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MEMORANDA
ON
POISONS

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MEMORANDA

ON

POISONS.

BY THE LATE

THOMAS HAWKES TANNER, M.D., F.L.S.

FOURTH AND COMPLETELY REVISED EDITION.

HENRY RENSHAW,
356, STRAND, LONDON.
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AUTHOR'S PREFACE

TO

THE SECOND EDITION.

These Memoranda are intended to refresh the memory of the practitioner on a subject which is not brought under his notice so frequently as many other departments of medicine. They are especially adapted to show at a glance the treatment to be adopted in each particular instance of poisoning to which a medical man is liable to be summoned.

There seems reason to fear that the crime of slow poisoning is more extensively practised in the present day than is generally believed. The study of the following pages will, it is hoped, put the physician on his guard; and prevent his attributing to natural disease symptoms due to the villanous administration of deadly drugs.

Henrietta Street Cavendish Square.

EDITOR'S PREFACE.

The present edition of the now well-known Memoranda on Poisons has been most carefully revised from end to end, and all necessary or advisable additions have been made to it. It was the belief of Dr. Tanner that cases of secret poisoning are more frequent than is commonly supposed, and it was his object to furnish the practitioner with a ready guide in dealing with such untoward incidents in a medical career. Whilst adhering to this general plan, the editor ventured in the last edition to add to the scope of the work to such an extent as to make it almost a new one; and experience has shown that in this guise it is at least as useful to the student as to the practitioner. The same object has been carefully kept in view on the present occasion. Moreover, to enable the reader to pick up at a glance the main points enforced, numbers,

capital letters, and italics have been freely used. As far as it goes, the book is a complete Manual of Toxicology; but its area is distinctly circumscribed. For the classification adopted, the editor is alone responsible.

A. S.

LONDON, *May 1st*, 1878.

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TOXICOLOGICAL MEMORANDA.

INTRODUCTION.

CHAPTER I.

DEFINITION AND MODE OF ACTION OF POISONS.

TOXICOLOGY (τοξικὸν poison, and λόγος discourse or description), is that branch of medical science which treats of the nature, properties, and effects of poisons.

DEFINITION OF A POISON.—It appears scarcely possible to give any definition of a poison which will bear critical examination; insomuch that some have preferred to deal with the evil effects of any substance, that is, with *poisoning*, rather than with the substance itself, the so-called *poison*. Most medicines are poisonous in improper doses, which need not be always very large; and even common salt (chloride of sodium) has caused death.* A poison has been defined to be any substance which, when applied to the body externally, or in any way introduced into the system, without acting mechanically, but by its

* In the year 1839, a young lady residing in the north of England took about half a pound of salt to rid herself of worms. Very soon afterwards she began to suffer from all the effects of an irritant poison, with general paralysis; and in spite of the use of the stomach-pump and of antidotes, she died in a few hours. Dr. Christison has recorded two somewhat similar cases.

own inherent qualities, is capable of destroying life. For a cherry-stone may cause death by becoming arrested in the vermiform appendix, and thus producing peritonitis; boiling water may cause death also; but neither are poisons: the one acting mechanically, the other by its heat merely.

THE LAW OF POISONS.—Any substance which can injure the health or destroy life is, by the law, regarded as a poison, if given with the *intent* to do mischief. But the whole law of poisoning must, from a recent decision of Lord Chief Justice Cockburn with the assent of Justice Hawkins, be considered unsettled. In this instance some cantharides had been exhibited with criminal intent, but because there had not been given enough to do harm no conviction followed.

In accordance with the Pharmacy Act certain substances have been defined as poisons within the meaning of that Act, so as to put some restriction on their sale to the public.

ADMINISTRATION OF POISON.—Poisons may be introduced into the body in various ways, and in various forms. Thus, they may be administered by the mouth, or by the rectum, by the vagina, or by the lungs, or underneath the skin, and they may be given in the form of solids, liquids, or gases, uncombined or mixed with various matters.

Some agents are more readily absorbed than others; whilst some textures permit of absorption taking place more quickly through them than other tissues. Hence it is that the most diffusible poisons prove most rapidly fatal, especially when introduced directly into the circulation by a wound in a blood-vessel or lymphatic, or when they are injected into the subcutaneous connective tissue. Their action is also speedy when applied either

in a gaseous state to the pulmonary air-cells, or as a fluid to that of the stomach or intestines. The serous membranes, such as the peritoneum, possess an activity of absorption superior to that of the mucous membranes; while absorption through the unbroken skin is slow, on account of the partially impermeable cuticle. Poisons taken into the stomach when that organ is empty, being less diluted, act much more speedily than when it is full. It is remarkable that the agents which most affect the nervous system do not appear to act at all when applied directly to the brain or the trunks of nerves. There are also some poisons, as curare and snake poison, which, although most deadly when introduced into the blood through a wound, are comparatively harmless when swallowed.

The effects of poisons may be considered as *local* and *remote*.

The *local* effects of poisons may be due to (*a*) ordinary chemical action, or to (*b*) the specific action of the substance employed, and these are unfortunately various.

The Local Effects of Poisons.—The *local* effects are mainly of three kinds, viz.:—

(*a.*) *Corrosion*, or chemical decomposition, as is seen in the effects of the strong mineral acids and alkalies.

(*b.*) *Irritation*, or *inflammation*, varying from simple redness, in its mildest, to ulceration and gangrene in its most severe degree, such as may result from the use of corrosive sublimate;

(*c.*) And *a local specific effect*, produced on the sentient extremities of the nerves, as is felt on the local application of prussic acid, aconite, &c.

The Remote Effects of Poison.—The *remote* effects

are those influencing organs at some distance from the part to which the poison has been applied. These may be either common or specific.

(*a.*) *Common*, such as the constitutional indications of inflammatory fever, however produced.

(*b.*) *Specific*, like the constitutional effects of opium, in contracting the pupil, producing constipation, and so on, over and above its local influence in relieving pain.

Various narcotic poisons produce but little local change, though their remote effects are very remarkable. For example, belladonna, in whatever way it may be introduced into the system, by swallowing, hypodermic injection, or direct application to the eyeball, paralyses the ciliary nerves, and so causes dilatation of the pupil, and accommodation for distant vision.

Many substances have both a *local* and *remote* action, as is well seen in the influence of cantharides upon the part to which they are applied, in producing blisters, and their remote effects upon the urinary organs, there producing strangury, and sometimes bloody urine.

The *remote* action of a poison may be said, according to the views now prevalent, to be due in every instance to its *absorption* either into the veins or the lymphatics, except where there is a direct continuity of effect traceable from the point where the poison was applied, to the point where the remote effect is shown. The part played by the nerves in producing the remote effect of a poison is not clear, but undoubtedly many of the symptoms recorded in anomalous cases of poisoning have been due to their influence. To illustrate what is meant, the great tendency to convulsions of various kinds in many cases of poisoning might be cited. This is just what is seen in ordinary practice, where a local irritation

may give rise to reflex phenomena of various kinds, but if very intense, or occurring in a neurotic subject, may induce convulsions: witness the convulsions of teething and of worms.

It is not worth while to describe here the various experiments by which the absorption of poisons into the circulation has been proved, the fact may be taken for granted. Nevertheless, it is well to bear in mind that certain substances affect certain organs in particular, even when they influence or attack more than one. Thus, to give a few examples: morphia and alcohol specially affect the brain; strychnia, the spinal cord; curare, the motor system of nerves; digitalis, the heart; stramonium, the lungs; antimony and arsenic, the stomach; mercury, the liver; cantharides, the urinary organs; ergot, the uterus; and so on. In all of them the action is complex, yet the organs named, seem to be specially picked out for the production of their respective effects.

Let it not be forgotten that a patient may die from the *shock* of a dose of a powerful poison, as he may from the shock of a mechanical injury.

Modification of the Actions of Poisons.—The same poison does not invariably act in the same way, even when a number of people are attacked at the same time.

By far the most important of the modifying agencies is (*a*) the *quantity* or *dose*. Many substances which are deadly in large doses are exceedingly useful as remedies in small quantities; such are prussic acid, opium, digitalis, arsenic, &c. Then again (*b*) the *mechanical state* of aggregation is of consequence; a solid being usually much less active than a fluid or a gas, and a pure and soluble substance much more active than one mixed

with foreign insoluble materials. Even more important is (*c*) the *chemical constitution* of the poisonous agent. As already pointed out, poisonous effects result from absorption of the poisoning body, and absorption implies solution; the more soluble, therefore, the compound is, the more speedy are its effects, whilst compounds insoluble in water, or any of the juices of the body are inert. It is not, however, enough that the substance be insoluble in water; it must be so also in the gastric juice and other digestive fluids, or it may give rise to characteristic symptoms. Thus, calomel is insoluble in water, yet it is a powerful medicine; orpiment is insoluble in water, yet, when swallowed, it may give rise to symptoms of arsenical poisoning, and so on. The *mental* (*d*), and *bodily* (*e*), *condition* of the recipient must be taken into account. Thus, in excited maniacs, and in certain convulsive disorders, doses of sedatives may be given, without producing any effect, which in ordinary individuals might give rise to serious consequences. The bodily condition, especially as influenced by habit, is still more important. It may be broadly stated, that by gradually increasing the dose of a substance ordinarily poisonous, in course of time enormous quantities may be borne without producing immediate ill-effects. This is especially seen in the practice of opium-eating and smoking, and in a less degree in arsenic eating, as practised in Styria. The latter instance is, however, contrary to the usual rule; for whereas with vegetable substances, such as opium, the dose requires to be constantly increased to keep up the effects, with minerals, the contrary seems to be the case, especially with antimony and mercury, which cannot be long given without danger to the recipient.

CHAPTER II.

THE DIAGNOSIS OF POISONING.

The chief characteristics of poisoning are, that the symptoms commence suddenly, not long after swallowing any substance, the individual being, up to that time, in a state of health; that these symptoms progress steadily, and are uniform in their nature throughout their course; and that they prove more or less speedily fatal.

There are many exceptions to these rules. Thus, if the stomach be loaded the appearance of the symptoms may be delayed some hours. Intoxication will mask the effect of narcotics. Again, the individual poisoned may possibly be suffering from disease, and an agent may be given which will only aggravate existing symptoms, not produce new ones. The fact must not be forgotten that sometimes a poisonous draught is substituted for a harmless medicine. And lastly, after a poison has manifested its effects the symptoms may remit for a time.

When poison is administered with a criminal intent it is generally in such a dose as to take immediate effect, although this is by no means necessary, as there are numerous substances which accumulate in the system, and when given in small and repeated quantities, ultimately prove fatal, notably antimony. It must also be remembered that there are many diseases, as cholera, internal hæmorrhage from the bursting of an aneurism, &c., which commence suddenly, and rapidly run to a fatal termination. In inflammation of the stomach or intestines, especially from improper food, the symptoms often set in suddenly, and might be mistaken for poisoning; such is also the case in intestinal obstruction, and

yet again in ulceration and perforation of the bowels, such as may occur in latent typhoid. So also in organic diseases of the heart, where the symptoms may have remained latent for some time, death often occurs suddenly from syncope. The diagnosis of the effects of irritant poisons is not so difficult as it is in the case of narcotics or other neurotics, where the symptoms are very similar to those produced by apoplexy, epilepsy, tetanus, convulsions, or other forms of disease of the brain.

Generally speaking, a person may be supposed to be suffering under the effects of a poison, if soon after taking food or drink, he be seized with violent pain, vomiting, purging, and convulsions: or if he be attacked under the same circumstances with delirium, or great drowsiness. It must not be forgotten, however, that poisons may be introduced into the body, not only (*a*) by the mouth, along with food and drink, but also (*b*) by means of suppositories and enemata, or (*c*) in females by vaginal injections, or (*d*) by inhalation, or (*e*) by subcutaneous injection, or (*f*) through the true skin after the removal of the cuticle. Should death ensue, the presumption of unfair play will of course be strengthened by the discovery of post-mortem appearances similar to those known to be produced by the poison from which the person apparently suffered.

The post-mortem appearances, however, except in a few instances, are not very characteristic; nevertheless they may be of great *negative* value in proving that a certain poison has not been administered, or that the patient died from the effects of disease.

The detection of poison in some of the food which has been left untaken or in the matters vomited would seem to be conclusive evidence of the administration of poison; but it is to be recollected that designing per-

sons have mixed noxious materials with food, or vomited matters, or fæces, in order to feign poisoning, or to cast unjust imputations upon others; and it is quite possible that a patient, after having taken poison, may die from natural causes.

CHAPTER III.

THE DUTIES OF THE PRACTITIONER IN CASES OF POISONING.

When called to a case of supposed poisoning during life the practitioner's duty is twofold.

I. His first aim must be to preserve life.

II. His second, to forward the interests of justice.

But if he reaches the spot too late to save life his duties are undivided, for he has but to see that justice is done, and in order that there be no failure in this respect it is important that all his observations should be made as carefully as possible, and *committed as speedily as possible to writing*.

He should, 1. Inquire as to the time at which any substance was last taken by the sufferer;

2. The nature of the symptoms, observed from the beginning of the illness onwards;

3. The hour at which they commenced, and

4. The precise time at which death occurred.

5. He must take possession of any *food*, *medicine*, *vomited matters*, *urine*, or *fæces* which may be in the room; and he is to seal them up, in *new* and *clean* vessels, duly labelled for examination. No old pickle-jars or bottles, or anything of the kind must be used. Then the (*a*) *position* and (*b*) *temperature* of the body are to be observed, the appearance (*c*) of the *countenance*, the

presence or absence (*d*) of *rigor mortis*, with the *nature* (*e*) and *warmth* of the apartment, (*f*) the situation of any *marks of violence*, and (*g*) the condition of the inside of the *mouth and gullet*.

Post-mortem Examinations.—In addition to the ordinary rules to be observed in conducting *post-mortem examinations*, something more must be done, in cases of suspected poisoning, with a view to preserving portions of the body for subsequent examination. The alimentary canal is the most important organ to be thus secured, and it should be removed in separate portions. A double ligature should be passed round the œsophagus in the chest, and the duodenum a few inches below the pylorus should be secured in like manner; by cutting across the gullet and gut between these ligatures, the stomach may be removed without any danger of spilling its contents. It is best to open the stomach after it has been introduced into the receptacle prepared for it, so that its pathological condition may be noted as early as possible. Another ligature should be tied low down in the rectum, and the intestines removed and introduced into a separate vessel prepared for them, and then examined like the stomach. Sometimes it may be necessary to remove the gullet in like fashion. As much blood as possible should be saved for the chemist, and a portion of the liver, if not the whole organ, should also be secured. When everything has been tied up, the jars should be (*a*) *sealed*, (*b*) *numbered*, (*c*) *labelled*, and (*d*) *initialled*, to prevent subsequent confusion and to facilitate identification. In women, the vagina, uterus, and ovaries must be inspected. The brain, spinal cord, and thoracic viscera ought likewise to be examined, and portions of the spleen, kidneys, and muscles should be reserved for

analysis. No antiseptic or preservative fluid is to be used. When possible it will be best to make the autopsy within twenty-four hours after death; taking care to make the examination patiently, thoroughly, and with a mind free from any bias. For poison may be found in a body, and yet a question may arise as to its having been the cause of death. Hence in these investigations every organ of the body is to be examined, in order to learn whether any disease has existed to a sufficient extent to account for the fatal result.

Behaviour of Suspected Persons.—Any suspicious conduct on the part of those surrounding the poisoned individual should be carefully noted. Acts of this kind arrange themselves in three heads, as occurring (*a*) before, or (*b*) during the fatal illness, or (*c*) after death. With the first category the practitioner has ordinarily nothing to do, but his attention to those coming under the second and third is often of essential service to the ends of justice.

Though by far the most notable of the accounts given of the circumstances which should attract the attention of the practitioner in a case of poisoning has been presented to us by Christison, in his classic work on Poisons, it will, perhaps, be best here to give an admirable example recorded by Dr. Ogston. The case was one of poisoning by arsenic, with which a man named Burnett murdered his wife, and it was tried in Aberdeen in 1829. Now—

1. The arsenic was bought, not at the nearest place where it was obtainable, but in a distant town.

2. It was purchased under false pretences—viz., for the destruction of rats; but no proof could be got of the presence of these rats.

3. This purchase was made not long before his wife's

death, which he (the husband) had predicted as likely to take place soon.

4. He had lived away from his wife for two years; but, just before she was taken ill from the effects of the poison, he had returned, and remained with her all night.

5. A daughter, who attended on her mother, was, on this night, sent away to another part of the house.

6. He administered a dose of what he called medicine to his wife, though he had not been accustomed to do so.

7. When he went to bed he did not undress, but lay down ready to be disturbed.

8. When his wife was taken ill from the arsenic, he opposed sending for any proper medical aid; but, on the other hand,

9. Showed some laxative powders, one of which he said he had administered to his wife.

10. He destroyed the vomited matters.

11. He broke the teacup in which he had given his wife the arsenic.

12. He pushed on the funeral of his deceased wife.

13. He refused to allow an inspection of the body.

14. Finally he had been cohabiting with another and younger woman, to whom he was about to be married when arrested, a few days after his wife's death.

CHAPTER IV.

TREATMENT OF POISONING.

WHEN the practitioner is called in to a case of poisoning while yet there is life, he must set himself to preserve it in whatever way he best can. In this, of course, he must be guided by circumstances, but several broad rules may be laid down. All have one end, but the order may be varied.

This is the first rule—

NEVER WAIT FOR A REMEDY, HOWEVER PERFECT, IF AN IMPERFECT ONE IS AT HAND.

THAT IS BEST WHICH IS READIEST, the grand rule being LOSE NO TIME.

Most of the modes of treatment come under one or other of the four following heads:—

I. GET RID OF THE POISON.

II. STOP ITS ACTION.

III. REMEDY THE MISCHIEF IT HAS DONE.

IV. FIGHT AGAINST THE TENDENCY TO DEATH.

I.—TO GET RID OF THE POISON.

This is ordinarily the first thing to be done, but not always. To do so when the poison has been swallowed, two means may be employed: *vomiting* or the *stomach-pump*.

The latter is one of the most certain means we possess of emptying the stomach; and by means of it (*a*) this viscus may be washed out, and the (*b*) antidote, if any be known, administered. In speaking hereafter, however, of the treatment to be adopted in each particular instance, it will be seen that there are some cases, such as poisoning by corrosives, in which this instrument cannot be used. It might not only cause laceration of the tissues, but even perforation of the œsophagus or stomach, and deliver its contents into the pleura or peritoneum. It is hardly necessary to mention that in all cases a certain knack is required in its employment; the tube having, on more than one occasion, been introduced into the trachea, and the lungs injected with water, &c. It is always best to keep the point of the tube gently pressed against the back part of the pharynx and œsophagus until it reaches the stomach. It is a good rule also to withdraw less fluid than is pumped into the stomach.

Supposing, however, that this instrument is not at hand, or that it is an improper occasion for its employment, two means are available for emptying the stomach—the use of a *syphon arrangement*, *or vomiting*, natural or artificial. Nowadays, when indiarubber tubing is so common, it may not be amiss to bear in mind its uses in such cases. Fairly thick tubing is easily introduced into the stomach either through the mouth or through the nose. Once introduced into the stomach by means of an ordinary funnel, it is likewise easy to introduce a quantity of lukewarm water through the tube into the stomach, then by placing the patient flat on his face, the tube may be used to empty the fluid contents of that organ. *Vomiting* is, in many instances, one of the first and most important signs of poisoning, especially by irritant substances. When such is the case, it is only necessary to foster the tendency by *copious draughts of lukewarm water*; but if there be no vomiting and the stomach-pump be not at hand, an *emetic* must be given. Of these remedies perhaps there is not one which can be generally used with so much advantage as the *sulphate of zinc* in 20-grain doses; for not only is it more rapid in its action, but its effects are less depressing than those of any other emetic except mustard. *Ipecacuan wine* (six or eight drams), or a scruple of powdered *ipecacuanha*, with the same quantity of the ordinary *carbonate of ammonia*, may be administered in a wineglassful of water. In the absence of these, *mustard*, as aforesaid, proves an excellent substitute. A teaspoonful or two is to be given in warm water, and frequently repeated. *Common salt* (*a handful in a pint of lukewarm water*) may be used with good effect. Let it not be forgotten that vomiting may also be excited by *tickling the fauces*, as well as by the free administration of *warm water*.

When the poison has been applied locally, as in snake bite, to prevent its absorption a ligature must be applied between the trunk and the wounded part, as near the latter as possible; while the deleterious substance is to be removed by free incisions and plentiful washings. Sucking by the mouth or by cupping-glasses may also be employed. The most lamentable class of cases of this kind with which in this country we are acquainted are those resulting from the bite of a mad dog. In all of these the wound should be promptly cauterized by means of strong fuming nitric acid, the fluid being allowed to permeate everywhere, and potass being at hand to neutralise it when its work is done. Should this not suffice to arrest the action of the poison where symptoms appear, the only remedy which, up to the present moment, seems to offer a chance of recovery, is *curare*.

II.—To stop the action of the Poison if it cannot be readily and immediately removed.

The means whereby this is effected is ordinarily the administration of an antidote. As no universal antidote is known, the treatment will of course vary with the substance taken.

The most reliable antidotes will be mentioned in connexion with each particular poison, as far as specific antidotes are likely to be of service.

An antidote should possess the following properties:—(*a*) It should be capable of being taken in a large dose without danger; (*b*) it should act upon the poison, whether liquid or solid, (*c*) it should be capable of combining with the poison immediately, at (*d*) a temperature equal to or below that of the body; (*e*) its action should be quick; and (*f*) lastly, it should deprive the poison of its deleterious properties.

Antidotes mostly operate (*a*) by forming *harmless* chemical combinations, or (*b*) by producing *insoluble* compounds, and thus preventing or delaying absorption. In most cases they have no effect upon the constitution; but some may be looked upon as a kind of counter-poison. Thus, the antagonistic action of opium and belladonna seems fairly made out, and we might perhaps include under this head chloroform as, in some degree, an antidote to strychnia.

Animal charcoal which has been proposed as an antidote, seems to act in a great measure mechanically, but it has also a power of absorbing alkaloids, which may render it useful. Such substances as magnesia and gruel are sometimes, and often most usefully, given with the view of protecting the walls of the stomach.

III.—To remedy the mischief done; and,
IV.—Obviate the tendency to death.

Unfortunately, in a great number of instances, too great an interval has elapsed between the exhibition of the poison and the time when the first-mentioned indications can be fully carried into effect; for, as before implied, if absorption has taken place, direct antidotes will be of little avail.

Our object must then be to *palliate the symptoms* as they arise, as well as to *neutralise the effects* of the poison on the constitution, by remedies of an opposite character. Thus in poisoning by depressing agents (like digitalis) and narcotics (as opium), or such as arrest certain modes of nervous force (as curare), all lowering measures must be avoided, and agents used which will exert a contrary effect, as stimulants, galvanism, &c. Shock must also be taken into account, in dealing with such cases. In many forms of poisoning this is too

much overlooked, and the only idea which enters the practitioner's head is to get rid of the poison.

Direct injection of liquid ammonia into the veins has been found successful in the treatment of snake bite in Australia, by Professor Halford and others, but this has totally failed in India (Fayrer), where such acutely poisonous snakes—if we may use the term—as the cobra are encountered.

Claude Bernard has shown the importance of particularly attending to the way in which poisons destroy life. For example, *curare paralyses the motor nerves*, puts a stop to all motion, suspends respiration, and so brings on suffocation; yet by keeping up artificial respiration for a sufficient length of time, life may be preserved till the poison is eliminated and the danger over. *Strychnia attacks the sensitive portion of the spinal nervous system*; but if the external excitement, which perpetually provokes reflex action, and thereby brings on fatal convulsions, be guarded against, recovery may ensue. A frog, poisoned by strychnia, rapidly dies if frequently excited; whereas left perfectly quiet under a bell-glass, it will, cæteris paribus, recover.

Lastly, we must endeavour to promote the elimination of the poison from the body. To give an example, in chronic lead poisoning, iodide of potassium is useful, apparently by rendering the lead more soluble, and so more easily got rid of by the kidneys or bowels.

CHAPTER V.

DETECTION OF POISONS.

The detection of a poison is, in many instances, no easy matter; it should not, therefore, be rashly undertaken,

except by one well skilled in the minutiæ of the processes to be adopted; whilst, on the other hand, there are so many points of practical importance which may be noted by the practitioner in charge of a patient suffering from poisoning, that his attention should be specially directed to these. The exact determination of the cause of death will depend partly on the symptoms noted during life, partly on the appearances found after death. These come within the province of the ordinary practitioner; on the other hand, the special physical, chemical, and physiological portions of the inquiry should be referred to the expert. In a book of this scope it is impossible to give full details with regard to these last, but a brief sketch may be useful.

The PHYSICAL EXAMINATION, say of the contents of the stomach and intestines, should be made at the time of the *post-mortem* examination. The condition and appearances of these organs should be carefully noted at the time, and the notes carefully preserved. Next, the examining surgeon should take heed of the smell, colour, and general appearance of the matters contained in these organs. The *odour*, for instance, may be useful in indicating the presence of prussic acid, of alcohol, of opium, or of phosphorus. The *colour* may indicate the presence of salts of copper, of fragments of cantharides, or of arsenic as sold mixed with various colouring matters—soot, indigo, and the like. The *general appearance* may give some clue to the mode of introducing the poison, the kind of food or drink used to conceal it, &c. Seeds of poisonous plants may be found: this is especially the case in India, where the seeds of datura are frequently used for criminal purposes. Or the poisonous substance may have been administered in such quantity that a portion of it may at once be

secured for analysis, as not unfrequently happens in poisoning by arsenic. It is not enough to employ the naked eye in examining these suspected matters; a hand lens of some power should be used; in this way characteristic crystalline forms, botanical peculiarities, and the like, may be made out.

