulphate of iron, an alkaline carbonate, and liquorice, thickly coated with sugar and coloured with carmine.

Phospherine.—Quinine, phosphates, and hyposphites.

Seigel's Syrup.—Aloes, capsicum, liquorice, and treacle.

Steedman's Teething Powders.—Calomel and starch.

Warner's Safe Cure.—Nitrate of potassium (about 10 grains to the ounce) and various diuretic herbs.

Woodward's Gripe Water.—Liquor magnes. carb., ol. anethi, sugar, and a trace of alcohol.

Drink Cures.

Mrs Terry's.—Sugar (98 per cent.) and salt (2 per cent.).

Antidipso.—Chlorate of potash and sugar.

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