Still, these investigations are merely introductory to the most important part of the research, which ought to be undertaken systematically, especially if the quantity of material to be operated on is small. Most frequently the matters to be examined are mixed, some soluble, some insoluble; but there may also be submitted for analysis portions of the pure substance. The object of the analyst is to obtain the substances which he has to examine chemically in as pure a condition as possible, so that there may be no doubt about the results of his testing; also, of course, to separate active substances from those that are inert, all being mixed together in the stomach and alimentary canal. Again, in dealing with such fluids as the blood, or the tissues of the body, their natural constituents must be got rid of before the foreign and poisonous body can be reached. There is this difficulty further to contend with: that some of the most poisonous of substances are of unstable composition and readily altered by chemical reagents; to this group belong many vegetable and most animal poisons. These, therefore, must be treated differently from the more stable inorganic compounds. With an inorganic poison we may destroy all organic materials mixed with it, trusting to find the poison still recognisable after this process; not so with an organic substance: that must be separated by other than destructive means.

When the mixture submitted for examination consists

of bodies, some of them perfectly soluble and some perfectly insoluble, *simple filtration* may suffice to secure their separation; but this is rarely the case, some colloidal material being ordinarily mixed with the crystalloid, and the plan of separating them by *dialysis* not being altogether successful.

When the substances looked for are volatile, destillation may be employed to secure them in a state of purity; in this way prussic acid is separated; but in the case of the poisonous alkaloids other means must be adopted.

I. In the separation of such an alkaloid as strychnia, for example, the suspected material is,

1. First of all acidulated by one of the weaker mineral or stronger vegetable acids (hydrochloric acid is best), and the whole

2. Carefully heated over a water-bath. After a time this mixture

3. Is to be filtered,

4. The filtrate well washed with boiling destilled water, and

5. The filtered fluid subjected to evaporation. When dry the substance

6. Is to be rubbed up with destilled water, and again filtered; this process to be repeated until a tolerably pure product is obtained. This is next

7. To be neutralised by hydrogen sodium carbonate—*i.e.* bicarbonate of soda, and

8. The freed alkaloid taken up by rubbing or shaking it with chloroform or ether, and the whole set aside in a well-corked tall test tube. Finally,

9. The ether or chloroform containing the alkaloid is to be removed by a pipette and allowed to evaporate spontaneously, when the alkaloid will probably be left

behind in a state fit for testing. This process is a modification of that invented by Stas, in following out the case of the Count Bocarmé.

II. For the destruction of organic matter in the search for an inorganic poison, such as arsenic, a process introduced by Fresenius and Von Babo is commonly employed. Its essentials are as follows:

1. The organic matter is to be reduced to as fine shreds as possible, and

2. Mixed with about one-eighth of its bulk of pure hydrochloric acid. This is to be

3. Heated, and, as it boils,

4. From time to time crystals of potassic chlorate are added, until the solids are reduced to a straw-yellow fluid. This is

5. Next treated with hydrogen sodium sulphite, or bisulphite of soda, until a distinct smell of sulphurous acid is given off, after which

6. Sulphuretted hydrogen is to be passed through the fluid (concentrated if necessary) for some hours, thus throwing down most metallic poisons in the form of sulphide. This precipitate is to be collected and further tested.

When exceedingly small quantities are dealt with the microscope is of use, and the plan of subliming alkaloids and examining their crystals under the microscope, introduced by Guy, Helwig, and Wormley, will be found very useful. The shape of crystalline poisons is a valuable means of determining their identity; arsenic and antimony may thus be readily distinguished from each other, as may some other well-known substances.

The spectrum has not yet been applied to toxicological research, although it has been employed to determine the existence of blood stain.

CHAPTER VI.

CLASSIFICATION OF POISONS.

THERE is nothing more difficult in toxicology than to give a satisfactory classification of poisons, insomuch that some have fallen back on the no-classification, or natural history system, and grouped poisons as *mineral*, *vegetable*, and *animal*, according to their source. In despair of achieving anything better, a modification of an old and well-known system is here followed, poisons being classed as CORROSIVES, IRRITANTS (*Simple* and *Specific*), and NEUROTICS; the last group is, however, further subdivided.

The group of *corrosives* should comprehend all poisons which by contact destroy the bodily textures, and so by chemical action alone occasion death.

These same substances, when diluted, may be incapable of destroying the tissues directly, but may do so by setting up inflammation; these, with certain others having like effects, would form the group of *simple irritants*. They kill by virtue of their secondary effects on the constitution. But some substances, like arsenic, are not only capable of inducing local inflammations, with their secondary effects, but are also possessed of certain specific and well-marked properties differing in each case. These are *specific irritants*.

Neurotics comprehend all poisons whose effects are mostly referable to the nervous system, necessarily a most diverse group, which we are not yet in a position to minutely analyse. Some, however, act mainly on the *brain* (*opium*), some on the *spinal cord* (*strychnia*), some on *certain nerves* only (*curare*), or on the *vasomotor system of nerves* (*nitrite of amyl*); some act it is hardly possible to tell how.

There was an old group of *septic* poisons. To this might still be referred certain noxious gases, such as sulphuretted hydrogen; or were it made to include all poisons acting directly on the blood, it would include the still more dangerous gas, carbonic oxide.

The following table exhibits these subdivisions, and some of the poisons contained in each :—

Corrosives.	Strong Mineral Acids . .	Sulphuric.
		Nitric.
		Hydrochloric.
	Vegetable Acids	Oxalic.
	Organic Derivatives . . .	Carbolic Acid.
	Alkalies	Strong Alkalies,
		Alkaline Carbonates, &c.
Simple Irritants		The above diluted.
		Lime.
		Zinc.
		Silver, &c
Specific Irritants		Arsenic.
		Mercury.
		Antimony.
		Phosphorus.
		Iodine, &c.
Neurotics		Opium.
		Prussic Acid.
		Chloroform.
		Belladonna.
		Aconite.
		Strychnia.
		Conium.
		Tobacco.
		Carbolic Acid, &c.

CORROSIVE POISONS are characterised by these three things:—1. *Immediate action.* 2. *Local effects*, especially *staining*; and in many cases by, 3. *Death* from *shock*.

IRRITANT POISONS give rise to—

1. *Pain in the stomach* and *bowels.* 2. *Faintness* and *sickness*; and 3. *Purging* with *straining.* 4. The evacuations are often tinged with blood. 5. The pulse is feeble and irregular; and 6. The skin is cold.

Many of the substances of this class, from irritating the tissues with which they come in contact, produce a severe burning sensation in the mouth and œsophagus, as well as in the stomach. The degree of local destructive action produced will of course vary in proportion to the amount of the vehicle with which the noxious agent may be diluted. Irritants cause death by inducing collapse or convulsions, or by exciting severe inflammation; or, after a variable interval, by leading to stricture of the œsophagus. The diseases which most resemble the action of irritants are, malignant cholera, severe diarrhœa, colic, gastritis, enteritis, rupture of the stomach or intestines, and obstruction of the bowels, mechanical or otherwise.

NEUROTIC POISONS.—The symptoms of certain diseases bear a resemblance to those caused by some of the poisons of the *neurotic* class. Thus, *belladonna* gives rise to *delirium* with spectral illusions or convulsions. Sometimes there is *tetanus*, as in *strychnine* poisoning; sometimes *coma* (*opium* and *carbolic acid*), or *syncope* (*digitalis*). Diseases of the brain and spinal cord, likely to be confounded with the effects of these poisons, are often very insidious in their progress, and hence may suddenly give rise to suspicious symptoms. The history, mode of attack, &c., will generally negative any suspicion of poisoning.

I.—CORROSIVES.

CHAPTER VII.

THE CONCENTRATED MINERAL ACIDS.

The first division of the Corrosive consists of the Strong Mineral Acids. In this chapter we have to review the effects and properties of the acids commonly met with, which are Sulphuric Acid, Nitric Acid, Hydrochloric Acid, or a mixture of two or more of them.

Sulphuric Acid (*Oil of Vitriol*).—This heavy, oily-looking liquid is met with in two states, concentrated and diluted; and being extensively employed in commerce and manufactures is much more frequently used as a poison than the other mineral acids. Many infants and young children have been poisoned by it; occasionally also men, under the influence of drink. The acid is not unfrequently thrown over the person, either to disfigure the features, or to destroy the clothes. The parts of the body with which it is brought into contact are stained at first of a white, and afterwards of a dark-brown or black colour. The smallest fatal dose of concentrated acid recorded, in the adult, is *one dram*; but recovery has taken place after as much as two ounces. But it must be understood that the acid proves fatal mainly by its power of corrosion, so that a small

dose of the concentrated acid is more dangerous than is a much larger dose of it in the dilute form. The average period at which death occurs is from sixteen to twenty-four hours; but on the other hand, death may not occur for months, and may only follow the organic changes induced by cicatrisation following the swallowing of the acid, or the malnutrition following its destructive action on the coats of the stomach.

Death may arise from the action of sulphuric acid without that substance entering the stomach. It may act on the respiratory passages, causing closure of the glottis, or it may destroy the lining membrane of the air-tubes. This is most common in children.

The signs of poisoning by oil of vitriol during life are chiefly these:—

(*a*) *Staining* of the lips and mouth—usually brown, but the mouth may be white at first. If a spoon or the neck of a bottle has been used, the mouth may escape.

(*b*) *Pain*—this comes on *immediately*, and extends from the mouth to the stomach; usually it is very severe.

(*c*) *Vomiting* shreds of mucus altered in colour, and of coffee-ground-like matter, mainly blood more or less altered; the matters first vomited are strongly acid, discolour cloth, and act on limestone. Vomiting may be absent.

(*d*) *Great prostration of strength.* Death usually takes place from shock or asphyxia within twenty-four hours.

The usual post-mortem appearances if death has been speedy, are these:—

1. Softening and destruction of the lining membrane of the mouth, pharynx, and œsophagus, sometimes with separation.

2. The stomach is perforated or softened, its contents

black, and tar-like from altered blood, the blood in the vessels hard and black; if perforated, the edges of the opening are dark and ragged; often the organ is so soft that it cannot be moved without rupture. If the contents of the stomach have escaped, the surrounding organs may like itself be softened and blackened. N.B.—This softening may be partly post-mortem, if the acid has not been neutralised during life.

3. If life has been slightly prolonged, there will be marks of inflammation in the bowels, peritoneum, and other parts not directly acted upon by the acid.

4. If the acid has entered the air-passages, similar marks of corrosion will be found there.

Tests.—It is not within the province of these Memoranda to treat of the various processes by which poisons are to be detected; for to make a trustworthy analysis requires the skill of a professed chemist, whose assistance should be allowed in these medico-legal investigations. Where the character of a dead man or the life of a supposed criminal is at stake there must be no chance of error. The ordinary tests will, however, be briefly described, if only to help the physician to treat the case more satisfactorily than he could do by merely guessing that an irritant or narcotic had been employed:

Concentrated sulphuric acid is usually a brownish-coloured liquid, which chars or corrodes wood or other organic matter brought into contact with it, and when mixed with water gives out heat. When diluted, its presence may be thus detected:—

1. The liquid is known to be acid by its action on litmus paper.

2. Add to a portion of the suspected liquid a few drops of nitric acid, and then a solution of nitrate of barium; a white precipitate (sulphate of barium) will

fall if sulphuric acid be present. This test is extremely delicate; for although other acids yield a precipitate on the addition of nitrate of barium, yet as such deposits are all soluble in nitric acid the previous addition of this acid will prevent their formation.

3. The precipitate should next be collected, dried, and reduced with charcoal by the blowpipe flame, or mixed with black flux and heated in a reduction tube, to the condition of barium sulphide. This, when treated with a drop of hydrochloric acid, gives off sulphuretted hydrogen, known by blackening paper dipped in acetate of lead solution.

Cloth stained with this acid is usually either brown or black, the texture destroyed, and the stain has a great tendency to attract water. To examine a piece of cloth stained with this poison it is only necessary to boil it in destilled water, and then apply to the liquid the barium test as before.

Treatment.—On no account use the stomach-pump; the tissues are usually too much softened, and perforation might be the result.

Neutralise and give diluents freely.—Thus powdered chalk, whiting, or pounded plaster may be given in milk or water. So too may ordinary calcined magnesia, or liquid magnesia; small quantities of ordinary washing-soda in milk or water may be given if the patient can swallow it, but often it produces great pain; linseed tea, barley water, oatmeal gruel, diluted starch—all are useful.

Nitric Acid (*Aqua fortis*).—This substance is sometimes given or taken in poisonous doses, but not so often as oil of vitriol. It is found in commerce in a concentrated and in a diluted state. Cases of death

from its use are rare. Two drams is the smallest quantity which has destroyed life; but less than this would probably prove fatal, if it specially affected the windpipe. Death has occurred from it in one hour and three-quarters; the average would be within twenty-four hours.

Symptoms.—The symptoms of poisoning by nitric acid do not differ materially from those of poisoning by oil of vitriol, save in respect of the stains produced. These are at first *white*, but this lasts only a very short time; afterwards becoming *yellow* or *orange*, and finally *brownish-red*. They are very persistent. So too the vomited matters are yellow or brown.

The vapour of nitric acid has sometimes proved fatal. This has occurred in more than one instance where a vessel containing a large quantity has been broken and the gas inhaled. Death has probably arisen from inflammation of the lungs and air-passages. The fumes produced by the action of nitric acid on various organic substances, such, for instance, as are given off in the manufacture of gun-cotton, are likewise dangerous.

Appearances after Death.—The most characteristic are the discoloration already mentioned, together with erosion and softening of the mucous membrane of the digestive tract, but the stomach is rarely perforated, though softened. The appearance of the stomach may be altered as regards colour—(*a*) by the action of the acid on itself (yellow); (*b*) by the action of the acid on the blood (black); and (*c*) by the action of the acid on the bile (green or brown).

Treatment.—On no account use the stomach-pump. If the patient can swallow, give lime-water, or chalk in water, magnesia, boiled starch, linseed tea, or any

stimulant at hand. The use of alkalies must depend on the patient's feelings.

Tests.—Concentrated nitric acid may be known by its orange-coloured irritating fumes, and by its action on copper, tin, or mercury.

1. When poured on copper-filings, effervescence takes place, a red acrid vapour is given off, and a green liquid remains (solution of nitrate of copper).

2. In a diluted state it is detected (*a*) by its acid reaction; (*b*) by no precipitate being obtained by nitrate of barium or by nitrate of silver, proving the absence of sulphuric and hydrochloric acids; further, (*c*) by neutralising the liquid with potass, evaporating it, and then procuring crystals of nitrate of potassium, in the form of lengthened fluted prisms, which are permanent in the air. These (*d*) crystals may be powdered and moistened with strong sulphuric acid, when a colourless acid vapour (nitric acid) will be evolved, which, (*e*) if directed through a solution of sulphate of iron will turn the fluid black or brown. Or (*f*) the powdered crystals may be mixed with an equal bulk of fine copper filings, moistened with water, and treated with a few drops of sulphuric acid; when ruddy acid fumes will be given off.

3. Other tests for nitric acid are, α, its action on morphia, which it turns red; β, its action on green iron sulphate, which it blackens; γ, a trace of it along with sulphuric acid gives with narcotine a blood-red colour; and finally, δ, along with hydrochloric acid it dissolves gold.

Hydrochloric Acid (*Muriatic Acid, Spirit of Salt*).—Though much used in the arts, poisoning by hydrochloric acid is rare. In May, 1859, a woman sixty-three years old was admitted into King's College Hospital within three-quarters of an hour of swallowing half an ounce

of the strong acid. The mucous membrane of the mouth was *white* and softened. She had burning pain in the throat and stomach, vomiting of brown shreddy matters, and great prostration. Death occurred in eighteen hours, from the corrosive action of the poison. This is the smallest dose which has been known to prove fatal.

Tests.—The concentrated hydrochloric acid of commerce is of a yellowish colour, it fumes in the air when strong, and produces dense white fumes with the vapour of ammonia.

1. It may be identified by boiling with black oxide of manganese, chlorine being given off. This gas is known by (*a*) its odour, (*b*) its yellowish-green colour, (*c*) its bleaching properties, and (*d*) its power of setting free iodine from iodide of potassium. Thus it blues a paper dipped in solution of iodide of potassium and starch.

2. When diluted, hydrochloric acid is known by nitrate of silver causing a dense white precipitate (chloride of silver). The chloride is distinguished from other salts of silver by, (*a*) its insolubility in nitric acid, and in caustic potass; (*b*) by its being soluble in ammonia; and, (*c*) by its melting and forming a horny mass when dried and heated.

Mixed Acids.—These acids being used for commercial purposes when mixed—*the nitro-muriatic* (aqua regia) to dissolve gold, and the *nitro-sulphuric* (aqua reginæ) to dissolve silver—are sometimes employed as poisons. *Sulphate of indigo*, which consists of a solution of indigo in strong sulphuric acid, has also proved fatal in cases where it has been accidentally taken.

Recapitulation.—The *symptoms* produced by the mineral acids are much the same in all cases. There is violent, burning pain in the mouth, gullet, and

stomach, commencing *immediately*. The burning is followed by retching and vomiting of a dark-coloured liquid with shreds of mucus, and portions of the mucous membrane of the œsophagus or stomach. The inside of the mouth is shrivelled and more or less corroded, unless the agent has been given in a spoon, drunk out of a bottle, or otherwise passed over the tongue to the back of the fauces. The outside of the lips and mouth will otherwise probably present the stains characteristic of the acid used. There is great thirst, difficulty of swallowing, and impeded respiration, which last may arise from pain in the abdomen. The bowels are confined; the urine scanty or suppressed. Next succeeds great exhaustion, the pulse becomes quick and feeble, and the skin gets cold and clammy. The countenance is anxious and expressive of great suffering; death speedily occurs, the intellectual faculties remaining clear to the last.

These acids may prove fatal without entering the stomach by causing asphyxia, the glottis becoming closed by swelling of the fauces, or of the mucous membrane of the larynx. They have sometimes been administered by the vagina, rectum, &c., and been poured into the ear during sleep.

Where recovery takes place from the immediate effects of the strong acids, there is always fear of death resulting at the end of one or two years from stricture of the œsophagus, and even at an earlier period, unless proper treatment is adopted. Occasionally one of the secondary effects of poisoning by these acids has been profuse salivation.

The *post-mortem appearances* are the following:—The body may have a healthy appearance. Usually there are stains about the mouth, fingers, and wherever the cuticle has been reached by the acid. The inner sur-

face of the mouth, fauces, and œsophagus, is usually white and corroded at first, but dark brown and shrivelled, or otherwise discoloured after a time, the mucous coat being easily detached. The epiglottis and glottis are usually swollen. The gullet resembles the mouth in most respects. The outer surface of the stomach and intestines is very vascular, that of the former being sometimes corroded and occasionally perforated. The stomach is sometimes contracted, sometimes distended with gas, and contains a thick, dark-brown fluid; its inner surface has sometimes a charred, blackened appearance, the mucous membrane between the rugæ being of a scarlet hue. The pylorus is mostly contracted; while the inner coat of the duodenum and small intestines presents a similar appearance, in a less degree, to that of the stomach if the patient has lived long enough. When perforation occurs it usually takes place posteriorly if the patient, or after death the body, has been lying on its back, and the edges of the rent are softened. The escaped matters may have acted on the adjacent viscera.

According to Casper, after poisoning by sulphuric acid the bodies resist putrefaction for some time, owing perhaps to the acid neutralising the ammonia of decomposition. It may be the same with the other mineral acids.

Treatment.—The first remedy at hand is the best. Bicarbonate of soda, or *calcined magnesia*, or the *carbonate of magnesia*, should be immediately given, mixed in milk or any mucilaginous fluid; the doses being continued at short intervals, until it may be inferred that the acid is neutralised. In the absence of these remedies substitutes may be found in chalk, whiting, soap and water, or the plaster of the apartment beaten up with water. Oleaginous and mucilaginous

fluids, as olive oil, linseed tea, barley water, milk, gruel, &c., may be freely given, either alone, or as the vehicles of the antidote. *The success of the treatment will depend upon the promptitude with which it is adopted.*

The stomach-pump should not be employed; the disorganised and softened state of the gullet and stomach rendering them excessively liable to perforation.

Should the larynx be affected and the breathing impeded, *tracheotomy* must be at once had recourse to.

After a sufficiency of the antidote has been given the use of mucilaginous diluents must be continued for some time, and the subsequent treatment will be that for gastro-enteritis. Great benefit will be derived from the use of oily enemata.

The external parts which have been injured by the acid should be well bathed with soap and water, and treated like burns.

CHAPTER VIII.

THE CORROSIVE VEGETABLE ACIDS.

OXALIC ACID (*Acid of Sugar*).—This is one of the most important poisons with which we have to deal. From its cheapness and well-known properties it is frequently made use of in cases of suicide, while from its resemblance to Epsom salts it has on several occasions been taken in mistake for that medicine. The fatal dose of this poison is, comparatively speaking, large, usually not less than half an ounce; one dram killed a boy aged sixteen, in eight hours. It proves rapidly fatal. Taylor relates the case of a woman, aged twenty-eight, who was found dead one hour after swallowing three drams of the crystallised acid. Christison mentions

an instance in which one ounce destroyed life in ten minutes, and another case where the same quantity killed a girl in thirty minutes. One example has been recorded where a fatal result ensued probably within three minutes of the acid being swallowed.

The poisonous properties of the *Binoxalate of Potash* (Salt of Sorrel, Essential Salt of Lemons) are due to the oxalic acid it contains. This salt, which exists in the leaves of the wood sorrel (Oxalis acetosella), is sold to bleach straw, remove ink-stains, &c. It is very cheap; is almost as powerful as oxalic acid itself, and gives rise to the same kind of symptoms; it has been taken for the purpose of suicide, as well as in mistake for cream of tartar.

Oxalate of lime exists in considerable quantity in the leaves and stalks of the common edible rhubarb.

Symptoms.—The effects of poisoning by oxalic acid are peculiar. When the dose is large (half an ounce or more) and the solution concentrated, it proves very rapidly fatal. It produces—

(*a*) A hot burning sensation in the act of swallowing; (*b*) Severe burning pain in the stomach; and (*c*) In most instances immediate vomiting.

The vomited matters are strongly acid, of a dark-brown or black colour, and consist of the contents of the stomach with altered mucus and blood. In some cases *no* vomiting occurs. The remaining symptoms are—(*d*) Sense of constriction about the throat, or suffocation; (*e*) Lividity of the countenance; (*f*) Great pain and prostration of strength; (*g*) Feeble pulse, cold clammy perspirations; and (*h*) Convulsions, which speedily terminate in death.

When a large dose has been taken, death takes place from utter collapse. When a smaller quan-

tity has been taken, or the poison has been much diluted, its corrosive properties are weakened or destroyed, but the nervous symptoms, as (α) cramps, and (β) numbness, may be well marked.

In cases of recovery the mouth may remain sore for some time, the tongue swollen, the abdomen tender, the stomach very irritable, and there may be troublesome diarrhœa. In two instances there has been loss of voice for several days, owing to the action of the poison on the nervous system. Twitching of the muscles of the face and extremities, as well as numbness, have also been observed.

Post-mortem Appearances.—The mucous membrane of the fauces, œsophagus, and stomach is generally *white*, and *soft* or *brittle*, but often coloured with the brown mucous matter discharged. The stomach often contains a black fluid, like coffee-grounds, consisting principally of altered blood; and its submucous coats are vascular and dark-coloured. The stomach, though seldom perforated, may yet be so softened as to be with difficulty removed entire, and sometimes this is not possible. This softening may be partly due to the post-mortem action of the poison; but its effects during life in softening and blanching the mucous membrane are sufficiently marked. Occasionally the stomach is *black* and gangrenous looking. If death has occurred quickly, the small intestines are seldom much affected; but where the symptoms have been protracted, there are usually signs of congestion and inflammation.

Treatment.—Never use the stomach-pump. Chalk, whiting, or magnesia, suspended in water, or in some demulcent fluid, must be administered *immediately*; and, if necessary, vomiting should be excited by tickling the fauces, or administering emetics; but the use of much fluid containing no antidote (which is *lime* in any shape)

is to be avoided, as tending to favour absorption of the poison. The antidote, to be effective, must be given as soon as possible, the plaster of the apartment, or any form of mortar, may be used in the absence of the remedies just mentioned. Alkalies (soda, potash, or their carbonates) are not only useless, but they form salts with oxalic acid, which are as injurious as the acid itself. Where there are symptoms of collapse, stimulants are to be freely employed, but they should be given per rectum.

Tests.—Crystals of oxalic acid are met with as four-sided prisms, colourless, without odour, permanent in the air, and (*a*) very acid; this last character distinguishing them from crystals of sulphate of magnesia and sulphate of zinc. The crystals, when heated, (*b*) melt, and are (*c*) dissipated without being charred, and (*d*) leave no residue. This character is important as a means of distinguishing oxalic acid from other similar crystals. They are soluble in from eight to twelve parts of cold water. This acid may be thus recognised in solution:—

1. *Nitrate of silver* throws down, with oxalic acid, (*a*) an abundant white precipitate (oxalate of silver), which is (*b*) soluble in nitric acid. This oxalate of silver, when dried and (*c*) heated on platinum foil, detonates, and is dissipated in a white vapour.

2. *Sulphate of calcium* causes (*a*) a white precipitate with oxalic acid (oxalate of calcium) which (*b*) is soluble in nitric or hydrochloric acid, but (*c*) not in any vegetable acid.

The solution containing the acid should be concentrated before testing, if it is not present in considerable quantity.

Lime water and all soluble lime salts throw down precipitates with oxalic acid; but as these are liable to be mistaken for a precipitate with sulphuric acid, it is better to use sulphate of calcium, which is slightly soluble, as

test agent. A good deal of the test solution must be used, and the precipitate takes time to settle.

3. *Sulphate of Copper* gives (*a*) a faint bluish precipitate with oxalic acid (oxalate of copper), which (*b*) is not redissolved by a few drops of hydrochloric acid.

N.B.—These tests will not act if the solution contain nitric acid in excess, in which case the liquid must be evaporated to crystallisation, and the crystals washed and redissolved in water.

Separation from Organic Mixtures.—The tests for oxalic acid should never be applied without previously separating it from all organic matter. This is best done by first of all—

1. Digesting with water and filtering to get rid of solid matters.

2. Acidulating the suspected fluid with acetic acid, and then

3. Adding acetate of lead. This combines with the oxalic acid to form a white insoluble salt, which may ordinarily be removed by renewed filtration or subsidence.

4. This filtrate, after being well washed, is

5. To be diffused in water, and into this a current of sulphuretted hydrogen gas is to be passed for some considerable time. This will throw down the lead as sulphide, leaving the oxalic acid in the fluid; any organic matter will also be carried down.

6. Filtration will separate the solids from the liquid containing the acid, which may now be evaporated until crystals are formed, and tested in the usual way.

Acetic Acid.—Although this acid, in its concentrated state, is highly corrosive, yet it is very seldom brought under the notice of the toxicologist.

In the case of a young woman reported by Orfila, death quickly occurred after several attacks of convul-

sions. At the subsequent post-mortem examination, the tongue and œsophagus were of a dirty brown colour, the latter being intersected by a fine network of capillary vessels; and the interior of the stomach was interspersed with black elevations caused by the presence of coagulated blood in the submucous areolar tissue. The mucous membrane was entire.

As regards the *treatment*, it is only necessary to administer draughts containing magnesia or its carbonate, followed by mucilaginous or demulcent drinks.

TARTARIC ACID, though not a corrosive, may be here placed along with the other vegetable acids. Strange as it may seem, tartaric acid has destroyed life in at least one instance in this country; an ounce having been given in mistake for an aperient salt. The deceased swallowed the whole at once, and immediately called out he had been poisoned. He complained of intense pain in the throat and stomach, as if he had swallowed oil of vitriol, or was on fire. Soda and magnesia were administered without avail; and after death, at the end of nine days' suffering, the stomach and intestines were found much inflamed.

CHAPTER IX.

CORROSIVE ORGANIC DERIVATIVES: CREASOTE AND CARBOLIC ACID.

BOTH creasote and carbolic acid possess poisonous properties, but, as the use of the latter is immensely more common than is that of the other, for which it is commonly substituted, a description of its effects will here suffice.

Carbolic acid is a product of coal-tar, and is found in

various states, in the pure state as crystals and impure as a liquid. It has a highly characteristic odour, and hence is not likely to be used for homicidal purposes, except in the case of children or people who are intoxicated; but inasmuch as it is now so largely used as an antiseptic, many accidents have happened from its being swallowed by mistake, in spite of its taste and smell.

Though placed here among corrosives, carbolic acid has a two-fold action—one local, of a corrosive nature; another, from its effects on the nervous system; and it is this last which seems most frequently to prove fatal; nevertheless, it may be most conveniently discussed in the present connexion.

Symptoms.—When swallowed, carbolic acid gives rise at once to pain in the stomach and whitening of the lips and mouth. Vomiting does not appear to be a common symptom, and pain is not always noted. But in a few minutes there come on (*a*) coma, (*b*) stertorous breathing, and (*c*) *the pupils are contracted* to a very marked degree. Death usually follows within a period of from a few minutes to eight or ten hours or more, but most frequently within an hour or two. If urine is passed or drawn off it is usually dark-coloured.

Appearances after Death.—The mouth, throat, gullet, and stomach are (*a*) whitened and sodden, and the mucous membrane readily removable. Between the folds of the stomach reddening is observed. The vessels of the brain are (*b*) congested if the patient has lived for any length of time, and (*c*) its fluids, together with the blood in other parts of the body, may give off the odour of carbolic acid. (*d*) This same odour is also appreciable in the stomach, in the intestines, and frequently in other organs, as the kidneys.

The usual fatal dose is about an ounce of the impure acid, but smaller quantities have proved fatal.

Treatment.—Death in poisoning by carbolic acid is usually so rapid that little time is left for treatment. The object of this should be the immediate removal of the poison. Oleaginous substances, which will dissolve the acid and so dilute it, but which cannot be absorbed in the stomach, may be given, together with sharp emetics, to get rid of them; if allowed to be absorbed they will only aggravate the evil. There is not the same objection to the stomach-pump here as there is in the case of some other corrosive poisons, as the softening is superficial; nevertheless, it must be used with caution.

Tests.—Of all tests for carbolic acid its odour is the most characteristic. Where it is present in any quantity, heating, with or without a small quantity of sulphuric acid, will set it free, and it may be collected by a retort in the usual way. Bromine water throws down a whitish-yellow precipitate in a weak solution of carbolic acid.

In a case of poisoning by carbolic acid the symptoms do not differ greatly from those of poisoning by opium; do not neglect, therefore, to note the appearance of the mouth, and the smell of the breath.

CHAPTER X.

THE CAUSTIC ALKALIES AND THEIR CARBONATES: POTASH, SODA, AMMONIA.

THE second great division of the class Corrosives has now to be considered. It contains the Caustic Alkalies,

and some of their Salts. Poisoning by any of these agents is rare.

Potash.—This substance, in its caustic state, as found in commerce, is in the form of grey-coloured cakes. It has an acrid taste, is soapy to the touch, and very deliquescent. Moulded in cylinders, it is often employed as a caustic (Potassa fusa). In solution (Liquor potassæ) it is strongly alkaline, and imparts a brown stain to black cloth.

Potassium Carbonate or *Carbonate of Potash* (Pearl-ash) is extensively used by laundresses and in the dressing of woollen cloth. It is generally sold in a granular condition, white, inodorous, and strongly alkaline; it is soluble in water, but not in alcohol.

Caustic Soda.—This agent resembles potash in its general properties. The *Sodium Carbonate* or *Carbonate of Soda* (Soap-lees) bears a similar resemblance to the carbonate of potash, except that it crystallises easily, and does not deliquesce, but effloresces on exposure to the air.

Ammonia.—When pure, ammonia is a colourless, pungent gas; but it is commonly met with dissolved in water, as the liquor ammoniæ. Its vapour is poisonous, and may prove fatal by producing inflammation of the larynx and trachea, and even of the lungs. A case is recorded of a French boy, aged six, who killed his younger sister by making her swallow several teaspoonfuls of a solution of ammonia. Other instances have also occurred where the liquor ammoniæ, has either been taken in mistake for the aromatic spirit of ammonia, or purposely, to destroy life. An instance is recorded by Dr. Taylor, as occurring in the practice of Mr. Hilton, where liquor ammoniæ, given by mistake, caused corrosion of the throat and gullet, and obstruc-

tion of the bronchial tubes by false membrane. The œsophagus was completely dissolved at its junction with the stomach, and there was an aperture in the anterior wall of that organ, such as might have been caused by oil of vitriol. The most characteristic feature of ammonia poisoning, besides the fact that it may be detected by means of a glass rod dipped in acid, and held near the mouth, is the frequency with which the air-passages are affected.

The *Ammonium Carbonate* or *Carbonate of Ammonia* (Hartshorn, Smelling Salts) has been used as a poison. It may be distinguished from other salts by its being alkaline, by its entire volatility, and by its pungent odour. A young woman, in a state of unconsciousness, was made to swallow a quantity of hartshorn. In an hour there was great pain, sickness, and vomiting of blood. The hæmatemesis continued for some days, and then feebleness and emaciation set in, death occurring in three months. On examination the pylorus was found contracted to the size of a crow-quill, while there was a large cicatrix on the posterior wall of the stomach.

Symptoms.—The chief symptoms occasioned by the foregoing poisons are, an acrid, burning taste coming on during swallowing, with a sensation of excoriation and burning extending along the mouth and throat, to the stomach. There soon ensue exquisite pain in the epigastrium, and tenderness on pressure. Frequently there is cough, hoarseness, dyspnœa, as well as vomiting of altered mucus mixed with blood and detached portions of the mucous membrane. The tongue, mouth, and fauces become swollen, soft, and flabby, and deglutition is difficult. The surface of the body becomes cold and moist, the pulse small

and feeble, and there is great pain over the abdomen, with diarrhœa. Death took place, in the case of a boy, in three hours from the time of swallowing a strong solution of carbonate of potash. Ammonia, by its effect on the air passages, has proved fatal in four minutes. When recovery from the immediate effects of the poison has taken place, death has subsequently ensued from stricture of the œsophagus, producing starvation. By the proper use of bougies, life may occasionally be prolonged for many months, or even for years. In some instances, however, it is almost impossible to effect dilatation, owing to the whole of the gullet becoming thickened and contracted, so that the opening into the stomach will hardly admit a crow-quill. The pylorus may also be contracted in like manner.

Post-mortem Appearances.—The mucous membrane of the mouth and gullet is softened and inflamed, and portions of it detached. The coats of the stomach and intestines are inflamed, stained of a dark colour, and sometimes ulcerated. When death has resulted from ammonia, signs of inflammation are usually found in the larynx and bronchial tubes. The other caustic alkalies may also destroy life by producing inflammation of the glottis, which consequently may be found thus occluded after death.

Treatment.—Never use the Stomach-Pump.—The object must be to neutralise the poison, which may be effected by a weak acid. Vinegar and water is perhaps the best antidote, and is most readily procurable: its administration may be followed up by the free use of acidulated demulcent drinks, lime- or lemon-juice, orange-juice, &c. The use of oil has been recommended, on the principle that it converts the alkali into a soap. But that its efficacy is doubtful has been in some measure shown by

the death of two young children from swallowing a mixture of ammonia and oil. In one of these cases nearly two ounces of linimentum ammoniæ (made of one part of liquor ammoniæ to two of olive oil) were poured down an infant's throat by a child five years old. Were, however, the oil given in much greater abundance, the result would probably be different. At all events, its administration should not be neglected.

Tests.—The specific character of these substances is their strongly marked alkalinity, ammonia possessing, over and above, that of volatility. Potash is known from soda by being precipitated of a creamy yellow by platinum perchloride, soda remaining unaffected by that reagent.

II.—SIMPLE IRRITANTS.

CHAPTER XI.

SALTS OF THE ALKALIES AND LIME.

Potassium Nitrate or Nitrate of Potash (*Nitre, Saltpetre, Salprunelle*) is a more dangerous poison than is commonly supposed, provided the dose be large. It has ordinarily been given in mistake for other salts as a purgative, and in one instance caused death in about two hours. In another such instance, referred to by Orfila, an ounce proved fatal in three hours. This may be considered as the usual fatal dose, the time required being from two to three hours. It produces symptoms of irritation of the alimentary canal, vomiting, and diarrhœa. There is generally also severe pain at the pit of the stomach, trembling of the limbs, scanty urine, and collapse. Marks of violent inflammation are found after death in the stomach and along the intestinal canal.

Potassium Sulphate or Sulphate of Potash (*Sal Polychrest, Sal de Duobus*, &c.) has proved fatal when taken in a large dose. It has caused death in two or three cases when purposely administered to procure abortion. Taylor quotes an instance of a lady, a week after delivery, being directed by her medical attendant

to take ten drams of this salt, in divided doses, as a laxative. After the first dose she was seized with severe pain in the stomach, with vomiting, &c., the symptoms increasing after each dose, and proving fatal in two hours. At the post-mortem examination the mucous membrane of the stomach and intestines was seen to be pale in some parts but reddened in others, and the stomach contained a quantity of reddish-coloured liquid. This, on being analysed, was found to contain no other irritant but this salt.

Bitartrate of Potass or Hydrogen Potassium Tartrate (*Cream of Tartar*, *Argol*).—This salt has caused death in one case at least, in which about an ounce and a half was taken. The symptoms were those of an irritant poison, with what seemed paralysis of the lower extremities. Death occurred within forty-eight hours.

Sulphuret of Potassium (*Liver of Sulphur*) has also caused death as an irritant poison.

Treatment.—As no antidotes are known to these salts the treatment must consist in producing vomiting as speedily as possible by means of emetics; or the stomach-pump may be used. Demulcent drinks should be freely given, together with soothing applications to the bowels. Ice may be given in any quantity.

Lime acts as an irritant poison, though a feeble one, when taken into the stomach or applied to a vital part. One fatal instance is reported, where a boy swallowed some lime in an apple-pie. He died in nine days, after suffering from a burning pain in the abdomen, great thirst, and obstinate constipation. Unslaked or imperfectly slaked lime may also prove fatal by being inhaled, and so giving rise to inflammation of the

larynx and trachea. A man was ordered to drink lime water. He took a piece of burnt limestone, put it in water, stirred it about, and drank the thick fluid. He died in a few hours.

CHAPTER XII.

SALTS OF THE METALS:
ZINC—SILVER—TIN—BISMUTH—CHROME—IRON.

Two preparations of ZINC must be noticed:—

SULPHATE OF ZINC (*White Vitriol, White Copperas*).—This is a very mild irritant, resembling in its appearance Epsom salts and oxalic acid. It is very useful as an emetic in scruple or half-dram doses, dissolved in any thin fluid.

In one case an ounce was accidentally taken. Great pain in the stomach, vomiting, and prostration, soon set in. Subsequently there was gastritis, and recovery only occurred after a prolonged convalescence.

Treatment.—Vomiting is to be encouraged by milk or albuminous fluids. As antidotes, remedies containing tannin (strong tea, decoction of oak bark, or tincture of Peruvian bark) are to be given.

CHLORIDE OF ZINC.—A solution of chloride of zinc forms a valuable disinfectant, but is also a dangerous irritant, or, if sufficiently strong, a corrosive poison. Sir William Burnett's Fluid consists of gr. xxv. of this salt to the dram of water. It has been taken in mistake for fluid magnesia, pale ale, &c., and has caused death.

Symptoms.—A burning sensation in the mouth and throat is immediately produced; often with signs of local corrosion, though these may be absent. This is

followed by nausea, vomiting, and signs of collapse, purging, sometimes with cramps and convulsions. Death has occurred in less than two hours.

Post-mortem Appearances.—The mucous membrane of the throat and stomach has been found corrugated hard, and leathery. In the case of a sailor who died from about half a pint of Burnett's solution, the cerebral vessels were engorged, and the lungs were congested. The mucous coat of the stomach was of a purple red, and partially corroded, while the pyloric orifice looked as if caustic had been applied to it. There were patches of congestion in different parts of the small intestines.

Treatment.—Albuminous drinks, as milk and white of egg, followed by some preparation of tannin, should be freely given.

Tests.—Zinc is distinguished from all other substances by giving a white precipitate with sulphuretted hydrogen. Note that the solution containing the poison must be neutralised, so as not to be too acid, or no precipitate will be formed. Zinc also gives white precipitates with ferrocyanide of potassium and ammonia.

Nitrate of Silver (*Lunar Caustic*).—This is a powerful irritant, and has proved fatal in at least two instances. The antidote is common salt, which may be given freely and at once, followed by emetics.

Tin.—The chlorides of tin are employed in dyeing, colour-making, &c., which may lead to their being used as poisons, or being taken accidentally. Death from their use is rare. They are decomposed by magnesia, which should therefore be freely administered, followed by albuminous and mucilaginous drinks.

Bismuth.—The nitrate or magistery of bismuth has

caused death in nine days, after a dose of two drams. The symptoms were those of a strong irritant, but in all probability were caused by some impurity in the substance. *Arsenic* is frequently present in this way. As no antidote is known, vomiting must be promoted and emollient drinks freely given.

Chrome.—The bichromate of potassium is extensively used in the arts, and has caused death in more than one instance. Emetics, and magnesia or chalk, must be the remedies employed.

It is well to know that this substance is apt to produce troublesome sores on the hands of those engaged in its manufacture. Some slight abrasion begins the lesion, which does not heal, but forms on its surface a tough slough, which separating, leaves a foul and most intractable ulcer, with hard edges behind it.

Sulphate of Iron (*Green Vitriol, Copperas*).—Although not a powerful irritant, sulphate of iron has proved fatal when taken in a large dose. It is sometimes given to procure abortion. The *perchloride of iron* has also produced alarming symptoms, after being taken for the same purpose.

Magnesia and diluents, freely administered, must constitute the treatment.

CHAPTER XIII.

SIMPLE VEGETABLE AND ANIMAL IRRITANTS.

THIS division of the class of simple irritants is an important one, on account of the substances composing it consisting in considerable part of ordinary remedies or drugs, which, given in over-doses, may produce symptoms of poisoning. They chiefly give rise to vomiting and purging.

VEGETABLE IRRITANTS.

The most important are *aloes*, *colocynth*, *jalap*, *gamboge*, *scammony*, *elaterium*, *croton oil*, *castor-oil seeds*, various species of *arum*, *euphorbium*, *bryony*, *mezereon*, *physic nut*, and others less commonly known. Dr. Taylor says that aloes and colocynth are the basis of *Morrison's pills*, which in many instances have induced fatal purging. In *Holloway's pills*, aloes is the chief ingredient. A favourite remedy with nurses for promoting the catamenia is *hiera-picra*, a brown powder consisting of four parts of aloes to one of canella bark. This may give rise to dangerous symptoms.

The *symptoms* induced by these substances are those of irritation of the intestinal canal, severe pain, vomiting, diarrhœa, tenesmus, &c.; followed by collapse, cold sweats, and occasionally convulsions.

The *treatment* must be directed to the removal of the injurious substance by emetics and diluents, unless spontaneous vomiting has freely taken place, when it need merely be encouraged by the use of diluents. If the irritant has passed out of the stomach into the intestines it must be carried off by purgatives, such as castor oil. The inflammatory symptoms should be cautiously

combated, on account of the great prostration usually caused by these poisons. Opiates, emollient enemata, and fomentations to the abdomen will subsequently be found useful.

SIMPLE ANIMAL IRRITANTS.

The substances which require consideration under this head, though few, are important.

Poisonous Fish.—Several kinds of fish are constantly poisonous, while some only act injuriously on particular constitutions. The chief effects are sickness and vomiting, irritation of the eyes, depression, and severe urticaria or nettle-rash. In this country the different varieties of shell-fish are those most frequently injurious, especially cockles, mussels, crabs, and such-like.

Poisonous Meat.—The flesh of animals which have died of disease has produced serious symptoms when eaten, and has even destroyed life. Several substances, as sausages, cheese, bacon, &c., also become poisonous from putrefaction.

The *treatment* in these instances should consist in the use of emetics, purgatives, and diluents. The vital powers must be supported by stimulants, tonics, nutritious diet, &c.

CHAPTER XIV.

IRRITANT GASES.

The chief acrid poisonous gases are *chlorine*, *sulphurous-acid gas*, *nitrous-acid gas*, and *hydrochloric-acid gas*. When diluted, they admit of being inhaled; not so when pure.

Chlorine.—This gas has a greenish-yellow colour, and a powerful suffocating odour. It is used to fumigate

buildings, being a valuable disinfectant. Chlorine is employed by the calico-printer and paper-maker for its bleaching properties. The men who work in an atmosphere slightly impregnated with it suffer from dyspepsia, but are long-lived, and it has been supposed to be actually beneficial to consumptives. Any attempt to inspire chlorine in its concentrated state would at once prove fatal by closing the glottis and causing asphyxia. Even when diluted, it excites excessive irritation of the air-passages, cough, difficulty of breathing, and inflammation.

In poisoning by chlorine, the inhalation of a small quantity of sulphuretted hydrogen appeared to afford relief in a case reported by Christison, but with that, or any other of the irritant gases, our treatment must chiefly consist in the instant removal of the sufferer to pure air. Then the cautious inhalation of ammonia, sulphuric ether, or the vapour of warm water, will be useful.

Sulphurous Acid Gas is one of the products formed by the combustion of most samples of ordinary coal. It possesses bleaching and antiseptic properties; and is very irritating when inspired. It is nowadays a good deal used in medicine when dissolved in water.

Nitrous Acid Gas is a very violent poison when inhaled, producing inflammation of the lungs and air-passages. It has proved fatal in several instances, when given off by nitric acid.

Hydrochloric Acid Gas is irrespirable in its concentrated state, and when diluted produces great irritation of the lungs and air-passages. This gas, which is a waste product in the manufacture of washing soda (sodium carbonate), is the chief cause of the barrenness which surrounds soda works where it is allowed

to escape, it being extremely destructive to vegetable life.

Ammonia.—It has been already noticed that the vapour of ammonia may, if not largely diluted, excite inflammation of larynx, bronchitis, and pneumonia. Serious symptoms have sometimes arisen from its indiscriminate application in cases of syncope, and narcotic poisoning.

III.—SPECIFIC IRRITANT POISONS.

By Specific Irritant Poisons we mean those which, taken internally,

(*a*) Produce *local inflammation or irritation*, which is indicated by certain constitutional symptoms; but over and above these, which may be the result of ordinary inflammation, there are—

(*b*) Certain *specific signs* of the action of a poison, in most instances peculiar, and frequently pointing directly to the poison employed.

This group is one of the utmost importance in Toxicology, and includes substances acting in many different ways, all, however, giving rise to the common symptom of gastric irritation.

CHAPTER XV.

SPECIFIC MINERAL IRRITANTS: IODINE AND IODIDE OF POTASSIUM—BROMINE AND BROMIDE OF POTASSIUM.

Iodine is an active poison, although its effects are variable. Some constitutions are violently affected by two or three grains, or even less, of iodide of potassium, whereas others are uninjured by half a dram or a dram for a dose.

The *symptoms* of acute poisoning by iodine itself consist of an acrid taste, tightness about the throat, epigastric pain, vomiting, and purging, especially if much

has been taken. In a case which came under observation, a man took an ounce of the compound tincture of iodine, in mistake for a purgative draught. He was immediately seized with an intense burning pain in the throat and epigastrium, and vomiting, followed by great thirst, headache, and syncope. The vomiting was encouraged, large quantities of arrowroot given, starch enemata administered, and in twelve hours all the symptoms had disappeared, leaving him in a state of exhaustion, from which he recovered in a few days.

In chronic poisoning, or what is called *iodism* (which, however, in certain constitutions may be an acute symptom) the use of very small quantities of iodide of potassium, give rise to signs of *irritation* of the *alimentary canal*, an *eruption* which may be measly, but which may also be distinctly a *form of acne*, or even like hydroa, *headache* about the region of the frontal sinuses, *dryness* and *irritation of the throat*, *pytalism*, and *running from the nose* and *eyes*, with *reddening* of the *nostrils* and *eyelids*. These symptoms have no distinct relation to dose, for cases have occurred in the practice of the writer where half a grain three times a day could not be borne. In certain forms of syphilis enormous doses (compared with the above) may be given with advantage.

The *treatment* should consist in the encouragement of vomiting, and the free administration of amylaceous fluids, as gruel, arrowroot, boiled starch, flour and water; in fact, whatever is at hand in acute poisoning. This should be continued until the matters vomited are of their natural colour; for as long as any iodine remains they will be rendered blue, iodide of starch being formed. For iodism it is usually enough to discontinue the drug and use a little chlorate of potash gargle. There is no certain record of any fatal case.

Tests.—1. Iodine may be readily detected by the blue colour it gives to starch.

Iodide of potassium gives the same when the iodine is set free by an acid, such as sulphuric acid.

2. It also forms a scarlet precipitate with perchloride of mercury, soluble in excess of either reagent; and

3. It gives a yellow precipitate with acetate of lead.

Bromine and Bromide of Potassium.

Bromine is an intensely acrid and partially corrosive fluid, giving off very irritating vapours. It has rarely been used as a poison. In one case where an ounce of bromine was taken on an empty stomach, death ensued in seven hours. Besides the ordinary signs of irritant poisoning, the bromine had transuded the stomach and stained the tissues around.

Bromide of Potassium, now so largely used in medicine, gives rise, in certain constitutions, to an eruption something similar to that produced by iodide of potassium, but not to the symptoms of coryza so marked in the latter.

CHAPTER XVI.

PHOSPHORUS.

Phosphorus is much more frequently used as a poison abroad than in England.

The way in which it has been chiefly so employed has been as rat poison (phosphorus paste) and the ends of matches. To obviate such risks matches are now often made without phosphorus, or it is used in what is called the amorphous form. A child has died from sucking two matches, and correspondingly small quanti-

ties have proved fatal to adults, but usually the quantity required is upwards of one grain.

In one case death followed in half an hour, but usually it does not occur till some days after the exhibition of the poison.

The *symptoms* of poisoning by phosphorus are very varied, often insidious, and might be described as naturally arranging themselves in two groups—1, those following immediately on its ingestion, and 2, those coming on some hours after.

1. At first there may be merely the ordinary signs of irritant poisoning. The vomited matters are luminous in the dark, sometimes bilious, sometimes bloody, or stained with the colour of the matches or phosphorus paste. Sometimes the breath smells of garlic. There is very great prostration, and there may be diarrhœa with bloody stools. These symptoms sometimes abate, and everything seems going on well, when suddenly, from the third to the fifth day, a new train of symptoms, still more serious, develop themselves.

2. These are such as would occur in the worst forms of blood poisoning: (*a*) harsh, dry, *yellow* (jaundiced) *skin*, with (*b*) discharges of blood from the various passages, and the formation of *extravasations* below the skin. (*c*) The liver is enlarged. (*d*) The urine is ordinarily retained or suppressed, what little there is being *albuminous* or bile-stained. Finally, (*e*) acute delirium with convulsions sets in, and the patient dies (*f*) comatose.

The *post-mortem appearances* after death by phosphorus are very peculiar. If the case has proved rapidly fatal there are the ordinary signs of irritant poisoning, more or less distinctly marked. But if death occurs at a later period there may be softening of the stomach, extravasations in the skin and various parts of the body, so

that in many respects the lesions resemble those of the worst forms of sea scurvy. The most marked changes are the remarkable fatty degeneration of the *liver*, *kidneys*, *heart*, and other *muscles*, especially of the first. The blood is usually fluid.

The *diagnosis* of poisoning by phosphorus will depend on the peculiar odour of garlic exhaled by the patient, and the luminosity of the breath and vomited matters, in addition to the other signs referred to. In many respects the signs, both before and after death, resemble acute atrophy of the liver.

Treatment.—There is no regular antidote for phosphorus; early evacuation by the stomach-pump and the free promotion of vomiting are the main points. Magnesia or its carbonate should be given freely in mucilaginous fluids. Oils had better be avoided, except for the purpose of removing all traces of the poison by the stomach-pump. Prompt treatment is all in all.

Detection.—There is but one really satisfactory plan for detecting phosphorus in organic mixtures, that invented by *Mitscherlich*. The suspected material is introduced into a retort, and acidulated with sulphuric acid. The stem of the retort is conducted into a tall glass vessel kept cool by a stream of water on the outside. The retort is heated, and destillation allowed to go on in the dark. If phosphorus be present it passes over as vapour, and is condensed in the cool vessel beyond. At each condensation a *flash of light is perceived*, which is the characteristic test relied on. The phosphorus thus collected may be further oxidised by means of nitric acid and estimated as phosphoric acid.

Chronic Poisoning by phosphorus used to be exceedingly common among match manufacturers, but is now, comparatively speaking, rare, allotropic or amorphous

phosphorus being much more generally employed than it used to be, and the ventilation of the workshops being better. Its subjects were attacked with toothache, their teeth became carious, and the jaw exposed. Thence the disease spread, gradually extending and implicating the jaw-bone, and ultimately giving rise to great deformity.

CHAPTER XVII.

ARSENIC.

ARSENIC is by far the most important of metallic poisons, whether we consider the deadliness of its effects or the fatal frequency with which they are made manifest. Arsenic exists as an impurity in several metallic ores, notably in iron pyrites, which being commonly employed as a material for the manufacture of sulphuric acid, renders arsenic one of the most frequent impurities of commercial oil of vitriol. This should never be forgotten in testing any substance for the poison. All forms and preparations of arsenic produce similar symptoms, and poisoning by either of them requires nearly the same treatment.

The peasants in parts of Styria and Hungary are said to eat arsenic, taking from two to five grains daily; the men doing so in order that they may gain strength, and be able to endure fatigue, the women that they may improve their complexions. These statements are so contrary to all that we know of the power of this poison, that they have been regarded as unworthy of credit. Evidence has, however, been brought forward by Dr. Craig Maclagan, of Edinburgh, which shows clearly that arsenic-eating is something more than a mere fiction. This gentleman gave, and saw a Styrian eat, a piece of

arsenious acid, weighing over four grains, and afterwards determined the presence of arsenic in urine passed in his presence by the said peasant. Advantage was taken of these reports in the trial of Miss Madeline Smith (Edinburgh, July, 1857), when the court was asked to believe that arsenic found in the possession of the prisoner was used by her as a cosmetic.

Arsenite of Copper, in one form or another, either as Scheele's green, emerald green, Brunswick green, &c., is unfortunately largely employed in the manufacture of green paper-hangings, artificial flowers, toys, and even some kinds of confectionery. Too many cases of ill-health caused by this practice have been recorded to permit any doubt as to its deleterious effects. These are often manifested by people living in a room furnished with green paper-hangings. The chief symptoms are—sneezing, lachrymation, frontal headache, nausea, and loss of appetite, with colicky pains, thirst, &c. Among the workmen employed in preparing these paper-hangings more serious symptoms sometimes manifest themselves. The irritation of the pigment gives rise to circular patches of ulceration on the alæ of the nose, in the folds of the arm, in the groin and scrotum—in short, wherever dirt tends to lodge. These prove very intractable, except the employment is abandoned. In November, 1861, a young woman died in London from the poisonous effects of arsenite of copper used in dusting wax leaves. The workmen who employ the pigment in its dry state suffer, while those who use it in a moist condition are less affected by it. A simple method for roughly detecting arsenite of copper in these fabrics is as follows:—A small portion of the suspected material is to be put into a test tube with strong ammonia. If a blue tint be produced, a salt of copper is shown to be present. Withdraw the

Test in wall paper

object, and drop a small piece of ordinary caustic (nitrate of silver) into the ammonia; if arsenic be there, the nitrate of silver will be covered with a yellow coating of arsenite of silver, which will disappear on stirring. On igniting arsenical paper and allowing it to smoulder, the odour of garlic may be detected in the fumes given off. Another mode in which the noxious effects of arsenic are produced is by the use of bright green tarlatans as ball-dresses, when, as is often the case, the arsenic is left loosely adherent to ball-dresses and wall-papers, it is scattered in showers about the room.

Arsenious Acid (*White Oxide of Arsenic, White Arsenic, Arsenic*).—This is the preparation of arsenic most frequently used as a poison; the facility with which it used to be procured, its cheapness (twopence an ounce), and the ease with which it may be administered, all tended to recommend it to the murderer or suicide. According to a parliamentary report, the number of fatal cases of poisoning in England in the years 1837, 1838, amounted to 543, of which no fewer than 186 were caused by arsenic, 185 arising from the use of the arsenious acid, and 1 from orpiment or yellow arsenic.

Since the passing of the various acts relating to poisoning, the deaths from this agent have greatly decreased, and are now, comparatively speaking, rare.

Arsenious acid is found in commerce in the form of a white powder, or in small opaque cakes. It is very feebly acid, tasteless, or slightly sweet in small doses, though not very soluble, an ounce of cold water dissolving about one grain. The quantity so held in solution may, however, be increased by dissolving the arsenic in boiling water and allowing it to cool.

Death has often occurred from a dose of arsenic in

two or *three* hours, though it may not happen under four or five days, or even more.

Two and a half grains may be said to be a *fatal dose*; less has caused death. On the other hand, enormous quantities, relatively speaking, have been taken, and when prompt vomiting occurred recovery has followed. In the latter group of cases the poison has usually been mixed with some foreign body or used in cakes, sweetmeats, or some other article of food.

Symptoms.—The symptoms of poisoning by arsenious acid commence within half an hour or an hour of swallowing the poison. These are (*a*) faintness; (*b*) nausea; (*c*) incessant vomiting; and (*d*) a burning pain in the epigastrium, increased on pressure, and gradually extending over the whole abdomen. Next follow (*e*) headache, mainly frontal; (*f*) diarrhœa; (*g*) a sense of constriction and heat in the fauces and throat; (*h*) great thirst; and (*i*) catching, painful respiration; (*j*) the heart's action becomes depressed; (*k*) the pulse is quick and feeble; (*l*) there is great restlessness and anxiety; (*m*) cold, clammy skin; and (*n*) perhaps tenesmus, with heat and even excoriation round the anus. Death usually occurs within twenty-four hours.

These symptoms are liable to great variety.

1. *Pain* and *vomiting* may be absent.
2. There may be coma.
3. There is often spasmodic twitching, or cramps, especially of the legs.
4. Sometimes there is tetanus.

In some instances death may take place from collapse, sometimes it follows on convulsions.

The *vomited matters* may be *clear and ropy*, or *red* or *brown* from admixture with blood or bile; or they may

be *blue* or *black*, if the arsenic has been coloured with indigo or soot, according to Act of Parliament. Although the vomiting, pain, &c., are generally *continuous*, yet sometimes all the symptoms remit, and the patient rallies for a time, only to sink more rapidly.

The symptoms of *chronic* poisoning by arsenic, such as result from wall-papers, are loss of appetite, a silvery coating to the tongue, thirst, nausea, colicky pains, diarrhœa, frontal headache, langour, sleeplessness, cutaneous eruptions, soreness of the edges of the eyelids, emaciation, and anæmia. In some cases, when small doses have been administered for many days in succession, with the intent to destroy life, the symptoms have been masked by other substances. The most marked results of this practice have been sickness and vomiting, pain in the bowels, nervous irritability, and emaciation. The practitioner must be careful not to mistake these symptoms for those due to simple gastritis or enteritis.

Arsenic is not a poison that accumulates in the system, but is slowly eliminated from it, especially by the kidneys, but partly also by the bile.

The *local application of arsenic* to the mucous membranes, to wounds, or to surfaces deprived of their cuticle, produces constitutional effects similar to those just described. The only difference is that the symptoms show themselves more slowly. Not a few lives have been sacrificed from the application by ignorant quacks of a mixture of arsenious acid, realgar, and oxide of iron to ulcerating cancers.

Cases of compound poisoning have been met with. When arsenic is taken mixed with opium, the symptoms produced by the former are masked.

Post-mortem Appearances.—Arsenic appears to exercise a specific influence over the alimentary canal, and more

especially over the stomach; for in whatever manner it may have been introduced into the system, it is to this organ especially that we must look for its effects. These consist in the signs of acute inflammation commencing in the stomach, and often extending along the duodenum, small intestines, and colon. In acute cases the stomach is the viscus most affected; but in chronic cases the whole alimentary canal is found inflamed and ulcerated, particularly the duodenum and rectum. When death has occurred within five hours of taking the poison, the stomach has been found intensely inflamed in an adult; while the same result was witnessed in a child who died at the end of two hours. The stomach often contains a dark grumous fluid, mixed with tenacious mucus, occasionally tinged with blood. On removing the contents the mucous membrane is seen red and inflamed, the inflammation being most intense around certain spots. On examining these spots, particles of arsenic will probably be found adhering to the walls of the stomach and surrounded by a zone of inflammatory redness. Sometimes also blood is effused into the visceral walls, giving rise to an appearance resembling gangrene. Ulceration of any of the coats of the stomach is rare, and perforation is still more so.

In a few exceptional cases there has been no appearance of inflammation in the stomach or bowels.

Putrefaction of the body is said to be remarkably retarded after death from arsenic.

Treatment.—The first object in dealing with a case of arsenical poisoning must be to get rid of the poison from the stomach, for which purpose the *stomach-pump* may be advantageously employed, or emetics of *sulphate of zinc*, *mustard*, or *ipecacuan* administered, unless vomiting is already going on. The sickness must be promoted

by the free use of albuminous or mucilaginous diluents, or tepid greasy water. Raw *eggs* beaten up in *milk* are particularly useful, as is likewise a mixture of albumen, milk, and lime-water; equal parts of *oil* and *lime-water* may be used, for the oil invests the poison, and the lime renders it less soluble. A large dose of castor oil (℥j to ℥ij) may be given, to carry off any of the poison which may have passed into the intestines, as soon as sickness has subsided. *Animal charcoal*, *magnesia*, and other similar insoluble or only partially soluble substances, when taken in large quantities, may be of service by enveloping the arsenic, and preventing its contact with the mucous membrane of the stomach. Oil or milk acts more efficiently in this manner. The HYDRATED PEROXIDE OF IRON* should be administered moist, and in large doses, after the stomach-pump has been used; or indeed, this compound may be first injected and then withdrawn by the stomach-pump, thus washing out the stomach. *This is the most efficient antidote known.*

The subsequent treatment must be conducted on general principles, according to the severity of the symptoms; but the great depression must not be overlooked. Henbane or opium, in many instances combined with stimulants, ice internally, and hot fomentations externally, will frequently be found of great service.

Tests.—In its *solid state* arsenious acid may be known by the following properties:—

* If not kept prepared, the remedy may be speedily got ready in any chemist's shop in the following way: Mix together the contents of the bottles containing tincture of the muriate of iron (the liquor ferri perchloridi does as well) and liquor ammoniæ fortior. Run the mixture through a loose filter, saving the precipitate; turn filtering paper or tow (if that has been used), and all into a vessel containing water, shake well, and use the precipitate by spoonfuls as it falls to the bottom.

1. Heated on platinum foil or on the point of a penknife, it produces a white smoke and is entirely volatilised.

2. If some of the powder be heated in a small test-tube, it will be sublimed, and small octahedral crystals, visible to the naked eye, or by a lens, settle on the sides of the test-tube.

3. If arsenious acid be (*a*) mixed with freshly burnt powdered charcoal, and (*b*) heated in a small test-tube, (*c*) a ring of shining metallic arsenic of a grey colour will be found on the cool portion of the tube, and (*d*) an odour of garlic is perceptible. If (*e*) this deposit be driven about from place to place it will gradually become oxidised, and (*f*) octahedral crystals of arsenious acid formed. Further (*g*) if the tube be divided and the part containing the arsenious acid be washed out with destilled water, (*h*) the liquid tests may be applied to the solution. This is called the *Reduction test*. It is very delicate, detecting, according to Christison, the 300th part of a grain.

In solution, arsenious acid may be detected by what are called the liquid tests. A solution of it in water is *colourless*, almost *tasteless*, and has a very *slightly acid* reaction. If a few drops be evaporated on a glass slide and examined by the microscope, numerous minute and mostly imperfect *octahedral crystals*, or an amorphous deposit, will be seen, presenting triangular surfaces by reflected light.

1. The *ammonio-nitrate of silver* (prepared by adding a few drops of liquor ammoniæ to a solution of nitrate of silver, till the brown oxide of silver at first precipitated is nearly redissolved) throws down with arsenious acid *a rich yellow deposit* of arsenite of silver.

2. The *ammonio-sulphate of copper* (formed by adding

liquor ammoniæ to a solution of sulphate of copper till the bluish-white oxide of copper is almost redissolved) produces a *pale green precipitate* (arsenite of copper, or Scheele's green.) Care must be taken not to add too much of the test in the first instance, otherwise its blue may overpower the green of the precipitate.

3. *Sulphuretted hydrogen water* throws down a *yellow deposit* of sulphide of arsenic. It is better, however, to use pure and well-washed sulphuretted hydrogen generated in the usual manner. (*a*) Care must be taken that the liquid to be tested is not alkaline, or no precipitate will be produced, even through arsenic be present. For this reason yellow sulphide of ammonium will not precipitate arsenic until acidulated with pure hydrochloric or some such acid. (*b*) The precipitate should be collected, carefully washed, and dried. (*c*) It should then be mixed with black flux or dry ferrocyanide of potassium and reduced, so as to give rise to the mixed crust of metallic arsenic and arsenious acid produced in the Reduction test.

These tests are so delicate, especially the first mentioned, that they will detect the 8,000th part of a grain of arsenic in solution. They should be employed so that each may corroborate the other. There are several other processes for the detection of arsenic, especially in admixture with foreign substances, which require to be noticed, namely—(1.) Marsh's process, the process known as (2.) Reinsch's process, (3.) Fresenius's process, and the (4.) Destillation process.

Marsh's Test or Process.—This process is founded on the fact that arsenious acid is decomposed by nascent hydrogen, and the consequent formation of arsenuretted hydrogen gas. This gas possesses the following pro-

perties. (*a*) It burns with a bluish-white flame, and (*b*) gives off a white smoke (arsenious acid), which (*c*) possesses a slight garlic odour. If (*d*) a piece of glass or porcelain be held in the flame a blackish metallic stain will be deposited upon it, consisting (*e*) of metallic arsenic. This stain might be confounded with one produced by antimony under similar circumstances. But the (1.) antimonuretted hydrogen gas does not burn with the odour of the arsenuretted hydrogen. (2.) The antimonial stain is sooty, and has not a metallic lustre. The arsenical stain (3.) is further readily dissolved by a solution of chloride of lime (bleaching powder) whilst the antimonial stain is not affected. To the stain (4.) may be added a few drops of strong nitric acid; it will dissolve the arsenic; if this be allowed to evaporate, and the acid be neutralised, (5.) a few drops of nitrate of silver solution will give a brick-red precipitate of arsenate of silver.

Marsh's test is best carried out in this way:—A flask furnished with a cork, (1.) through which pass a funnel, and a long bent tube drawn to a point, is prepared, so that the funnel reaches almost to its bottom. (2.) Several pieces of pure zinc are introduced, and then (3.) some sulphuric acid is poured through the funnel. In this way hydrogen gas is produced and escapes by the bent tube. When all the air has been expelled the gas should be ignited as it escapes, and a piece of cool porcelain held over the flame. If there be no deposit it is plain that neither the zinc nor the sulphuric acid contains arsenic. (4.) A portion of the suspected fluid is next introduced into the flask by the funnel, and the issuing gas again tested. Should (5.) a stain giving the characters alluded to above be produced, the fluid contains arsenic in some form or other.

Reinsch's Process.—The liquid suspected of containing arsenic, is:

1. Boiled with from one-sixth to one-eighth of its bulk of pure hydrochloric acid; and,

2. A bright slip of copper introduced. If arsenic be present the copper will be coated with it, in the form of an iron-grey deposit. Next after removing the copper;

3. Washing it with destilled water, and

4. Drying it between folds of blotting-paper;

5. Cut it into slips, and

6. Introduce it into a reduction-tube, and

7. Apply heat.

If arsenic be present, arsenious acid will be sublimed and deposited on the sides of the tube, in the form of minute octahedral crystals. These may be dissolved in water and tested in the usual way. Before resorting to this test, the hydrochloric acid as well as the copper foil, must be examined to make sure of their purity. This is easily effected by boiling the copper with a mixture of the acid and distilled water before adding the suspected liquid. In conducting the analysis in the case of Smethurst, Taylor and Odling found that all the varieties of copper in common use for Reinsch's process contained arsenic. A copper of ascertained purity must therefore be used.

Arsenic in Organic Matters.—The following process, which has been introduced by Dr. Taylor, is a very convenient one. The suspected matters are to be thoroughly dried in a water-bath or otherwise, taking care not to use too great a heat. They are then to be introduced into a flask fitted with a long bent tube; to the dried material is to be added a quantity of strong hydrochloric acid, proved free from arsenic, sufficient to drench it,

and the whole allowed to digest for some hours. At the end of that time heat is to be applied to the flask by means of a sand-bath, and a receiver fitted to the bent tube. The receiver should contain a little water, and both it and the bent tube should be kept cool. As destillation goes on the arsenic passes over in the form of chloride of arsenic, and is collected in the receiver beyond. A second portion of hydrochloric acid may be used to remove any traces of arsenic in the organic material. The arsenic may be recovered from the chloride by boiling with pure polished copper, as in Reinsch's process.

The process of Fresenius and Von Babo given at page 21 is especially adapted for the recovery of arsenic from organic admixture, and is probably the best.

Several cases of poisoning by *arsenuretted hydrogen*, when this gas has been accidentally inhaled, are on record, some proving fatal. This may occur when hydrogen has been prepared from impure zinc and sulphuric acid, when intended for the purposes of inhalation. The symptoms much resemble those of ordinary arsenical poisoning.

CHAPTER XVIII.

ANTIMONY AND ITS COMPOUNDS.

In its metallic state antimony is not regarded as poisonous. Two of its preparations, however, claim attention; namely, tartar emetic, and chloride of antimony.

Tartar Emetic (*Tartrated* or *Tartarised Antimony*, *Potassio-Tartrate of Antimony*, *Tartar Emetic*).—Since

the trials of Palmer, Dove, Smethurst, and Pritchard, and especially since the Bravo case, poisoning by this compound has attracted much attention. (1.) In large doses it has been sometimes administered or taken without any serious result, a circumstance which may be accounted for by the promptitude with which it excites vomiting and purging. But again, (2.) given in small doses, frequently repeated, the effects of tartar emetic may be made to simulate, in some degree, those due to natural disease.

Three-quarters of a grain has killed a child; and a dose of two grains has destroyed an adult, under circumstances which favoured its action; but the ordinary fatal dose is not less than a dram; more may be taken (as much as half an ounce or more) and recovery take place, vomiting so speedily following on its being swallowed.

Symptoms.—In acute poisoning by this agent there is a *metallic taste* in the mouth, coming on immediately after swallowing the poison, *nausea*, and *violent vomiting*, *burning heat*, with *pain* in the *stomach*, and *purging*. *Difficulty* in *swallowing*, *thirst*, *cramps*, *cold perspiration*, and *great debility* soon set in. Should the case terminate fatally, death may be preceded by giddiness, insensibility, difficult respiration, utter prostration, with violent spasms, tonic or clonic; but even when matters appear to be most critical, symptoms of improvement are often manifested, and recovery gradually follows.

All cases of poisoning by antimony have sunk into the shade as compared with what was called the autumn "sensation" of 1876. As regards the conduct of the case, no words could make it blacker than it stands forth—a disgrace to the legal annals of this country. Mr. Bravo, a weak, vain man, met Mrs. Ricardo, then a wealthy widow, and speedily married her. According to her statement

she told him before marriage that she had been on too intimate terms with a Dr. Gully, well known at Malvern. It is certain that Mr. Bravo knew of this connexion, and it rankled in him, nor does he seem to have been sparing in letting his wife know this. At all events, the facts connected with his miserable death are here embodied.

Mr. Bravo was a young barrister of about thirty, strong, healthy, and hearty. He had hardly ever suffered from ill-health, was a remarkably cheerful man, and of temperate habits. On Tuesday, April 18, 1876, after breakfast at his own house at Balham, he drove with his wife into town. On their way, according to her statement, they had an extremely unpleasant discussion. He had a Turkish bath, lunched with a relation of his wife's at St. James's Hall, and walked on his way home to Victoria Station with a friend and fellow-barrister, whom he asked out for the following day. He arrived at home about half-past four.

Shortly after his return home Mr. Bravo went out for a ride, in the course of which the cob on which he was riding bolted with him, and carried him a long distance. From this he returned tired, ill, and exhausted. When seen at half-past six, Mr. Bravo was sitting, leaning forward, on his chair, looking ill, and with his head hanging down. He ordered a hot bath, and in moving to get it he cried out very loud with pain, and put his hand to his side. After his bath he did not appear very much better, but seemed to suffer pain all through the time of dinner, though he seemed to avoid attracting the attention of his wife and Mrs. Cox, her companion, who dined with him.

The dinner-hour was half-past seven, but from certain causes it was delayed for a few minutes. The

articles composing the food eaten at dinner were partaken of more or less in common by all three.

As regards drink this was not the case. Mr. Bravo drank burgundy only; Mrs. Bravo and Mrs. Cox only sherry and marsala. Burgundy was the wine Mr. Bravo usually drank, and this had been decanted by the butler some time before dinner,—how long he could not say. The butler noticed nothing unusual in the wine; and Mr. Bravo, who would only drink wine of a good quality, and who seemed, moreover, a connoisseur of wine, remarked nothing as to its taste and quality, but drank it as usual. The quantity of wine he commonly took at dinner was about three or four glasses. If he had burgundy for luncheon he finished the bottle at dinner; but if not, as on the day in question, the remains of the bottle were put aside in an unlocked cellarette in the dining-room. Whether or not any wine was left after dinner on this day could not be found out, the butler could not remember. At all events, no remainder of the wine then consumed was discovered. This cellarette was opened at least twice subsequently to this, and prior to Mr. Bravo's illness—once by Mrs. Cox, and once by the housemaid.

As regards the food itself, Mr. Bravo seems to have eaten fairly well. It was clear, therefore, that the adventure on horseback had not completely destroyed his appetite; but it is also clearly on evidence that he was not himself, from whatever cause. It was said he had been suffering from toothache or neuralgia, and he had just received a vexatious letter.

Here the element of time assumes a greater and greater importance. There was no reason to believe that Mr. Bravo had swallowed any poison up to half-past seven o'clock or twenty minutes to eight. The dinner lasted

till past eight, there was some talk, and then the three people who partook of dinner passed into the morning-room, where conversation was continued up to about nine o'clock. Mrs. Bravo and Mrs. Cox went upstairs, leaving Mr. Bravo alone, and Mrs. Cox went to fetch Mrs. Bravo some wine and water from the dining-room.

Upstairs Mrs. Bravo undressed and made ready for bed, Mrs. Cox still being with her, and she drank the wine and water brought up.

The next point of time was exactly fixed. The housemaid was accustomed to take up each evening some hot water for washing before the ladies went to bed. On this occasion the bell did not ring, and the housemaid, looking at the clock, and finding it half-past nine, of her own accord proceeded to take up the hot water. Mrs. Bravo then asked the girl to fetch her some marsala, which she proceeded to do, taking the glass which had contained the wine and water for that purpose. On her way back to the dining-room she encountered her master at the foot of the stairs. He looked "queer"—that is, "he looked very strange in the face, but did not appear to be in pain." He looked twice at the servant, yet did not speak, though that was his custom, but passed on. She thought "perhaps he was angry."

Mr. Bravo was alone after the departure of his wife and Mrs. Cox until the time when he passed on upstairs before the housemaid. He entered his wife's dressing-room, and the maid Mrs. Bravo's bedroom. In the dressing-room, according to Mrs. Cox's statement, Mr. Bravo spoke to his wife in French, upbraiding her for taking too much wine. This had frequently been the subject of unpleasant remarks before; but Mrs. Bravo did not remember his saying anything on this occasion.

This must have brought the time down to twenty minutes or a quarter to ten.

After this, Mr. Bravo left his wife's dressing-room, went to his own bedroom, and closed the door. The maid left Mrs. Bravo's bedroom, and met Mrs. Bravo in the passage, undressed, and on her way to bed. Mrs. Bravo and Mrs. Cox entered their bedroom, and Mrs. Bravo drank the marsala brought up by the maid, and went to bed. The interval between the point of time when Mr. Bravo left his wife's bedroom and entered his own and the next point in the history of the day is not easily measured. This helps. The maid had time to collect and put away Mrs. Bravo's day-apparel, to enter Mrs. Bravo's bedroom, where she had a few words of conversation with Mrs. Cox, who was sitting at the bedside, to leave the room, and to reach the foot of the stairs leading to Mrs. Cox's own bedroom upstairs, when the door opened, and Mr. Bravo, in his night-dress, shouted out, "Florence! Florence! hot water." All this could hardly have been done in less than a quarter of an hour, but after this for some time confusion reigned supreme.

The maid ran into Mrs. Bravo's room, calling out that Mr. Bravo was ill. Mrs. Cox, yet dressed, rose hastily and went to him. She found him standing at the open window apparently vomiting, and this the maid also saw. Mrs. Cox stated that Mr. Bravo said to her, "I have taken poison for Dr. Gully. Don't tell Florence" (his wife); and to this confession of having taken poison, on the part of Mr. Bravo, Mrs. Cox adhered throughout.

After this, Mr. Bravo vomited, and some hot water was brought by the maid. After vomiting, Mr. Bravo sank on the floor, became insensible, and remained so for

some hours. Mrs. Cox tried to raise him, procured for him some mustard and hot water to make him sick, but this he could hardly, if at all, swallow. Mustard was also applied to his feet, and camphor liniment to his chest. After the mustard-and-water he again vomited in a hand-basin. The vomited matters "looked like food, and were red." These were unfortunately thrown down the sink, and so disposed of. Meanwhile coffee had been procured, but Mr. Bravo was unable to swallow.

On the first alarm, Mr. Harrison, a practitioner, who had previously seen Mrs. Bravo, was sent for, but he lived at some distance. Mrs. Bravo, who had been roused from sleep by the maid, and who seems to have been greatly excited, insisted on a nearer practitioner being sent for, and in no long time Mr. Moore, a practitioner residing not very far off, arrived. Here again we have a point of time fixed. Mr. Moore arrived about half-past ten, and from this time the history assumes a more scientific aspect.

As already said, Mr. Bravo became insensible almost immediately after being seen by Mrs. Cox and the maid; but about this insensibility there seems to have been a good deal of misconception. Mrs. Cox rushed at the conclusion that Mr. Bravo had swallowed laudanum, chloroform, or some narcotic, and to this end to have given the mustard-and-water to get rid of the poison, and coffee to obviate its effect. The insensibility was not due to narcotism; it was the insensibility of utter collapse, of almost complete syncope.

Mr. Moore, on his arrival, found the patient sitting or lying on a chair. He was completely unconscious, the heart's action was almost suspended, and he was almost pulseless. His pupils were dilated. Mr. Moore caused

him to be laid on his bed, and tried to give him some hot brandy-and-water, but he could not swallow.

In twenty minutes or half an hour Mr. Harrison arrived. He was met by Mrs. Cox, who said she was sure Mr. Bravo had taken chloroform. This was taken in the sense that the chloroform was in a poisonous dose. Both Mr. Harrison and Mr. Moore early came to the conclusion that their patient was in a most dangerous state, and that in all probability he would not recover from the collapse from which he was then suffering. They, however, tried to administer stimulants, first by the mouth, but that failing, they gave him an enema of brandy-and-water. Seeing the dangerous nature of the case, other medical aid was suggested, and Mr. Royes Bell, cousin of the deceased, was sent for, with a request to bring some physician with him. He brought Dr. George Johnson, of King's College Hospital, and the two arrived at Balham about half-past two.

Meanwhile the case had begun to clear up. About two o'clock Mr. Bravo "began to vomit a bloody fluid;" the pulse rose, and he passed a bloody fluid in bed. There could no longer be any doubt that the patient was suffering from the effects of irritant poisoning.

Mr. Bravo had thus been as nearly as possible four hours without any other symptom of poisoning than profound collapse.

Shortly after the arrival of Dr. George Johnson and Mr. Royes Bell, consciousness began to return, and at three o'clock Mr. Bravo was again conscious and able to be questioned. Soon after the arrival of these two gentlemen, Mrs. Cox requested an interview with Mr. Bell, and then told him that Mr. Bravo had said, "I have taken poison; don't tell Florence." Mr. Bell, who seems to have been somewhat angry at this tardy state-

ment on the part of Mrs. Cox, summoned Dr. Johnson, who also heard it; so that when Mr. Bravo returned to consciousness, almost the first question asked of him was, "What have you taken?" From first to last—and this is an important feature in the case—the dying man (for he early felt that he was doomed) persisted in declaring in the most solemn manner that he had taken nothing except some laudanum for toothache. Yet he expressed no surprise at being thus taken ill, though he knew quite enough of medicine to appreciate the effects of opium, and to know that they were very different from those under which he was suffering.

At an early period Mr. Bravo's bedroom was searched, but nothing was found save the laudanum bottle, a little chloroform, and camphor liniment, which had been brought from another room. There were no remains or indications of any solid poison, no paper or anything else which could have contained it, no traces of a dirty tumbler or drinking-glass—in short, nothing. It must, however, be remembered that great confusion had prevailed; that many things, including vomited matters and dirty glasses, must have been removed; and that a fire was burning in Mr. Bravo's room. Mr. Bravo himself, on being questioned, mentioned, as poisons in the place, the laudanum, the chloroform, Condy's fluid, and "rat poison in the stable."

After recovering consciousness, Mr. Bravo did not again lose it to the time of his death. He remained collapsed, suffered fearful pain, vomited and purged matters of various descriptions, was severely convulsed, especially in his upper extremities; but he remained conscious throughout.

On Friday morning, at half-past two, the vomiting and purging ceased, and at half-past five Mr. Bravo died, having thus been fifty-five and a half hours ill.

On Saturday, the 22nd, Dr. Payne, of St. Thomas's Hospital, made a post-mortem examination of the body. "There was no appearance of inflammation, congestion, or ulceration. The stomach contained about eight ounces of thick, gruel-like matter, of a yellowish colour, containing small solid lumps, and had the odour of alcoholic fermentation. The œsophagus or gullet was natural, and contained some of the same matter as the stomach. The first portion of the bowels was very soft, being torn in tying it, but subsequent careful examination showed no perforation or ulceration. The surface was pale and yellowish, like that of the stomach. The whole of the small intestine was like this except the lower part, where there were some red spots. This part of the bowels contained yellow pasty matter without any admixture of blood. The large intestine at its commencement was of a deep-red colour, and contained clots of blood. Subsequent examination showed, in the portion called the cæcum, several small ulcers from which the bleeding had evidently taken place, but there was no perforation. The remainder of the large intestine was very deeply blood-stained, but without ulceration. The contents were soft, dark-red material, composed of fæcal matter mixed with blood. The liver and spleen were natural, as were also the pancreas or sweetbread, kidneys, and other abdominal organs. There was no appearance of hernia or rupture. On opening the head, the skull and the membranes of the brain were found quite natural, containing only the usual amount of blood. The brain-substance was also natural, and contained no excessive amount either of blood or of watery fluid. The mouth and lips were natural, except that the papillæ at the back of the tongue were somewhat more prominent than is usual. There was no other

appearance of disease in the body except what has been noted."

Such is the medical history of this extraordinary case; but it would be incomplete without some account of the chemical examination which was made by Professor Redwood, of the Pharmaceutical Society. Most extraordinary to relate, the matters which were vomited at the very beginning of the attack of illness which proved fatal to Mr. Bravo remained undisturbed on the leads of the house from Tuesday night till Thursday, and they were then seen both by Dr. Johnson and Sir William Gull. On that day they were directed to be removed, and they were handed over to Professor Redwood. Meanwhile, much rain had fallen, and a great part of the vomit, especially the liquid matters, had been washed away. No doubt in this way a large quantity—probably the larger quantity—of the poison had been lost. Nevertheless, in the vomit a great amount of antimony was discovered. Antimony, too, was discovered in the contents of the great gut after death, in the liver, and in smaller quantities elsewhere. Altogether the conclusion come to was that something like forty grains at least had been swallowed. This estimate nevertheless must be far under the mark; for if we bear in mind the quantity of matter vomited and thrown away, the quantity passed in the stools, and the quantity of antimony left in the tissues, over and above that detected and estimated, it is clear that an enormous dose had been taken.

That being so, the conclusion must be that the poison had been swallowed after half-past eight, when the party adjourned to the morning-room; probably after nine, when Mrs. Bravo and Mrs. Cox went upstairs; and very likely indeed after Mr Bravo himself had retired to his bedroom. This last notion is by far the most likely.

A large dose of antimony had been taken; sickness followed in a few minutes. Mr. Bravo, feeling this, shouted for hot water, and so great was the prostrating effect of the antimony, that in a few minutes he fell to the ground utterly collapsed. During the period of collapse and unconsciousness, which lasted from ten o'clock till three, but little of the poison would be absorbed, and thus all the more would be ejected in the matters vomited just after.

The post-mortem condition was most extraordinary. That there was great gastric irritation at one time, was evidenced by the vomiting of bloody matters to which Mr. Harrison and Mr. Moore bore testimony, but that must have been completely overcome before death.

Apparently the irritation and inflammation gradually extended downwards, leaving the upper portion of the bowel profoundly damaged, but presenting no signs of active and recent inflammation.

The only verdict which ought to have been come to was, that Mr. Bravo died from the effects of antimony, for there was no very reliable evidence to show whether the poisoning was suicidal or homicidal. Probability inclines strongly to the former.

The effects of *chronic* poisoning by antimony are, constant nausea, frequent attacks of vomiting and purging, a loathing for food, a weak frequent pulse, loss of muscular power, cold clammy sweats, and fatal exhaustion. The symptoms are of course aggravated after each administration of the poison, whether given in food or medicine. These features were well brought out in the case of Pritchard's mother-in-law.

Tartar emetic ointment applied to the *skin* produces a *pustular* eruption like that of smallpox; while, if much

be *absorbed*, there will be *nausea*, *sickness*, &c. Sometimes this same eruption appears in the throat and on the skin, after *swallowing* a large dose.

Post-mortem Appearances.—The most common are inflammation of the throat, stomach, and intestines. Sometimes the mucous membrane of the stomach is softened and infiltrated with blood. The cæcum and large intestine may also be inflamed, especially if life has been prolonged after the dose, as in chronic poisoning. The brain and lungs have been found congested.

Treatment.—Vomiting should be encouraged by warm greasy water, milk, &c. Liquids containing *tannin*, as *tea* without milk or sugar, *decoction of oak bark*, &c., must be freely given. *Cinchona bark* in tincture or powder may be advantageously prescribed. Afterwards opiates may be administered.

Tests.—Tartar emetic is soluble in water but not in alcohol.

In solution tartar emetic may be thus detected:

1. A drop evaporated on a glass slide leaves microscopic crystals, either tetrahedra or cubes, with the edges bevelled off.

2. The solution may further be proved to contain antimony by passing through it sulphuretted hydrogen or adding to it sulphide of ammonium, either of which throws down an orange-red precipitate of sulphide of antimony. This precipitate is (*a*) soluble in strong hydrochloric acid, which solution, being diluted (*b*), throws down a white precipitate.

3. The three dilute mineral acids (nitric is best) throw down a white precipitate with tartar emetic, which is soluble in excess of the acid used or in tartaric acid.

The metal may be separated from organic substances by Marsh's or Reinsch's process.

CHLORIDE OF ANTIMONY (*Terchloride* or *Butter of Antimony*) is a powerfully corrosive liquid. It produces violent inflammation and corrosion of the whole intestinal canal; occasionally also drowsiness or insensibility.

For distinctions between the behaviour of antimony and arsenic see page 69.

A gentleman took from two to three ounces of this substance, which proved fatal in ten hours and a half, after producing great prostration, nausea, violent griping pain, and tenesmus, followed by a tendency to sleep. On inspection, the whole of the inside of the alimentary canal was blackened, as if it had been charred; there was but little mucous membrane remaining, and the parts were much softened.

In two other cases where the liquid proved fatal about three ounces were used. Death occurred in eighteen and twenty-four hours respectively. In one it is stated that the mind remained clear; in the other this is not referred to, but there was no purging. In both the stomach was much changed and blackened.

Treatment.—Magnesia must be administered with *abundance* of milk or water, together with the remedies recommended in poisoning by tartar emetic.

CHAPTER XIX.

MERCURY AND ITS COMPOUNDS.

Of the preparations of mercury, corrosive sublimate is the most important to the toxicologist; for although they all possess in a greater or less degree poisonous properties, yet the instances in which the other compounds have been used to destroy life are extremely rare. The

treatment in all cases must be the same. It is worthy of remark that mercury, whilst in the metallic state, is destitute of injurious properties, but if oxidised or otherwise rendered fit for absorption, it may give rise to dangerous symptoms. Thus, workers in mercurial mines suffer much, as did those who were employed in silvering looking-glasses by the old process. Large doses (from half a pound to two pounds) have been given in obstinate cases of constipation, intussusception, &c., with much folly, but without any remarkable effect.

Corrosive Sublimate (*Oxymuriate of Mercury, Chloride of Mercury, Bichloride of Mercury*).—This preparation of mercury, *which, strictly speaking*, were it not for its specific effects, *belongs, like the chlorides of zinc and antimony, to the class Corrosives*, is usually met with in the form of imperfect crystalline masses or as a white powder. It has an acrid, coppery, or metallic taste, so powerful that but little could be swallowed without the individual becoming aware of it. It is very soluble in water.

Three grains is the smallest quantity that has been known to prove fatal; and from this to *five grains* may probably be stated as the average dose necessary to destroy life. Recovery has taken place after as much as eighty grains had been swallowed. Death has occurred in less than *half an hour*; while, in some instances, life has been maintained until the sixth day, and in one instance (where between three and four scruples had been swallowed) until the twelfth day. The average duration of fatal cases is from two to six days.

Symptoms.—In the majority of cases the symptoms of poisoning by corrosive sublimate commence *immediately*, with (*a*) an *acrid metallic taste*, often described as coppery,

and (*b*) a sense of constriction and *burning heat in the throat and stomach.* The burning pain gradually extends over the abdomen, and is (*c*) much increased by pressure. There is nausea, with (*d*) vomiting of the contents of the stomach. These matters are sometimes mixed with blood and stringy masses of mucus. The sickness is accompanied by (*e*) diarrhœa, *with bloody stools*, or dysentery, and (*f*) swelling of the abdomen. The countenance becomes flushed and often swollen, though it is occasionally pallid and anxious. (*g*) The *lips and tongue are white and shrivelled.* There is frequently (*h*) dyspnœa, while the (*i*) pulse is small, or wiry and frequent. Note well that pain may be absent. Death is brought about by *collapse, coma*, or *convulsions.* The symptoms marked by italics serve to distinguish poisoning by corrosive sublimate from most other specific irritants; but the most characteristic are those which come on should life be prolonged—the so-called *secondary* symptoms.

For should the poison not prove rapidly fatal, (*a*) the pain gradually lessens, though attacks of colic and nausea may come on at intervals for several days. (*b*) Often the urine is suppressed. (*c*) After a time there are symptoms of hectic fever, with much depression. (*d*) The gums and salivary glands also become swollen, there is a coppery taste in the mouth, the breath is very fœtid, and there is severe ptyalism or salivation. This latter effect is the most prominent feature in the *chronic* form of poisoning, where small and frequently repeated doses have been given: it is often so severe as to cause death, when the patient would otherwise probably recover.

It must not be forgotten that *salivation* sometimes arises where no mercurial of any kind has been given. Thus the mineral acids, arsenic, bismuth, lead, iodide of potassium, opium, &c., may induce it in some very pecu-

liar constitutions. Small medicinal doses of mercury, such as a few grains of calomel even, may also excite it in certain individuals, especially where it does not purge; and in persons suffering from renal disease. It may also occur spontaneously, as in stomatitis, or inflammation of the mouth; and very troublesome examples of it may occur in pregnant women.

It is strange that neither in acute nor chronic mercurial poisoning do we observe any marked loss of muscular power. Yet workers in quicksilver, becoming gradually poisoned, owing to the absorption of the fumes of mercury during respiration, are very apt to suffer from a peculiar kind of *tremor*, sometimes called palsy. This commences in the upper extremities, with inability to direct the hands and arms, and goes on to a shaking or trembling of all parts of the body.

Post-mortem Appearances.—The appearances produced by corrosive sublimate are confined chiefly to the digestive canal. The mucous membrane of the mouth, fauces, and œsophagus is softened and of a whitish or bluish-grey colour. The stomach also presents marks of violent inflammation; beneath the mucous membrane numerous patches of extravasated blood are seen, and frequently corrosion or ulceration has been found. The large and small intestines, the peritoneum, and especially the urinary organs, often appear inflamed. If life is prolonged for a few days the rectum and lower bowels are usually found intensely congested.

Treatment.—The antidote for corrosive sublimate is raw *white of egg*, or the whole egg broken up with milk or water. *Vomiting* is best promoted by administering copious draughts of fluids containing albumen; but if necessary ipecacuan may be given. Gluten has been much recommended, and may readily be prepared by

washing flour in a muslin bag under a stream of water; but on an emergency it will be best to exhibit the flour at once, made into a paste with milk or water. The free use of demulcent drinks, milk, and ice will be very grateful to the patient's feelings. Gargles of chlorate of potash or borax do some good. Opiates may be given in small doses, if there be much pain, and we should allow only a milk or farinaceous diet. Sucking crystals of chlorate of potash does great good when there is salivation. The most useful remedy, however, in chronic poisoning is the iodide of potassium; for this salt destroys the compounds formed by the union of mercury with certain of the tissues, and eliminates the poison through the kidneys.

Tests.—Corrosive sublimate is completely *volatilised* by heat.

1. *Liquor potassæ* added to its solution gives a (*a*) *yellow precipitate.* This precipitate, if washed, dried, and (*b*) heated in a test tube, gives a (*c*) ring of metallic mercury in the form of globules in the cool part of the tube. In like fashion corrosive sublimate itself may be reduced and volatilised if heated with black flux, or freshly burned charcoal.

2. On adding a solution of *iodide of potassium* to a small quantity of the solution, a (*a*) bright scarlet precipitate, (*b*) soluble in excess of either reagent, is produced. Hence a single drop of the iodide may cause a red cloud, which disappears, to reappear on adding another, until the precipitate forms permanently. Too much of the iodide will redissolve the precipitate and form a nearly colourless or slightly yellowish solution.

3. If a drop or two of a solution of corrosive sublimate, slightly acidulated with hydrochloric acid, be

placed on a *sovereign*, and the solution and the gold be touched with a piece of zinc or an iron key, the mercury will be deposited as a bright silvery stain on the gold. The same plan may be adopted with the hoop of a ring. This constitutes at all times a ready method of testing for mercury.

Calomel (*Subchloride* or *Chloride of Mercury*) is a heavy white powder, which is usually regarded as a safe medicine. Yet in some peculiar constitutions, it has caused excessive salivation and death, even though only a few grains have been given. In large doses it may be regarded as an irritant poison. It is distinguished from corrosive sublimate by forming a black precipitate with caustic potash and by its insolubility in water.

Ammonio-Chloride of Mercury (*White Precipitate*).—This substance is a chalky-looking powder, containing about eighty per cent. of mercury. It produces vomiting, purging, great pain in the stomach, cramps, and convulsions. It has not often proved fatal.

Two young German chemists who had been for some time engaged in the preparation of *Mercuric Methide*, in the chemical laboratory at St. Bartholomew's Hospital, died apparently from the effects of this substance. There was dimness of sight, numbness, giddiness, with mercurial fœtor, and loss of power in the limbs.

The remaining preparations of mercury, which in rare instances have been used as poisons, are the *Red Oxide of Mercury* (red precipitate); the *Red Sulphuret of Mercury* (cinnabar, or vermilion); the *Cyanide of Mercury*; the *Nitrates of Mercury*; and *Turpeth Mineral*.

Mercury may be separated from organic admixture by *Reinsch's method*.

CHAPTER XX.

PREPARATIONS OF LEAD.

LEAD, in its metallic state, is not injurious, but it is readily converted into carbonate or other poisonous compounds, the chief of these being the acetate, sub-acetate, and the carbonate.

ACETATE OF LEAD (*Sugar of Lead*).—This is sold as a glistening white powder, or in the form of crystalline masses resembling loaf sugar. It is very soluble in water and has a sweetish metallic taste, but cannot be called a very active poison.

In one curious instance thirty pounds of this substance were accidentally mixed at the miller's with eighty sacks of flour. This was made into bread, from eating which 500 persons suffered severely. The chief symptoms were a sense of constriction in the throat and at the pit of the stomach, crampy pains round the navel, stiffness of the abdominal muscles, paralysis of the lower extremities, constipation, scanty urine, and the formation of a deep blue line round the gums. Although in many cases there was great prostration, with other alarming symptoms, yet under the use of purgatives all recovered. It was noticed that after a temporary convalescence many of the symptoms returned in an aggravated form without any apparent cause. Note that in poisoning by lead, *constipation*, not *purging*, is the rule, though sometimes there has been vomiting and purging, and there is great prostration, with cramps and convulsions.

Post-mortem Appearances.—They are not usually very distinct. The stomach and intestines have been found inflamed, and the surface of the former softened. There may be no characteristic signs, beyond the blue gums, in chronic poisoning.

SUBACETATE OF LEAD (*Goulard's Extract*).—This substance is known to have proved fatal in three or four instances, after having caused great agony. It is a more powerful poison than the acetate. It is found in the shops as a whitish-coloured liquid, due to the conversion of a portion of its substance into the insoluble carbonate by the action of the carbonic acid contained in the atmosphere.

CARBONATE OF LEAD (*White Lead, Ceruse, &c.*)—This is sold in heavy white masses, looking like chalk. It is readily acted on by acids, but is very insoluble in water.

Carbonate of lead derives its greatest interest from the chronic form of poisoning which it produces among white-lead manufacturers, painters, &c., known as "*the painters' colic*," which too often terminates in "*lead palsy*." In these instances the lead finds its way into the system by absorption from (*a*) the *digestive canal*, (*b*) the *lungs*, or (*c*) the *skin*; producing its characteristic effects, especially "dropped wrist," when a sufficient amount has been absorbed. It is this salt which is formed by the action of air and water upon lead.

The other preparations of this metal do not require any separate notice.

Treatment.—The *sulphates of soda*, or *magnesia* should be freely given, dissolved in water. *Milk*, or *milk and eggs* will be useful. If vomiting is absent, an *emetic* of sulphate of zinc should be administered or the stomach-pump may be advantageously employed.

Tests.—The presence of a salt of lead in solution may be thus ascertained:—1. On passing *sulphuretted hydrogen* through it, or on adding a few drops of sulphide of ammonium, a *black precipitate* is given. 2. A *white precipitate* results from the use of *liquor potassæ* or *liquor*

ammoniæ. 3. Dilute *sulphuric acid* gives a similar precipitate, which is *insoluble in nitric acid*. 4. *Iodide of potassium* affords a *bright yellow deposit* (iodide of lead).

Chronic Lead-Poisoning.—The chronic and insidious effects produced by lead upon the constitution are deserving of careful attention. Water impregnated with this metal in its passage through lead pipes or cisterns, acquires poisonous properties. Lead-pigments are sometimes improperly used to colour cheese, lozenges, snuff, &c. The Devonshire colic was due to the absorption of lead contained in cider, which had been made in vessels partly or wholly composed of lead; and in the wine district of Poictou attacks of colic were so common, from the impregnation of wine with this metal, that we still speak of lead colic as "colica Pictonum."

The pernicious influence of lead is manifested among those engaged in the manufacture or use of lead compounds, especially painters, lead smelters, plumbers, colour grinders, shot manufacterers, workers in sugar of lead, potters, compositors, enamellers of cards, &c. These artisans should be advised to prevent disease by great cleanliness, the occasional use of alkaline sulphates as purgatives, and by drinking freely of sulphuric acid lemonade. The substitution of moist for dry colour grinding has proved useful.

The most prominent *symptoms* of chronic poisoning by lead are as follows: (*a*) A *blue line around the gums*, and the liability of the latter to bleed from any slight cause; (*b*) *emaciation*, a *pallid tint of the complexion*, poorness of blood, and a feeble quick pulse; (*c*) *obstinate constipation*, *with* (*d*) *attacks of colic relieved by pressure*; diminution of the renal secretion and rheumatic pains; afterwards comes weakness of the hands, wrists, and arms, ending

in (*e*) *paralysis of the extensors*, or "dropped wrist," the paralysis gradually creeping up the arms.

The *treatment* of these cases must consist in the first instance in the use of purgatives; none being better than sulphate of magnesia, or sulphate of soda, with dilute sulphuric acid. But the remedy of all others in chronic cases is the iodide of potassium, in five or ten grain doses thrice daily; this agent acting most beneficially when employed in conjunction with galvanism to the paralysed limbs.

CHAPTER XXI.

SALTS OF COPPER.

Poisoning with the salts of copper is of comparatively rare occurrence; when it happens, it is generally the result of accident. The metal itself is not poisonous, but the action of the gastric juice may produce a very deleterious salt. Copper coins, when swallowed, sometimes on this account prove mischievous, though usually any ill effects which ensue are due to their mechanical action. Salts of copper have been accidentally introduced into the system by means of food which has been cooked in copper saucepans. Much trouble has been taken under the Adulteration Acts to repress the sale of preserved vegetables, tinted green by copper, but no real instance of any actual ill effect from such substances has ever been educed. The most important substances of this class to the toxicologist are the following:—

Sulphate of Copper (*Blue Vitriol* or *Blue-stone*) is met with in large crystals, which are very soluble in water, and possess an acrid metallic taste. In doses of

half an ounce it acts as a powerful irritant, and has sometimes been used as an emetic. It has been administered to procure abortion. In the case of a child sixteen months old, who sucked some pieces of bluestone with which she was playing, death occurred in four hours.

SUBACETATE OF COPPER (*Verdigris*).—This preparation is met with in masses, or in the form of a greenish powder. It possesses a powerful astringent metallic taste. It is often produced by allowing greasy substances to stand in copper saucepans. It has proved fatal in half-ounce doses.

ARSENITE OF COPPER (*Mineral Green*)—Derives its poisonous properties chiefly from the arsenic which it contains, and is referred to under that heading.

Symptoms.—The symptoms of poisoning by salts of copper, are mainly: (*a*) *Pain* in the epigastrium, gradually extending over the abdomen, (*b*) violent *vomiting*—the vomited matters being of a blue or green colour—and (*c*) *diarrhœa*, are the symptoms which set in the most speedily. Then there is usually dyspnœa, great depression, coldness of the extremities, headache with giddiness, and slight tetanic convulsions. Sometimes there is suppression of urine. (*d*) *Jaundice* very frequently occurs—a symptom the more important, as it is rarely met with in other forms of poisoning, save those by phosphorus. Occasionally stupor, coma, and paralysis supervene. Should death ensue, it may occur within a few hours, or not for several days.

The salts of copper taken in very small doses, for several days, give rise to a metallic taste in the mouth, thirst, debility, cramps and colicky pains, with symptoms of dysentery. In some instances there have been found retraction of the gums, with the formation of

a purple line, very distinct from the blue mark due to lead.

Post-mortem Appearances.—Evidences of inflammation are usually found in the stomach and intestines, the mucous membrane being often ulcerated and of a blue-green colour. Particles of the poison may sometimes be found adhering to the coats of the bowels. Perforation of the intestines has occurred.

Treatment.—Vomiting sets in spontaneously, and is to be encouraged by the use of warm water. The stomach-pump will rarely be needed. The only effectual antidote is albumen. The whites and yolks of several eggs should therefore be given, followed immediately by milk or mucilaginous drinks.

Tests.—Solutions of the sulphate and nitrate of copper are blue; the chloride is green. The salts of copper may be thus identified:

1. A *polished knife* or needle introduced into the solution is soon covered with a bright red *coating of copper.*

2. *Ammonia* produces with a salt of copper a (*a*) *bluish precipitate*, (*b*) readily soluble in excess of ammonia, and then (*c*) forming a splendid blue solution.

3. *Ferrocyanide of potassium* gives a *claret-coloured gelatinous precipitate*, if the copper be abundant; otherwise the deposit is of a light-brown.

4. *Sulphuretted hydrogen* gas yields a *deep-brown precipitate.*

5. A few drops of the *copper solution* are to be placed on *platinum* foil, and slightly acidulated; on touching the foil, through the solution, with a strip of zinc, *metallic copper* is deposited on the platinum.

CHAPTER XXII.

SALTS OF BARIUM.

THREE preparations of barium have caused death—viz., the *chloride*, the *nitrate*, and the *acetate*. These also give rise to specific nervous symptoms, as *cramps* and *convulsions*. Loss of voice has been specially noted in several cases. Consciousness is not impaired. In animals much urine seems to be passed. After death inflammation of the rectum has been usually found, besides the usual marks of irritant poisons in the stomach and bowels.

Barium salts are used in sizing cotton warps, and as a poison for rats and mice; hence accidents are likely to arise from them.

Chloride of Barium.—Half an ounce has proved fatal in two hours, after causing symptoms of irritation, with vertigo, paralysis, and convulsions.

Treatment.—The sulphate of soda or sulphate of magnesia should be speedily administered, by which the poison will be converted into an inert insoluble sulphate of baryta. Emetics should also be given, or the stomach-pump used.

CHAPTER XXIII.

SPECIFIC VEGETABLE IRRITANTS.

LABURNUM (*Cytisus laburnum*).—Every portion of this plant is poisonous. The seeds are frequently eaten by children, and give rise to vomiting and purging, with dilatation of the pupils, rigors, rigid limbs, &c.

Œnanthe crocata, *Phellandrinum aquaticum*, *Æthusa Cynapium*, &c., strictly speaking, belong to this group.

Black Hellebore (*Helleborus Niger*) or *Christmas Rose*, when eaten, gives rise to abdominal pain, vomiting and purging, vertigo, cold sweats, and collapse, resembling that of malignant cholera. An infusion of this plant is sometimes administered by quacks to destroy intestinal worms. It has proved fatal to children under these circumstances.

Several other substances variously grouped for the sake of convenience should come under this heading.

CHAPTER XXIV.

SPECIFIC ANIMAL IRRITANTS.

Cantharides (*Spanish Flies*).

This poison is well known, and is usually administered in the form of powder or tincture. Of the former, twenty-four grains have destroyed life; of the latter, one ounce. This poison has been employed as an aphrodisiac and to induce abortion, by persons ignorant of its dangerous effects. This is, perhaps, the most frequent cause of poisoning by cantharides. Applied externally it has proved fatal, as in the case of a girl affected with scabies, who anointed the whole of her body with cantharides ointment in mistake for that of sulphur. She died in five days, after suffering from the symptoms of poisoning by cantharides. In a Cornish case, tried before the Lord Chief Justice, where some of this substance was administered with criminal intent, the prisoner was

discharged, on the ground that enough had not been given to produce poisonous effects.

It produces an acrid taste, vomiting, purging, burning heat in the stomach, pain in the loins, *severe strangury*, *bloody urine*, and *priapism*. Then there is faintness, with giddiness, the limbs become rigid, and delirium, with convulsions, precede death. Sometimes the *matters ejected* from the stomach or passed in the stools contain *shining golden or green particles*, the remains of the wing cases of the beetles, which constitute the drug, readily seen with a lens, or even with the naked eye.

After death, marks of inflammation are found in the alimentary canal, kidneys, and bladder, and the genital organs.

Test.—The detection of Spanish flies, if taken solid, depends mainly on the presence of the *shining particles* already alluded to, in the stomach, or in the vomited matters. To make their nature certain, however, an extract of the suspected materials should be prepared, and this should be treated repeatedly with chloroform or ether. This fluid is to be allowed to evaporate till only a few drops are left, which may be applied on lint to some portion of the body where the skin is fine, as the forearm, the part being covered by a bit of isinglass plaster, or goldbeaters' skin. The *vesication* produced is the test of the presence of cantharides.

No antidote is known. Vomiting must be excited or encouraged; and linseed tea, and gum water, or gruel copiously administered.

IV.—NEUROTIC POISONS.

CHAPTER XXV.

NARCOTICS.

NEUROTICS, ACTING ON THE BRAIN AND PRODUCING SLEEP.

OPIUM.

OPIUM is the inspissated juice of the unripe capsules of the *Papaver somniferum*, or white poppy, and is a very complex substance. Its principal properties, however, are due to the presence of *morphia*, as meconate of morphia; but others of its constituent substances undoubtedly modify its action.

It is sometimes used as a poison in its crude state, but more frequently in solution in alcohol, forming tincture of opium, or laudanum. Opium is the chief ingredient in most soothing syrups for children, to whom opium is at all times especially dangerous; and many who do not die from its direct effects, do from the wasting indirectly produced.

Of quieting physic the chief preparations are *Godfrey's Cordial*, supposed to contain one grain of opium in two ounces; *Dalby's Carminative*, which contains one grain in six; and Mrs. Winslow's "Soothing Syrup," containing as much as one grain of morphia in an ounce.

The smallest quantity of *laudanum* which is known to have proved fatal to an adult is *two drams*, from which death occurred within seven hours. Half an ounce has

more than once proved fatal. Two grains and a half of the *extract*, a quantity said to be equal to four grains of crude opium, have produced a similar result. Much larger doses are, however, taken with impunity on many occasions, more especially by those habituated to the use of this drug, who remain almost unaffected by surprisingly large quantities. De Quincey, the English opium-eater, once found in a pirated edition of "Buchan's Domestic Medicine," a caution against taking more than "twenty-five *ounces*" of laudanum at one dose. He says that he always bore this *excellent* advice in mind; and it does not appear that he ever took more than sixteen ounces of the tincture of opium as his daily allowance. In certain diseases, patients quite unaccustomed to the use of sedatives can take excessive amounts without narcotism being produced. In some cases of tetanus, for example, upwards of four ounces of laudanum have been given daily for a week, without any marked effect. The same is the case in certain individuals the subject of diabetes.

On the other hand, it must not be forgotten that not a few individuals are unable to take even one-third of a grain without becoming narcotised. Young children are particularly susceptible of its effects; the tenth and twelfth parts of a grain having respectively proved fatal to infants two and five days old, and there is recorded the case of an infant seven days old, who died comatose eighteen hours after having had administered to it about the twelfth of a grain of opium, or the quantity contained in one drop of laudanum. The smallest fatal dose for a child (four weeks old) on record, is one of paregoric elixir equivalent to about one-*ninetieth* of a grain of opium. On the other hand, they sometimes recover from very large doses indeed.

The duration of a fatal case is generally from *seven* to *twelve hours*. The shortest period recorded is *three-quarters of an hour*; the longest *twenty-four hours*. In one case two days is mentioned. If the patient survives twelve hours there is good hope of recovery.

The quantity of MORPHIA found in opium varies from two to ten per cent. The chief salts of this alkaloid are the *acetate*, the *hydrochlorate*, and the *sulphate*, all being very energetic poisons. They cause symptoms similar to those about to be described as produced by opium. But, in addition, there has been especially noticed great itching of the skin, convulsive twitchings of the muscles of the face and limbs, and occasionally tetanus. Small doses of any of the salts of morphia may cause death. In a delicate woman half a grain is supposed to have proved fatal; in several instances one grain has proved fatal; and certainly a dose of two grains might kill a healthy adult unaccustomed to opiates. Nevertheless, under the influence of custom, large quantities may be taken. A young lady took daily fifteen grains of the hydrochlorate of morphia, without obtaining more than two or three hours' sleep from it; while for many days in succession, when suffering much pain, she increased the quantity to one scruple. The hypodermic injection of morphia has been similarly abused. In one case where a third of a grain was thrice repeated as an injection beneath the skin death followed in six hours.

Others of the opium alkaloids are poisonous; but instances of poisoning by their means have not occurred, except one doubtful instance of poisoning by narcotine, recorded by Sonnenschein.

Symptoms.—When a large dose of opium or its preparations has been taken the symptoms usually manifest

themselves in about twenty or thirty minutes. They commence with (*a*) giddiness, (*b*) drowsiness, and (*c*) stupor, then ensues (*d*) insensibility. The patient appears as if in a sound sleep, from which he can be roused by a loud noise, &c., although he quickly relapses. As the poisoning progresses the (*e*) breathing becomes slow and stertorous, the (*f*) pulse weak and feeble, and (*g*) the countenance livid. The eyes are closed, while the (*h*) pupils are generally contracted, often almost to the size of a pin's point, and (*i*) insensible to the stimulus of light. In some instances the (*j*) skin is cold and livid, in others it is bathed in sweat. So also the countenance may be either ghastly or placid, the pupils may even be dilated, and the pulse may be unaffected, or so small and frequent as to be scarcely appreciable. Vomiting sometimes occurs, with slight reaction, so that hopes of recovery are entertained. But frequently there is *a relapse*, the comatose state returns, and death quickly follows, occasionally preceded by convulsions.

The possibility of rousing a patient during the earlier portion of the progress of these symptoms will assist in diagnosing the effects of poisoning by opium from those due to apoplexy, epilepsy, &c. The contracted condition of the pupil will also assist; but it must not be forgotten that in lesion of the pons Varolii the pupils are also contracted. When permanent recovery ensues it is complete; but it is usually preceded for a day or two by severe nausea, a sense of weariness, constipation, and headache.

The habitual use of opium is most injurious, especially in the form of opium smoking.

Post-mortem Appearances.—The appearances in acute poisoning by opium are not very characteristic. The

most prominent are, great turgescence of the vessels of the brain, with effusion of serum into the ventricles and at the base. The turgid condition of the vessels often continues down the spinal cord. The lungs are usually gorged with fluid blood, and the right side of the heart distended with dark fluid or clotted blood.

Treatment.—The first object in dealing with a case of opium poisoning is to remove all the poison from the stomach, and this cannot be effected in any way so well as by the *stomach-pump*. In the absence of this instrument, *emetics* of half a dram of *sulphate of zinc*, or a tablespoonful of *mustard*, must be employed. The patient at the same time is to be prevented as far as possible from going to sleep. When the stomach has been thoroughly emptied, every means must be adopted *to keep the patient roused*. This is to be effected by dashing cold water over his head and chest, walking him up and down, or shaking him between two attendants in the open air, flicking the face, hands, or feet with a wet towel, applying electro-magnetic shocks to the spine, and administering strong coffee. In extreme cases artificial respiration must be tried.

The remedies recommended must be *perseveringly used*, remembering that as long as life lasts hope of recovery is not to be banished. In the great majority of cases the treatment is successful, and thus to gain time is to save life. The first twelve hours is usually the most dangerous period.

Tests.—There are no direct means by which opium may be detected. We endeavour therefore to obtain evidence of the presence of *morphia* and *meconic acid*. The two substances may be separated from organic admixture by the following process:

1. The suspected matters should be well boiled with

destilled water, and spirit acidulated with acetic acid, and strained.

2. To the fluid which has passed through, acetate of lead is to be added until precipitation ceases, and the whole—

3. After standing, is to be thrown on a filter. The (*a*) insoluble meconate of lead remains on the filter, the (*b*) soluble morphia passing through as acetate.

A. To separate the meconic acid the substance on the filter is to be diffused through water, and sulphuretted hydrogen passed for a time. Sulphide of lead is thus thrown down and may be separated by filtration, the meconic acid remaining in solution. On concentration this should give the requisite reactions.

B. In the search for morphia the filtered fluid above referred to is also to be treated with sulphuretted hydrogen, to secure the precipitation of all acetate of lead, &c., which is next to be carefully separated from it by further filtration. The fluid now passing through, containing the acetate of morphia, is next to be concentrated by evaporation over a water-bath, and carefully neutralised by bicarbonate of potass, if it be desired to obtain the pure alkaloid; but this is not necessary, as the acetate responds to all reagents. The acetate may be dissolved out of the mass in dilute alcohol (it is not soluble in ether) again filtered, the filtrate being finally evaporated to dryness and tested.

MORPHIA.—The best tests for this alkaloid, in substance or in solution (substance is preferable) are:

1. *Nitric acid*, which strikes an *orange-red colour*, varying in intensity with (*a*) the strength of the acid, and (*b*) the concentration of the morphia solution. Ruddy fumes are also developed.

2. *Neutral perchloride of iron*, strikes a rich *blue colour*

with morphia when added in small quantity; if added in excess, the yellow of the test, combining with the blue, may produce a green. This blue is *destroyed by acids* and by heat. Nitric acid not only destroys the blue produced by this test, but replaces it with the orange-red colour; so that the nitric acid may be applied to the same portion of morphia after the iron test, but not *vice versâ*.

3. *Iodic acid.* This acid becomes decomposed, owing to the reducing action of morphia, *setting free the iodine*. The latter is detected by its *brown colour*, and the *blue* which it strikes *with starch*. The iodic acid should be previously tested to ascertain its purity, as it occasionally contains free iodine.

Meconic Acid.—This is obtained from solutions of opium, in the form of little scaly crystals of a reddish tint, which are decomposed by heat and partly sublimed. In solution it may be detected by its acquiring a *blood-red colour* on the addition of the *perchloride of iron*. A similar colour is produced with iron by sulphocyanide of potassium, as found in the saliva; but the colour of the meconate is not discharged by chloride of gold, or corrosive sublimate; that of the sulphocyanide is.

Narcotine dissolves in sulphuric acid with a yellow colour, converted into a carmine red by the addition of a trace of nitric acid.

CHAPTER XXVI.

ANÆSTHETICS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING LOSS OF SENSATION.

CHLOROFORM—CHLORAL—BICHLORIDE OF METHYLENE —ETHER—NITROUS OXIDE.

THE anæsthetics which have hitherto been employed in the practice of medicine are chloroform, sulphuric ether (or a mixture of these), bichloride of methylene, nitrous oxide, and amylene. Any of these agents may cause death when introduced into the system by inhalation.

CHLOROFORM is a colourless, heavy, volatile liquid; having a fruity ethereal colour and a sweet pungent taste. It is formed by the union of chlorine and marsh-gas, but more commonly by the action of bleaching powder on ethylic or methylic alcohol. It is readily soluble in alcohol, but very sparingly so in water.

The *symptoms* produced by the vapour of chloroform may be divided into three groups of varying intensity; briefly they are these: First, a degree of relief from pain, with slight stimulation, the senses being but slightly affected; second, a stage of excitement and incoherence, wherein the patient is prone to struggle; and thirdly, a stage of which the most marked features are complete insensibility and narcotism, with relaxation of the muscular system. At first the patient is conscious of all that is passing around him, but there is dizziness and singing in the ears. Then the mental functions are impaired, there is often excitement, the saliva is in-

creased, the patient pushes away the inhaler, rigidity and spasms of the muscles may occur, and there is incoherent talk. In the next stage there is insensibility to pain, and the conjunctiva may be touched without causing flinching. If the use of this anæsthetic be pushed further the breathing becomes stertorous, the muscles quite relaxed, and the pupils dilated; while a still further increase of the chloroform embarrasses and then stops the breathing and arrests the heart's action.

Many cases of death from the vapour of chloroform have occurred, the fatal effect sometimes happening very rapidly from shock, syncope, or convulsions; in others, again, by way of asphyxia. The vapour of only *thirty drops* has destroyed life in one minute. Death *under* the influence of chloroform must not be confounded with death *from* its effects. The smallest fatal dose when the drug has been swallowed is *one dram* in a boy aged four.

The effects of chloroform taken by the mouth are of the same description as those which follow the inhalation of this agent; with this exception, that the fatal result seems to be longer deferred. A case reported in the *Medical Times and Gazette*, 10th May, 1862, illustrates the symptoms, &c., in a clear way. Mr. M., thirty-four years of age, a highly gifted, restless man, was in the habit of inhaling chloroform. At about 12.30 A.M. the gentleman drank some chloroform; the quantity being uncertain, though it was inferred to be about one ounce. At 7.15 he was in such a profound sleep that his wife felt uneasy, and sent for a physician, who found the patient in a tranquil sleep, the respiration being somewhat hurried and audible, the pulse full but slow, the body warm, and the pupils dilated and insensible. There was a perceptible smell of chlo-

roform in the breath and in the air of the room. The window was opened, ice was applied to the head, cold affusions were used along the spine, and an enema was administered. At 9.30 A.M., the patient was paler, breathing less audibly, and with a weaker pulse. Artificial respiration was employed, an ammonia lavement was given, and iced water to the chest and pit of the stomach was used alternately with warm coverings. The stupor continued, the abdomen became tympanitic, and the pupils began to contract. About 9 P.M. the eyes began to move, the pupils seemed sensible to light, the pulse was 160, there was abundant perspiration, and the patient sat up for a few moments and looked surprised. Exhaustion, however, set in, and death occurred just before midnight, nearly twenty-four hours after swallowing the poison.

In a second case a gentleman, fifty years of age, swallowed two ounces of pure chloroform at 8 A.M. He was not seen until 3 P.M., when he was found in a state of deep coma. His breath smelt strongly of chloroform, the pupils were widely dilated and insensible, the pulse slow and feeble, the surface colder than natural, the movements of the thorax scarcely perceptible, and sensation generally abolished. Ammonia, sinapisms, bottles of hot water, and cold affusion did no good; but on using a stomach-pump a quantity of chloroform mixed with watery mucus was withdrawn, and in less than an hour the patient was able to answer questions. For three or four days he complained of a burning sensation in the throat and epigastrium, and then got well. A consideration of the treatment employed in this instance suggests the idea that the first patient might have had a better chance of recovery had the stomach-pump been used at once.

Various plans have been suggested for the administration of chloroform with safety, but this must be remembered: that the use of anæsthetics is at all times attended with risk, and we can only at best diminish the danger. Apparatus may be used so as to reduce the risk to a minimum; but it is plain that any contrivance which in itself requires much attention, and thereby diverts it from the patient, is bad. More lives have been lost by bungling in the administration of chloroform than from the noxious character of the drug.

In the *treatment* of poisoning by the vapour of any of the anæsthetics mentioned in this chapter, we must *expose the patient to a current of pure air*, use *cold affusion*, and employ *artificial respiration* until the poison is eliminated. *Galvanism* may be employed to keep up the action of the diaphragm, either directly or through the phrenics. As these agents are got rid of through the lungs, the purity of the expired air is one test of the elimination being complete, though of course inferior to the evidence afforded by the subsidence of the symptoms. In poisoning by liquid chloroform or ether the stomach-pump ought to be promptly used.

Test.—Chloroform at a red heat is decomposed, and chlorine and hydrochloric acid are formed. Hence, to detect it, the substance supposed to contain the chloroform may be *heated* (by means of a water-bath) in a retort or other vessel, so as to expel the chloroform, which should be conducted away from the heated vessel by a tube bent at right angles. To this tube heat should be applied to decompose the vapour, and the products searched for by the ordinary tests. If these products be conducted into a solution of nitrate of silver (*a*), the white *chloride of silver* will be formed. (*b*) The *hydrochloric acid*, which also escapes, will redden litmus paper; and (*c*), the

chlorine will set free iodine from iodide of potassium, and so *blue* a paper coated with a solution of *iodide of potassium in starch*. The smell is a valuable criterion.

Chloral Hydrate, which with an alkali is converted into chloroform, is now much used as a narcotic and for easing pain both by the profession and unfortunately also by the public, to many of whom its use has become almost a necessity. It does not produce the nausea and headache which follow the use of opium. It is hardly possible to tell the dose required to cause death. In one case 30 grains is said to have done so. When the substance has been taken in one dose it has often happened at night, and the patient found dead in bed in the morning. When the symptoms have been observed there has usually been some excitement, with delirium, followed by profound unconsciousness, stertorous breathing, gradually becoming more and more feeble, lividity and pulselessness. The period of death is uncertain.

Treatment.—This should be strenuously directed to keeping up artificial respiration, for hours if necessary. The stomach-pump should be used if in time, and it is difficult to say when it is too late. Emetics of mustard and other stimulant substances, *except* ammonia, may be freely used.

Bichloride of Methylene has been used for anæsthetic purposes. It is supposed to be safer than chloroform. Practically they act much alike, and death happens with the one as with the other.

Sulphuric Ether.—Sulphuric ether, or ether, is a clear colourless liquid, very inflammable, soluble in alcohol, and less so in water. It is usually obtained by destilling common alcohol with sulphuric acid.

The effects produced by the inhalation of ether are very similar to those which result from chloroform. It

is, however, without doubt a much safer agent, but its effects are longer in manifesting themselves; it is more irritating to the air-passages and the salivary glands, and often gives rise to troublesome bronchitis, and much more of it is required. Deaths have occurred under its influence as under that of chloroform.

NITROUS OXIDE.—Comparatively recently the laughing gas of Sir Humphrey Davy has been introduced as an anæsthetic agent. Its successful use depends on the total exclusion of air from the lungs during its exhibition. It can only be used for a short time, hence it is chiefly employed in dental operations. It has, however, been given for a considerable length of time consecutively by allowing the patient to return to the verge of sensibility before giving a fresh dose.

CHAPTER XXVII.

INEBRIANTS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING INTOXICATION.

ALCCHOL—NITRO-BENZOLE—COCCULUS INDICUS—FUNGI, ETC.

ALCOHOL.—Spirituous liquors, when taken in large quantities, not unfrequently produce fatal effects.

Two wine-glassfuls of brandy proved fatal to a boy, seven years old, in thirty hours. Dr. Taylor mentions the case of a man who drank two bottles of port wine (containing eleven ounces of alcohol) in less than two hours. He speedily became intoxicated and utterly helpless, never rallied, and died from congestion of the brain and lungs. Another man who swallowed a bottle of gin for a wager died in half an hour, although much of the spirit was removed by the stomach-pump. A common cause of acute alcoholic poisoning is "sucking the monkey," as practised in the docks by labourers having access to spirit casks.

The *symptoms* generally come on rapidly, the individual appearing confused, and unable to walk steadily. This degree of intoxication soon passes into the stage of complete stupor and coma, and unless there is vomiting collapse soon sets in. In some cases a remission of the symptoms has occurred, death being postponed for a day or longer.

As the alcohol is eliminated by the lungs, stupor from drink may be detected by the odour of the breath. The

countenance is *usually flushed*, and the *pupils are dilated*, but in cases of acute poisoning the patient may be *deadly pale*. The pupils are not contracted, as in poisoning by opium; moreover, the individual may generally be roused for a few moments by a loud noise, &c.; a circumstance which may prevent intoxication being mistaken for concussion of the brain.

But it must not be forgotten that people who have been drinking may also be the subjects of disease; nay, that, feeling ill, a sick man may have had recourse to stimulants to overcome the symptoms of the disease. Therefore no case should be put aside abruptly or cursorily as "intoxication" merely.

Diluted spirits produce a state of excitement, terminating in stupor. It must be remembered that alcoholic liquids have been frequently made the vehicles of more virulent poisons.

As regards *treatment*, the poison is to be removed as quickly as possible by the stomach-pump, or emetics of the stimulant kind, especially mustard. Cold affusion should be applied to the head, but not to the body, which is often cold and clammy, and the diluted liquor ammoniæ or carbonate of ammonia, administered internally. Subsequently warmth must be promoted.

NITRO-BENZOLE AND ANILINE.—A compound, made from the rectified products of coal-tar and nitric acid, and known as *nitro-benzole*, is sometimes used as a substitute for essential oil of almonds. It is sold to perfumers under the name of "essence of mirbane." The effects of this substance do not usually show themselves for about two hours, and therein lies a valuable point of distinction between it and the essential oil of almonds, the effects of which (due to prussic acid) come on immediately. Death results by coma. The odour of the breath is highly

characteristic. The substance is very insoluble in water, hence the use of the stomach-pump promises well if undertaken soon after swallowing.

A lad employed in some chemical works, finding a syphon did not act, sucked through it some of the fluid, which happened to be nitro-benzole. No immediate effect resulted, but in a few hours he felt as if he were drunk. Stupor came on, and ended in death twelve hours after swallowing the poison.

Test.—To distinguish nitro-benzole from essence of almonds, a drop of sulphuric acid may be used; this reddens the almond essence, but does not affect the nitro-benzole.

Another product of the destructive destillation of coal in gas-making is *aniline* (into which nitro-benzole is converted in the human body), a colourless, limpid, acrid and poisonous liquid. It has given rise to very alarming symptoms when swallowed, as well as when inhaled in vapour. It produces a remarkable *blue* or *purple* discoloration of the body, particularly *the lips* and *nails*.

Cocculus Indicus.—The kernel of the berry of the Menispermum cocculus, or Levant nut, imported from the East Indies, contains from one to two per cent. of a poisonous principle named *picrotoxine*. Thieves sometimes mix a decoction or extract of the berries with spirits or beer, to give these drinks an intoxicating property (hocussing). Dishonest publicans, too, first reduce their beer by means of salt and water, and afterwards give it intoxicating properties by adding cocculus extract. The same substance is used by poachers to destroy fish. The symptoms produced appear to be, in some cases, vomiting and purging, a peculiar stupor, a complete loss of voluntary power, with a consciousness of passing events. In some cases there are convulsions, and an eruption like that of scarlatina has been observed.

DARNEL SEEDS (*Lolium temulentum*).—The seeds of this plant, which is often found growing with corn crops, when accidentally mixed in considerable quantity with wheat or rye, and ground into flour, have caused gastric pain, severe giddiness, vomiting, and other symptoms of intoxication. The sufferers complained that everything seemed of a green colour. A wet season is said to encourage the growth of darnel with the varieties of corn.

CAMPHOR.—This substance is very variable in its action. It has given rise to alarming symptoms on some occasions, and once it has destroyed life. In scruple and half-dram doses, it has produced giddiness, difficulty in walking, dimness of sight, difficulty of breathing, delirium, and insensibility.

Treatment.—In the case of all these substances the stomach-pump or emetics must be employed. If the effects are not very severe they will generally cease spontaneously after a time.

FUNGI.—The type of the class of poisonous fungi may be taken as the Amanita muscaria. This is an autumn fungus of an orange-red colour, and is used among the Siberian tribes, especially the Koraks, as an intoxicating agent, and produces symptoms somewhat similar to those of alcohol.

The Agaricus campestris and A. esculentus are the fungi most frequently used as articles of food, but even these are indigestible. They occasionally produce diarrhœa, with a pruriginous or exanthematous rash in dyspeptics; and should only be eaten in great moderation.

Ketchup, the juice of the mushroom flavoured with salt and spices, has produced faintness, nausea, and colic, lasting for some hours.

There are no very positive characters except those afforded by an accurate botanical knowledge, whereby

the wholesome fungi may be distinguished from the unwholesome. By careful treatment even those usually unwholesome may be safely eaten. Moreover those which may be eaten with impunity by some individuals prove destructive to others. Thus, a French officer and his wife died from breakfasting off mushrooms which others in the house ate without inconvenience. As a general rule highly coloured mushrooms, with an astringent, styptic taste, a forbidding pungent odour, and which grow in dark and shady places, should be avoided.

The symptoms produced by poisonous fungi are usually those indicative of gastro-intestinal catarrh, with a disordered condition of the nervous system, and considerable depression; but, again, they may act much more like pure narcotics.

In treating these cases, the stomach and intestines must be thoroughly emptied, and the prominent symptoms are to be relieved according to their urgency.

CHAPTER XXVIII.

DELIRANTS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING DELIRIUM.

BELLADONNA—STRAMONIUM—DHATOORA—HYOSCYAMUS—NIGHTSHADE.

ATROPA BELLADONNA (*Deadly Nightshade*). — The Deadly Nightshade is indigenous, and grows in woods and gardens. The roots, leaves, and berries are poisonous, this property being due to the presence of an alkaloid called *Atropia*.

Symptoms.—Poisoning by Belladonna or its alkaloid: (*a*) *Dryness of the mouth and throat, with thirst* which nothing allays, (*b*) *nausea* and *vomiting*, (*c*) great *dilatation* of the *pupils* (*d*) *indistinct* and *double vision*, (*e*) *giddiness*, palpitation of the heart, physical and mental depression, perversion of the sense of taste, and (*f*) *delirium* followed by (*g*) *stupor*, form the chief symptoms. They may set in within from half an hour to three or four hours of swallowing the poison. Death has followed *in two hours and three-quarters* after swallowing *a dram* of the extract. Sometimes *the face is red and swollen* and a (*h*) *scarlatinal kind of rash* upon the skin, a disposition to *laugh and talk wildly*, *fanciful delusions*, a rapid flow of ideas, and difficulty in walking have been observed. There is often also a desire, without the ability, to pass water. Muscular twitchings, especially of the legs, are not unusual, and death may be brought about by *convulsions*,

A large detachment of French soldiers, halting near Dresden, ate freely of the belladonna berries. Shortly afterwards they were seized with nausea, thirst, dryness of the throat, difficult deglutition, insensibility of the eye, great dilatation of the pupil, delirium and coma.

Post-mortem Appearances.—Congestion of the cerebral vessels and lungs, dilated pupils, red patches at different parts of the alimentary canal, and a (dyed) purple hue of the gastric mucous membrane, if the berries have been eaten, are the most common appearances.

Treatment.—Stimulant emetics, castor oil, and animal charcoal are the remedies to trust to. In a certain number of cases opium has seemed to act as a physiological antidote to belladonna, but this is not to be relied upon, though it may be found useful.

ATROPIA.—Atropia by way of subcutaneous injection has often produced serious symptoms, and in one case where a young man took two grains of *atropia*, on going to bed, he was heard to snore heavily during the night, and was found dead at seven o'clock in the morning. No trace of poison was found on analysis.

Test.—There is no very certain test for *Atropia* beyond its effects on the pupils and on vision, which may be produced by the substance if recovered from the viscera.

STRAMONIUM (*Datura Stramonium, Thorn-Apple*) is indigenous in Great Britain. The fruit and seeds are the most poisonous parts of the plant. The active principle, an alkaloid, named Daturia, has properties identical with those of Atropia.

The poisonous effects of stramonium are the same as those of belladonna, and are to be relieved by similar remedies. When this drug is prescribed as a medicine, as it often is for spasm of the bronchial tubes, it should

be immediately discontinued if it produces dryness of the throat and dilatation of the pupils.

Dhatoora.—In India the seeds of the Datura alba, a plant which grows abundantly in most parts of that country, are frequently used for the purpose of hocussing travellers, in order that they may be robbed with impunity. The seeds, which closely resemble those of the capsicum, are mixed with food, and give rise to total insensibility, often with noisy delirium or delusions. Death is not infrequent after a large dose, although it would seldom seem to be administered for murderous purposes, but rather to procure the state of insensibility favourable to the committing of robbery. Its effect may be for the time being to completely alter the disposition of the individual, and to cause him to give way to all kinds of foolish notions and antics.

HENBANE (*Hyoscyamus niger*).—All parts of this plant are poisonous; but the seeds are more powerful than the root or leaves. In medicinal doses it is a feeble narcotic. It owes its powers to an alkaloid (*hyoscyamia*) which it contains, but which has seldom if ever been isolated.

In very large doses henbane produces *giddiness*, flushings, excitement, and a sense of weight in the head; the limbs tremble, and there is general loss of power; the *pupils* become *dilated*, there is *double vision*, *presbyopia*, flashing of light before the eyes, and great drowsiness, ending in *coma*. If vomiting supervene these symptoms generally pass off; otherwise we may find fierce *delirium*, loss of speech, complete loss of power over the limbs, cold sweats, and exhaustion.

In some instances, when the roots have been eaten by mistake for parsnips, the symptoms have been those of drunkenness and delirium. This error it is said was

committed one night at a monastery. The monks who partook of the roots had such hallucinations that the establishment resembled a lunatic asylum. They rang the bell for matins at midnight; and those who attended were unable to read, or they read that which was not in the book. In another case the roots were put into soup, of which nine persons partook. Although no unpleasant flavour was noticed at the time of eating, yet very shortly afterwards all complained of an acrid taste, nausea, indistinctness of vision, restlessness, delirium, and great somnolency, which continued some time. Hyoscyamus has seldom if ever proved fatal.

Treatment.—To prevent a fatal result from the use of henbane or others of this group, we must trust to the *stomach-pump, stimulant emetics*, as *sulphate of zinc*, and full doses of *castor oil*, so as to get rid of the offending substance.

Test.—The only test for hyoscyamus is the botanical characters of the plant, when taken in substance, and its power (common to all in this group) of dilating the pupil.

NIGHTSHADE.—The *Solanum dulcamara* (Bitter-sweet, or Woody Nightshade) and the *Solanum nigrum* (Garden Nightshade) contain an active principle known as Solania. The red berries of the first-named plant, and the black berries of the second, have been eaten by mistake. They give rise to thirst, headache, giddiness, dimness of vision, dilated pupils, convulsions, vomiting, and purging. They may even cause death.

CHAPTER XXIX.

CONVULSANTS.

NEUROTICS PRODUCING CONVULSIONS.

NUX VOMICA—STRYCHNIA—BRUCIA.

THE chief plants which yield the alkaloid Strychnia are the *Strychnos nux vomica*, and the *Strychnos Ignatii*. The effects of the active principles yielded by these plants are exerted chiefly upon the spinal cord. This is shown by the violent convulsions and the tetanic contractions of the muscles which they produce. They have no effect on the brain, consciousness remaining intact until death.

NUX VOMICA.—Thirty grains of the powder have proved fatal, in one somewhat doubtful case. Nux vomica is seldom if ever used nowadays as a powder, and it is not easy to say what would be the smallest fatal dose—half an ounce has destroyed life in well-recorded instances, and so have *three grains* of the *alcoholic extract*. Death may occur in from *fifteen minutes* to *twelve hours*. It is possible that nux vomica may accumulate in the system, as serious symptoms have arisen from the long-continued use of small doses. Thus a lady took nine grains of the powder daily, in divided doses, for sixteen days. As purging then set in with colic, the medicine was withdrawn. Five days after the withdrawal there was ringing in the ears, with drowsiness, impairment of speech, &c.; on the ninth day tetanic symptoms set in, with trismus; and on the twelfth day, after several tetanic convulsions, death took place from exhaustion,

BRUCIA.—Nux vomica yields both strychnia and brucia, the latter is an alkaloid which has the same properties, and causes the same symptoms as strychnia, though it is much less powerful.

STRYCHNIA.—This alkaloid may very justly be termed a deadly poison. It is the active ingredient of some preparations sold to the public for destroying vermin: "Battle's Vermin Killer" consists of flour, Prussian blue, sugar, and strychnia in the proportion of twenty-three per cent. The use of strychnia, as a poison, became notorious by the trials of Palmer and Dove.

One-sixteenth of a grain of strychnia caused the death in four hours of a child between two and three years of age. *Half a grain* of *sulphate* of *strychnia* has proved fatal, and death occurred in *twenty minutes*. But death has occurred in five minutes, and in ten. The symptoms come on almost *immediately*, but may be deferred for *three hours*, though usually all danger is over in *two hours*. A woman twenty-two years of age died in the Jersey Hospital, from the accidental administration of half a grain.

Symptoms.—The time at which the symptoms commence varies according as the strychnia has been taken in solution or in the solid form. In the former case (*a*) a very *bitter taste* is experienced during swallowing, usually followed in a few minutes by a sense of (*b*) *suffocation* and (*c*) *difficulty* of *breathing*. Soon there follow (*d*) *stiffness about the neck* and *sense of impending death*, (*e*) *twitchings of the muscles*, *jerking movements of* the *lower limbs especially*, and a *quivering of the whole frame*. (*f*) The limbs become rigid, the head is bent back, while the body is *stiffened and arched*, so that it rests on the head and heels (opisthotonos). The difficulty of breathing causes the face to

become (*g*) *dusky*, the eyeballs prominent, and the lips livid, whilst the features assume a peculiar grin (*risus sardonicus*). There is much thirst, but (*h*) *inability to drink from spasm of the jaws*; the sufferer is (*i*) *quite conscious*, is much alarmed, and is impressed with the idea that death is surely stealing upon him. As the attacks of spasms begin the patient cries out, and warns those about him of the approach of the seizure; he begs for help, and perhaps asks to be held, or rubbed, or turned over; and when the seizure passes off, at the end of forty or sixty seconds, he is exhausted, and bathed in sweat. The more he is disturbed or excited the shorter is the interval between the attacks; and though a firm grasp seems to afford relief, yet a slight touch, a gust of air, or the opening of a door, will bring on a fresh attack and increase the suffering. As death approaches the tetanic spasms rapidly succeed each other, and the patient sinks, (*α*) *suffocated* during an attack, or (*β*) *exhausted* during an interval, in about two hours from the beginning of the symptoms.

There is commonly a wide difference between tetanus arising from a wound or from disease, and that provoked by strychnia. In the former case (*a*) some exciting cause can be detected; the (*b*) symptoms come on gradually, and (*c*) only attain their full development at the end of several hours; (*d*) the rigidity of the muscles is more or less permanent, there being (*e*) no intervals of relaxation as there are in poisoning by strychnine; and (*f*) death has hardly been known to occur in less than twenty-four hours; most frequently it is deferred for two or three days.

Post-mortem Appearances.—Although the body may be relaxed at the time of death it usually quickly stiffens—frequently in the course of ten or fifteen minutes. The

rigor mortis is persistent for some time: in the case of Cook, poisoned by Palmer, the rigidity of the body and limbs was said not to have passed off after two months' interment. This is not, however, invariable, as a body may be flaccid or stiff after death from this cause as from any other. The hands are often clenched, and the soles of the feet arched and inverted. The membranes of the brain and of the upper part of the spinal cord are congested; and there is often considerable serous effusion under the spinal arachnoid. The lungs are generally loaded with dark fluid blood. The heart is usually contracted, but sometimes the right cavities are distended like the pulmonary vessels with black and liquid blood.

Treatment.—Emetics are to be given at once, and repeated until very free vomiting is induced. If the tetanic spasms have not commenced, the stomach-pump ought to be used. Chloroform is to be given to relieve spasm and pain, but the patient should be disturbed as little as possible, inasmuch as the least thing induces the tetanic attack.

There is no very suitable antidote, but tannic acid, in the form of green or black tea, oak bark, &c., might be given.

Animal charcoal and solution of iodine have also been recommended.

The patient is above all *to be kept warm and quiet.*

To separate strychnia from organic mixture the process given in the beginning of this book (p. 20) is the most useful.

Tests.—Strychnia is a white crystalline solid, very insoluble in water, soluble in alcohol or chloroform or weak acids, and having an intensely bitter taste.

1. *Pure strychnia* is *not changed in colour* when treated with *iodic acid* or with either of the *strong mineral acids;*

but as this alkaloid generally contains brucia, nitric acid reddens it.

2. Strychnia, when dissolved in *sulphuric acid*, gives rise to no change; but on adding a fragment of *bichromate of potass* to the solution a series of *blue, violet, purple, and red tints are produced.* The same result is brought about by using *ferricyanide of potassium, permanganate of potassium*, the *peroxide of lead*, the *black oxide of manganese*, and similar oxidising bodies.

3. If the skin of a *frog* be dried, and a few drops of a solution containing strychnia applied to it, *strong tetanic convulsions* will ensue, and be reproduced every time the animal is touched or irritated. According to Dr. Marshall Hall, this strychnoscopic test will detect the $\frac{1}{50000}$th of a grain, or even less. This test, under the Vivisection Act, is now unlawful without a judge's order.

4. An exceedingly useful class of tests for many poisons has been introduced by Dr. Guy; these are the *crystalline appearances* presented on subliming the substance and condensing it on a cool microscopic slide, or the crystalline forms observed as modified by various reagents. Thus the strychnine sublimate, touched with a drop of carbazotic acid, forms groups of arborescent crystals, each branch forming part of a circle.

Brucia, whilst not responding to these colour tests, is *reddened* by *nitric acid*, but it does not decompose iodic acid, and may thus be distinguished from morphia.

The *Akazga Ordeal Bean* gives rise to symptoms similar, it is said, to those of nux vomica, and its reactions resemble those of strychnia.

CHAPTER XXX.

PARALYSANTS.

NEUROTICS PRODUCING PARALYSIS OF THE MOTOR NERVES.

CURARE—CALABAR BEAN.

THOUGH paralysis of the voluntary muscles is a frequent symptom of poisoning by neurotic agents, yet there are several whose most marked effect is this muscular paralysis. The type of these poisons is *Curare*. This substance has been imported in various forms—first on arrow-points, latterly in the shape of extract. It has been largely used in physiological investigation, but no case of poisoning by its agency has occurred in man. It has little effect when swallowed, being chiefly active when introduced beneath the skin. Its effects are *complete muscular paralysis*, as far as the voluntary system of muscles is concerned, with slowing of the *heart's action* and *diminished respiration*, until gradually life becomes extinct. It is said that no affection of the sensory nerves results from its use; and it is quite certain that prolonged artificial respiration may tide an animal over its effects. Curare has been proposed as a remedy for hydrophobia, and one case is recorded where its persistent employment, and the use of artificial respiration, is said to have succeeded in saving the patient's life.

Tobacco, antimony, and other substances have been used to produce muscular relaxation before the introduction of chloroform, but none of them seem to act in exactly the same way as curare. Its use as an *anæsthetic* has been prohibited by the Vivisection Act.

In the case of such substances as chloroform, both the sensory and motor nerves are paralysed: that is to say, it

is both an anæsthetic and paralysant. But the anæsthesia comes first, and it may be used as a pure anæsthetic, without interfering with motor power.

CALABAR BEAN (*Physostigma venenosum*).—This bean, which grows on the West Coast of Africa, is on that coast used as an ordeal. According to the notions of the natives the innocent vomit and are safe, the guilty die. Its most characteristic effect is contraction of the pupil. It seems to act by paralysing the motor muscles, leaving the senses intact. There is great interference with the heart's action, it beating tumultuously, but death seems to follow paralysis of the muscles of respiration. In some cases, one fatal, occurring in Liverpool, there was much vomiting.

CONIUM (*Conium maculatum, Common or Spotted Hemlock*).—The seeds, leaves, and roots of the *Conium maculatum* are all poisonous. The effects are rather variable, sometimes consisting chiefly of delirium, stupor, coma, and convulsions; on other occasions, the action, being chiefly exerted on the spinal cord, gives rise to *gradually extending paralysis*, the lower limbs being first affected, afterwards the arms and chest, thus producing death by apnœa from *paralysis* of the *muscles of respiration*. Probably, however, could artificial respiration be kept up, the heart would continue to beat much longer.

The alkaloid of hemlock is a pale yellow, volatile, acrid, oily-looking liquid, known as *conia*. It is a potent poison, occasioning general paralysis without loss of sensibility. This alkaloid, which is found in all parts of the plant, may be readily recognised by rubbing with caustic potass. This sets free the alkaloid from its combination, and being readily volatile its mouse-like odour becomes at once apparent. Chemically it is allied to ammonia, and gives many of the reactions of that substance.

CHAPTER XXXI.

HYPOSTHENISANTS, OR SYNCOPANTS.

NEUROTICS PRODUCING DEATH BY SYNCOPE.
ACONITE—PRUSSIC ACID.

ACONITE (*Aconitum Napellus, Monkshood, Wolfsbane, Blue Rocket*), of which *aconitia* is the alkaloidal base, is probably the most deadly poison known; the fiftieth part of a grain of aconitia having nearly caused death.

The chief *symptoms* of poisoning by aconite are (*a*) *heat*, (*b*) *numbness* and *tingling* in the mouth and throat, (*c*) *giddiness*, (*d*) *abolition of muscular power*, pain in the abdomen, with vomiting and purging. Sometimes delirium and slight stupor have been noticed. The (*e*) *pupils are usually dilated*, the (*f*) *skin is cold*, the *pulse exceedingly feeble*, the breathing oppressed, and there is a dread of approaching death. The sufferer is *perfectly conscious*, though (*g*) *numb and paralysed*, till death suddenly occurs after two or three hurried gasps. Death may be due to what might almost be called *shock*, or *sudden* and *complete collapse*, or to *asphyxia* from paralysis of the respiratory muscles.

A fatal mistake has sometimes been made in eating the root of aconite for that of horseradish. The sense of tingling and numbness produced by the former is so different from the pungent taste of the latter that with due care no mistake should occur, except the plants be allowed to grow together, which should never be done.

A case occurred in Ireland where a woman poisoned one man and nearly killed another by sprinkling powdered aconite root over a dish of greens.

Of the root one dram, of the tincture one ounce, and of the alcoholic extract four grains, have caused death. Death follows a considerable dose in less than an hour, but sometimes a longer period elapses.

The Bikh, or Bish poison, formerly much used in India, and still not unfrequently employed, has as its basis the Aconitum ferox, a still more dangerous drug than our indigenous plant.

Treatment.—No time must be lost in the use of remedies. In addition to emetics, or the stomach-pump, castor oil, and animal charcoal, benefit may be derived from administering strong coffee. Brandy or ammonia should also be given, while the limbs and back are well rubbed with hot towels. Artificial respiration should not be forgotten.

There is no good test for aconitia.

HYDROCYANIC ACID (*Prussic Acid*), on account of its energetic and rapid action, is one of the most formidable poisons with which we are acquainted. In its concentrated state it is a limpid, colourless liquid possessing a somewhat acrid taste, and having an odour, when diffused through the air, resembling that of oil of bitter almonds. When diluted with water, it forms the acid kept by the druggist. The properties of this variety are similar to those of the pure form; except that, if kept in the dark, it is not so readily decomposed. It is in this condition that it is used as a poison. The diluted acid of the British Pharmacopœia contains about 2 per cent., and that known as Scheele's from 4 to 5 per cent. of the strong acid; but all vary greatly with keeping.

One of the salts of hydrocyanic acid, the CYANIDE OF POTASSIUM, claims a short notice, since it is largely employed by photographers, workers in electrotype, &c. It has often been taken as a poison. The salt is sold in the form of deliquescent white crystals, or in crystalline

masses, which are very soluble in water, and possess the odour of prussic acid. From three to five grains will destroy life almost as rapidly as prussic acid itself, and in the same manner. A dose of five grains has proved fatal.

Several vegetable substances yield prussic acid, such as the kernels of the peach, apricot, nectarine, cherry, &c., the leaves of the cherry laurel, and the pips of apples and pears. Cases of alarming illness have occurred from eating *bitter almonds* too freely; while the essential oil obtained by destilling the pulp of these almonds with water is a powerful poison. This *essence* or *oil of bitter almonds* contains about ten per cent. of anhydrous prussic acid; and it is probable that from ten to thirty drops would prove fatal to an adult. The prussic acid may, however, be separated from it, and leave the oil harmless.

A destilled water obtained from the *Leaves of the Cherry Laurel*, which was formerly employed in medicine, proved dangerous from its very variable strength; it has been used as a poison. In the well-known case of Sir Theodosius Boughton, poisoned by Captain Donellan in 1781, *laurel water* produced death within half an hour after two ounces had been swallowed.

The smallest quantity of prussic acid which has been known to destroy life is nine-tenths of a grain of the anhydrous acid, equal to *forty-five minims* of the diluted preparation of the British Pharmacopœia; and it is probable that this would, in most instances, prove fatal. In the case referred to death occurred in twenty minutes; but from a larger dose it has ensued much earlier. The period may be said to vary from two, to five, and even forty minutes. Insensibility may, however, come on in a few seconds. In the case of seven epileptics accidentally

poisoned at the Bicêtre, death occurred in the first within twenty minutes, in the last after three-quarters of an hour, though the dose of the acid was the same in each instance.

Symptoms.—These will vary with the dose and the mode of exhibition. Inhalation of the vapour of anhydrous prussic acid would immediately cause death. The vapour of the diluted acid has given rise to serious symptoms with great rapidity. Scheele is said to have been suddenly killed by respiring the vapour of the dilute acid while making his experiments.

When the diluted acid is taken in a large dose the symptoms may commence *during swallowing*, death following so quickly that scarcely any effects can be observed. The chief symptoms, perhaps, are (*a*) insensibility, (*b*) slow gasping, or convulsive respiration, (*c*) a clammy cold skin, (*d*) fixed and glistening eyes, (*e*) dilated pupils, (*f*) spasmodic closure of the jaws, (*g*) an almost imperceptible pulse, and sometimes (*h*) convulsions of the limbs and trunk. The rapidity with which consciousness may be lost is well exemplified in an instance recorded by Hufeland, where a man about to be apprehended as a thief took an ounce of the acid, staggered a few steps and fell apparently lifeless. In a few moments a single violent inspiration was made, and within five minutes of taking the poison he was dead.

Insensibility is not, however, *in all instances, immediately produced;* many an authenticated case having occurred in which the symptoms were protracted for some minutes, the individual performing several acts indicating consciousness, such as replacing the cork in the bottle, adjusting the bed-clothes, or even running some distance to summon help.

The utterance of a shriek has been said to be characteristic of poisoning by this acid; but toxicologists know that such has not been observed in the human subject, and that there is merely a gasping for breath, or perhaps a call for help.

A small dose produces faintness, insensibility, difficulty of breathing, involuntary evacuations, loss of muscular power, convulsions, and temporary paralysis. If the proper treatment be employed, recovery may often be effected.

Post-mortem Appearances.—The body is generally livid, the countenance pallid, or sometimes livid and bloated, the jaws firmly closed, and the hands clenched. There is frequently blood or froth about the mouth, and the eyes are sometimes described as prominent and glistening. There is often an odour of prussic acid about the body, which is more perceptible on opening the stomach. The venous system is usually gorged with blood; and the brain, lungs, heart, liver, spleen, and kidneys have been found congested with dark-coloured fluid blood.

Treatment.—There is no chemical antidote to this poison which can be relied upon. Chlorine, and the *mixed oxides of iron*,* have been recommended; but even if one of these agents happened to be at hand, it is doubtful if its employment could be timely enough to be advantageous. *Ammonia* is probably the best, as

* If not kept prepared, the remedy may be speedily got ready in any chemist's shop in the following way: Mix together the contents of the bottles containing tincture of the muriate of iron (the liquor ferri perchloridi does as well) and liquor ammoniæ fortior. Run the mixture through a loose filter, saving the precipitate; turn filtering paper or tow (if that has been used), and all into a vessel containing water, shake well, and use the precipitate by spoonfuls as it falls to the bottom.

being the speediest remedy. Attempts must be made to restore animation by cold affusion, stimulating frictions to the chest and abdomen, warmth to the surface, and the application of ammonia to the nostrils. *Cold affusion over the head and neck* has proved most efficacious when promptly resorted to, and repeated at short intervals so as to cause a shock. The *direct injection of liquor ammoniæ into the veins* might be tried if the means were at hand.

If recovery ensue from the immediate effects, vomiting should be produced by emetics or otherwise; after which strong coffee, with brandy, ought to be administered.

Tests.—The best are the following:—

When *hydrocyanic acid* has to be separated from organic substances, such as *the contents of the stomach*, it is usual to take advantage of its ready volatility. If the acid be not in combination it may be given off so readily as to be detected by a watch-glass moistened with nitrate of silver held over the vessel containing the acid; but in order to make sure of its presence or absence the following process should be adopted:—

1. The suspected material should be acidulated with pure sulphuric acid so as to insure the prussic acid being in a free state.

2. The substances thus acidulated are to be placed in a retort.

3. Destilled over a water-bath, and

4. The destillate collected in a cool receiver *containing some caustic potass.* About one-sixth of the fluid substance should in this way be destilled over, when

5. The liquid in the receiver may be tested by the (*a*) silver or (*b*) iron tests, or the vapour as it passes over may be tried with the (*c*) sulphur test.

The peculiar *odour* of prussic acid is well known,

and is a very delicate test, taken in conjunction with others, of its presence.

(*a.*) *The Silver Test.—Nitrate of silver* yields, with hydrocyanic acid or cyanide of potassium, a *white clotted precipitate* (cyanide of silver) (*a*) insoluble in cold but (*b*) soluble in boiling nitric acid. If this precipitate be well dried and (*c*) heated, cyanogen gas will be given off, which may be known by (*d*) its burning with a purplish flame. This test is very delicate.

(*b.*) *The Iron Test.*—Of the liquid collected in the receiver above mentioned, or of the suspected acid liquid, carefully neutralised by caustic potass, a portion is to be taken, and to this is to be added a small quantity of a solution of *sulphate of iron.* A *dirty brownish or greenish precipitate* will fall, consisting of a mixture of the oxide of iron and Prussian blue. On adding a few drops of *dilute sulphuric* or *hydrochloric acid*, and thus dissolving the oxides, the intense colour of *Prussian blue* will immediately be made clear should hydrocyanic acid be present.

(*c.*) *The Sulphur Test.*—One of the most useful tests for prussic acid, whether in the fluid or volatile state, is the so-called *sulphur* or *Liebig's test.* It is best adapted for detecting the acid in a state of vapour, and to this end, (*a*) a drop of *yellow sulphide of ammonium* in a watch-glass is held inverted over the suspected liquid, which may be warmed by the hand to facilitate the evolution of the acid. In this position the watch-glass should be allowed to remain for some little time, till it has nearly dried, after which (*b*) a drop of a neutral solution of sulphate of iron is to be added, which will give rise to a *blood-red colour* completely *discharged* by *corrosive* sublimate. The colour produced by the persalts of iron

with *meconic acid*, is *not* so *discharged* by *corrosive sublimate*, or chloride of gold.

If the acid is in the liquid form a drop of the prussic acid and one of the yellow sulphide of ammonium may be mixed and heated until they thoroughly combine to form sulphocyanide of ammonium. A drop of sulphate of iron is then added as before, but all the sulphide must have been previously decomposed by heat, otherwise a black sulphide of iron will be produced, (even though prussic acid be present), instead of the ordinary blood-red colour.

(*d.*) *The Copper Test.—Sulphate of copper* added to prussic acid rendered slightly alkaline by potass, gives a *greenish-white precipitate*, which becomes *white* by the addition of a few drops of *hydrochloric acid* to dissolve the blue precipitated oxide of copper.

CHAPTER XXXII.

DEPRESSANTS.

NEUROTICS PRODUCING MARKED DEPRESSION OF THE HEART'S ACTION.

DIGITALIS—TOBACCO—LOBELIA—COLCHICUM—VERATRIA.

DIGITALIS PURPUREA (*Purple Foxglove*).—The seeds, leaves, and root of this indigenous hedge-plant are poisonous. *Digitalin* is the principle which these parts contain.

Digitalis is very uncertain in its action. When given medicinally its effects should be watched, as in some cases it is said to accumulate in the system, but in others, especially in heart disease, it may be given for months or years without hurt, and even with advantage. A poisonous dose seems to produce vomiting, purging, colic, headache, great *slowness and extreme irregularity of pulse*, dimness of vision, dilated pupils, lethargy, prostration, convulsions, and coma. In two instances death occurred within twenty-two hours. The appearances found afterwards have been chiefly congestion of the cerebral vessels and slight inflammation of the stomach.

Digitalin has acquired a certain importance from the trial and execution of De La Pommerais for poisoning the widow Pauw by its means. The facts were altogether inconsistent with his innocence, and though digitalin was not separated from the woman's body, yet extracts of the

vomited matters killed dogs with the symptoms of poisoning by digitalis. The extracts obtained from the stomach and bowels did not prove fatal to these animals. Tardieu and Roussin, who were engaged on the case, came to the conclusion that the woman had been poisoned by some vegetable poison, probably digitalin. The woman's symptoms, which were not, however, carefully noted, were violent vomiting and extreme depression.

Treatment.—In addition to the administration of emetics and castor oil, some infusion containing tannin, as strong tea, &c., should be given as an antidote in poisoning by digitalis. Substances containing tannin render the digitalin inert. Strong tea or coffee, with brandy, will likewise be needed, to lessen the depression and exhaustion.

Tobacco (*Nicotiana tabacum*).—All parts of this plant are very poisonous. An infusion of the leaves, exhibited as an enema, has, on several occasions, speedily proved fatal. Persons in attempting to acquire the habit of smoking often suffer from severe nausea, vomiting, great prostration, and insensibility; while in some instances more severe effects have ensued. Symptoms very much resembling those of apoplexy have also been produced by the excessive use of snuff. A celebrated French poet died in fourteen hours from swallowing the contents of his snuff-box, which had been mixed with his wine as a joke. Snuff or tobacco is also sometimes used for drugging persons with a view to nefarious purposes, as robbery and such-like.

Nicotia, or *Nicotina*, the alkaloid of tobacco, is as deadly a poison as prussic acid. It is an acrid, volatile, oily liquid, of a pale amber colour, smelling strongly of tobacco. A chemist was seen by one of the attendants at the Museum in Jermyn Street in the act of falling forwards out of a water-closet in which he had concealed himself.

The attendant raised him up, and with the aid of another man endeavoured to carry him to a table, but he heaved a deep sigh and died in their arms. The appearances afterwards found were great congestion of the membranes of the brain and a dark fluid state of the blood.

The only other important case of poisoning on record with this drug was the occasion of the *cause célèbre* Bocarmé. This man, a Belgian count, studied chemistry, apparently with a view to the preparation of this substance, made it in quantity, and, with the help of his wife, poisoned her brother. The count was condemned and executed. M. Stas was engaged to search for the poison, and thus was introduced his process, so often referred to.

Lobelia Inflata (*Indian Tobacco*).—This plant is a native of North America; and its powdered leaves and seeds have been much used as a remedy for asthma. In one instance, in which a quack prescribed a dram of the leaves, pain, vomiting, unconsciousness, feebleness of pulse, and contraction of the pupils supervened, and death occurred in thirty-six hours. Ignorant impostors, calling themselves "medical botanists" (more appropriately known as "Coffinites"), have poisoned several simple individuals, both in England and America, by physicking them with this mischievous and powerful drug.

Colchicum (*Colchicum autumnale, Meadow Saffron*).—This plant grows in most damp meadows. Its noxious properties are due to the active principle *Colchicia*, which in its effects is allied to that contained in white hellebore, *Veratria*. In two instances less than half a grain of colchicia proved fatal to adults.

White Hellebore (*Veratrum album*) is a poisonous plant which, when taken internally, has caused violent sick-

ness, purging, dilatation of the pupils, great prostration, and lowering of the heart's action, cold sweats, convulsions, and death. At the same time it is powerful in relieving pain. Its properties are due to *veratria*, an alkaloid, which may also be prepared from the seeds of the Asagræa officinalis, or Cevadilla seeds. Veratrum viride acts in a similar manner.

Emetics, purgatives, and stimulants are the means to be employed to prevent death in poisoning by any of these vegetable substances. They all produce extreme depression, hence stimulants must be freely used.

CHAPTER XXXIII.

ASPHYXIANTS.

NOXIOUS GASES, PRODUCING NEUROTIC SYMPTOMS BY MEANS OF BLOOD POISONING.

THE most important of these asphyxiant noxious gases are carbonic oxide, carbonic acid, sulphuretted hydrogen, and carburetted hydrogen.

CARBONIC OXIDE is a much more dangerous poison than is carbonic acid, but poisoning with it in a pure state is rare. It constitutes an ingredient in most vapours produced by burning coke or carbon, especially if the combustion is imperfect, as in poisoning by the vapour of burning charcoal. It forms with the colouring matter of the blood a remarkably stable compound of a light-red colour; in point of fact it is the impossibility of exchanging carbonic oxide for oxygen in the lungs which causes death. After death the blood is bright-red in hue, and gives a peculiar spectroscopic mark.

CARBONIC ACID GAS.—This heavy inodorous gas is the cause of numerous accidents, owing to the variety of sources from which it is produced. It is formed from burning fuel, from the calcination of limestone or chalk, and it is a product of respiration. It is diffused through wells, coal-mines, and caverns. During fermentation it is largely given off, and accumulates in beer vats. The vapour of charcoal partly owes its poisonous properties to carbonic acid gas, as does that arising from lime, and brick-kilns.

In this country suicides rarely resort to the vapour of charcoal to accomplish their ends: in France they very frequently do so.

Symptoms.—In its pure state this gas causes immediate death by asphyxia. When sufficiently diluted to be inspired it acts by absorption or arrest of diffusion, giving rise to giddiness, headache, vomiting, a tendency to sleep, and loss of muscular power. The heat of the body is gradually lost, and the limbs are usually flexible. The countenance gets livid, the respiration becomes stertorous, and complete insensibility ensues; while the heart's action, which was at first rapid, soon ceases.

Post-mortem Appearances.—The body is generally swollen and livid, especially about the face. The countenance is not always bloated, sometimes being calm and pale. The limbs are often rigid. The right cavities of the heart, the lungs, and large veins, are found gorged with venous blood; while the brain and its membranes are usually very vascular, and occasionally there is serous effusion.

Treatment.—Prompt removal to the pure air, cold affusion, and stimulating applications to the chest and extremities, are the best means for resuscitation. If the countenance is bloated, venesection may be performed. Artificial respiration, galvanism, and the inhalation of oxygen gas have been found useful.

Sulphuretted Hydrogen.—This gas is a very active poison, but from its offensive odour (resembling that of rotten eggs) it is not so liable to be accidentally inhaled as is carbonic acid. It is usually met with combined with other gases, resulting from the putrefaction of animal matter. When breathed in a diluted state, it speedily produces insensibility and death. Workmen

long engaged in drains and sewers, or in any atmosphere contaminated with sulphuretted hydrogen gas, suffer from giddiness, nausea, and weakness.

In acute cases there will be little hope of recovery, unless the individual can be quickly removed into the open air, and stimulants, &c., applied. Chlorine gas, well diluted with common air, might be employed, as it breaks up the gas.

Carburetted Hydrogen (*Coal Gas*).—The symptoms produced by this gas, when mixed with air and inhaled, re those of asphyxia. If the person breathing it should be roused before a fatal quantity has been inhaled, the chief effects will be intense headache, laboured and oppressed respiration, quickened action of the heart, sickness, and great loss of power.

In 1841 a whole family in Strasburg was poisoned by being in an atmosphere contaminated with coal gas, for forty hours. Of the six members, four were found dead, while the father died in twenty-four hours; but the mother recovered. The gas escaped from a pipe which passed under the cellar of the house where this family resided; so that it probably poisoned the air gradually, and gave rise to no suffering to warn the unfortunates.

CHAPTER XXXIV.

ABORTIVES.

SUBSTANCES PRODUCING ABORTION.

This group, though far from a natural one, is nevertheless convenient. It comprehends a great variety of substances, first among which comes

Ergot of Rye (*Spurred Rye, Secale cornutum*).—The grain of wheat, barley, oats, and rye is apt to be attacked by a parasitic fungus which imparts to it specific properties. This substance has the power of inducing contraction of unstriped muscular fibre, especially in the smaller arteries and uterus. Ergotised grain, in full doses, gives rise to lassitude, headache, nausea, and diarrhœa. From small quantities, frequently repeated, gangrene of the extremities has resulted. The peculiar influence of ergot on the muscular coat of the uterus renders this agent a valuable medicine when we wish to induce powerful contractions, but in the hands of the ill-intentioned it is frequently used to procure abortion; but its action in this way is far from certain, and at all times dangerous.

Savin and its Oil are irritant poisons, only indirectly affecting the uterus; nevertheless, they not unfrequently are used to induce miscarriage.

Oil of Tansy has also been employed in America as an abortive agent, and in three instances, at least, has caused death.

The Yew (*Taxus baccata*), which has acquired in cer-

tain districts a reputation as an abortive, acts as do some others, by producing irritation of the bowels, and so communicating a kind of stimulus to the uterus. The leaves and berries of the yew have both proved fatal, commonly with irritant symptoms; but those of coma have also been observed.

In America extract of Cotton-wood has a reputation as an abortive.

APPENDIX.

I. Bites of Venomous Reptiles.

Accidents from serpents' bites rarely happen in this country, but are of frequent occurrence in India (where thousands of lives are annually lost by them), Australia, and America.

On the morning of the 20th October, 1852, one of the keepers at the Zoological Gardens in the Regent's Park was wounded by a cobra, which he had removed from its cage and was playing with. For twenty minutes after the animal bit him at the root of the nose no peculiar symptoms were manifested, and the part was merely bathed with water. Forty minutes afterwards the man was admitted into University College Hospital, his face then being livid, respiration impeded, and the power of locomotion imperfect. He pointed to his throat as the seat of pain, but could not speak, and was unable to swallow. Artificial respiration was employed for fifty minutes, and subsequently galvanism; but stupor rapidly succeeded to faintness, and the patient died comatose fifty-five minutes after admission. The chief appearances found on dissection were an unnatural fluidity and blackness of the blood, with great congestion of the lungs and spleen.

The only poisonous reptile indigenous to this country is the *common viper* or *adder*. It is found on the heaths

and in the dry woods of all parts of England, Scotland, and Wales, and is much feared on account of its venom. Very few cases are known in which the bite of this animal has proved fatal. In May, 1862, a little boy, at Burgess Hill, near Brighton, clambered up a bank, to examine a bird's nest. Groping with his hand among the moss, he felt, as he thought, a sharp prick from a thorn. It turned out to be a bite from an adder. As the real cause of the wound was not suspected, the swelling of the hand and arm was not properly attended to until too late, and the poor child died on the second day.

The poison apparatus of the viper consists of a gland placed by the side of the head, a duct, and a fang or pointed curved tooth, moulded in the form of a tube on either side. On being bitten, the person has pain in the wounded part, which quickly becomes severe and extends up the adjoining tissues. The limb swells greatly, becomes red and livid; while faintness soon sets in, and the pulse gets rapid and small. Bilious vomitings, dyspnœa, profuse cold sweats, jaundice, delirium, and convulsions, have also been noticed. In a few days the symptoms usually amend; but in weak sickly individuals gangrene of the limb may follow, or death may occur in the course of two or three days.

The *treatment* of the bites of venomous reptiles must be local and constitutional. Immediately the wound is inflicted it should be sucked freely and perseveringly. If the patient is too faint to do this for himself, a bystander may fearlessly help him; for it is well known that, provided there is no crack about the lips or tongue, these poisons may be even swallowed with impunity. At the same time a ligature is to be placed around the limb, above the wound; or if this be impossible, from its situation, the textures around are to be

compressed. Then, the bitten part may be excised; or it may be destroyed by the actual cautery, nitric acid, the strong liquor ammoniæ, or nitrate of silver.

Professor Halford, of the University of Melbourne, in a paper published at the commencement of 1869, recommended the injection of liquor ammoniæ into the veins for snake-bite. Of twenty cases of snake-bite treated in this manner, by different practitioners, recovery occurred in seventeen. The snakes were all venomous, and included the tiger-snake, the brown and black snake of Australia, &c. These, according to Professor Halford, are as deadly as the cobra and rattle-snake; but experience does not bear this out. The plan of proceeding is to expose the vein, and then to pierce its coats with the sharp point of a hypodermic syringe containing the officinal liquor ammoniæ—sp. gr. 0·959. At least thirty minims are to be employed; the dose being repeated as the power of the preceding injection is expended. Sir Joseph Fayrer, however, has found the proceeding a failure in India. This gentleman is of opinion that the activity of the poison in some Indian snakes is so great that it is impossible to counteract it by any method.

The constitutional remedies are derived chiefly from the class of diffusible stimulants. No agent is more generally recommended than ammonia; and therefore the officinal compound tincture of ammonia (formerly known as eau-de-luce) should be given in half-dram doses, well dilated; or the aromatic spirits of ammonia may be administered in the proportion of two drams to an ounce and a half of water. Supposing that no ammonia is at hand, brandy or whisky will prove an efficient substitute. Transfusion of blood has been likewise recommended.

II. Bites of Rabid Animals.—Many instances of death from the bites of mad dogs have recently been recorded, and accordingly it may not be amiss to say a few words here as to the mode of dealing with such and such-like wounds. This is briefly as follows:—The tissues round the seat of injury are to be compressed by a ligature or otherwise, to prevent absorption. Then the wounded part is to be excised as soon as possible; taking care to remove every portion touched by the animal's teeth, and to obtain a clean raw surface. The wound should then be thoroughly washed by a stream of water, long poured over it, and lunar caustic afterwards applied. Mr. Youatt preferred the nitrate of silver, freely used, to every other caustic; and he also recommended that after its application the wound should be quickly healed, though many authorities advise that it be kept open by irritating ointments. Some prefer strong nitric acid applied directly to the wound. Carbolic acid, in strong solution, might be similarly applied, but does not admit of such ready neutralisation as a strong mineral acid. As these operations are very painful, there is no objection to the patient being placed under the influence of chloroform. He should afterwards be assured that everything has been done to prevent any subsequent mischief; and to give him greater confidence, and to banish all fear from his mind, it may be as well to administer ammonia and bark for some days after the accident.

III. Stings of Bees, etc.—The effect of the stings of bees is usually slight, and the pain quickly passes off. In some few instances, however, there have resulted swelling and erysipelas, or suppuration, or gangrene, or even death.

The stings of wasps, hornets, and still more of scorpions, are more serious.

Again, serious results may be brought about by the swelling consequent on such stings, and the bites of ants and other insects in situations where swelling is dangerous. Thus, a youth, sixteen years of age, was drinking from a bottle, when a wasp, which he had not seen, got into his throat and wounded him. He died suffocated by the swelling.

For these stings and bites ammonia is the best remedy, but soap or any alkaline substance will often give relief. Sometimes, when the bees have extracted their honey from poisonous plants, injurious results have followed its use.

The following table from Dr. Garrod's "Materia Medica" shows the proportions in which some of the more important drugs of the "Pharmacopœia" are contained in the Officinal Preparations.

ANTIMONY.

(Tartar Emetic.)

$\frac{1}{4}$ gr. of tartarated antimony is contained in 1 fl. drm. of vinum antimoniale.

1 gr. of tartarated antimony is contained in 5 gr. of unguentum antimonii tartarati.

(Oxide of Antimony.)

1 gr. of oxide of antimony is contained in 3 gr. of pulvis antimonialis.

ARSENIC.

(Arsenious Acid, White Arsenic.)

$\frac{1}{24}$ gr. of arsenious acid is contained in 5 min. of liquor arsenicalis.

$\frac{1}{24}$ gr. of arsenious acid is contained in 5 min. of liquor arsenici hydrochloricus.

(Arseniate of Soda.)

$\frac{1}{24}$ gr. of arseniate of soda (dried) is contained in 5 min. of liquor sodæ arseniatis.

MERCURY.

(Metallic.)

1 gr. of mercury is contained in 3 gr. of hydrargyrum cum cretâ.

1 gr. of mercury is contained in 3 gr. of pilula hydrargyri.

1 gr. of mercury is contained in 2 gr. of unguentum hydrargyri.

(HYDRARGYRI PERCHLORIDUM.)

$\frac{1}{16}$ gr. of perchloride of mercury is contained in 1 fl. drm. of liquor hydrargyri perchloridi.

(HYDRARGYRI SUBCHLORIDUM, or CALOMEL.)

1 gr. of subchloride of mercury (calomel) is contained in 5 gr. of pilula hydrargyri subchloridi composita.

1 gr. of subchloride of mercury (calomel) is contained in about 6½ gr. of unguentum hydrargyri subchloridi.

ACONITE.

1 gr. of dried aconite root is contained in about 9 min. of tinctura aconiti.

ACONITIA.

8 gr. of aconitia are contained in 1 oz. of unguentum aconitiæ.

ATROPIA.

1 gr. of atropia is contained in 2 fl. drm. of liquor atropiæ.

1 gr. of sulphate of atropia in 2 fl. drm. of liquor atropiæ sulphatis.

8 gr. of atropia are contained in 1 oz. of unguentum atropiæ.

BELLADONNA.

1 gr. of dried belladonna is contained in about 22 min. of tinctura belladonnæ.

Each fluid part of linimentum belladonnæ contains the active portion of a solid part of the dried root.

CANNABIS INDICA.

1 gr. of alcoholic extract of Indian hemp is contained in about 22 min. of tinctura cannabis Indicæ.

CANTHARIDES.

1 gr. of cantharides is contained in about 88 min. of tinctura cantharidis.

COLCHICUM.

1 gr. of dried corm of colchicum is contained in about 5½ min. of vinum colchici.

1 gr. of colchicum seeds is contained in about 9 min. of tinctura colchici.

DIGITALIS.

1 gr. of dried leaves of digitalis is contained in about 9 min. of tinctura digitalis.

HEMLOCK.

1 gr. of hemlock fruit is contained in about 9 min. of tinctura conii.

IPECACUANHA.

1 gr. of ipecacuanha root is contained in about 22 min. of vinum ipecacuanhæ.

1 gr. of ipecacuanha root is contained in *twelve* morphia and ipecacuanha lozenges.

1 gr. of ipecacuanha root is contained in 4 ipecacuanha lozenges.

NUX VOMICA

1 gr. of nux vomica seed is contained in about 11 min. of tinctura nucis vomicæ.

(STRYCHNIA.)

1 gr. of strychnia is contained in 2 fl. drm. of liquor strychniæ.

OPIUM.

(ACETATE OF MORPHIA.)

¼ gr. of acetate of morphia is contained in 30 min. of liquor morphiæ acetatis.

(HYDROCHLORATE OF MORPHIA.)

¼ gr. of hydrochlorate of morphia is contained in 30 min. of liquor morphiæ hydrochloratis.

¼ gr. of hydrochlorate of morphia is contained in *nine* morphia lozenges.

⅛ gr. of hydrochlorate of morphia is contained in *nine* morphia and ipecacuanha lozenges.

½ gr. of hydrochlorate of morphia is contained in *each* morphia suppository.

(OPIUM DRIED SUFFICIENTLY TO BE POWDERED.)

1 gr. of opium is contained in 14½ min. of tinctura opii.

1 gr. of opium is contained in 14½ min. of vinum opii.

1 gr. of opium is contained in ½ fl. oz. of tinctura camphoræ composita.

1 gr. of opium is contained in 96 min. of tinctura opii ammoniata.

1 gr. of opium is contained in 1 fl. oz. of enema opii.

1 gr. of opium is contained in 5 gr. of pilula saponis composita.

1 gr. of opium is contained in 8 gr. of pilula plumbi cum opio.

1 gr. of opium is contained in 10 gr. of pulvis ipecacuanhæ compositus.

1 gr. of opium is contained in 20 gr. of pulvis kino compositus.

1 gr. of opium is contained in 40 gr. of pulvis cretæ aromaticus cum opio.

1 gr. of opium is contained in 10 gr. of pulvis opii compositus.

1 gr. of opium is contained in about 13½ gr. of unguentum gallæ cum opio.

1 gr. of opium is contained in *ten* opium lozenges.

1 gr. of opium equals about ½ gr. of extractum opii.

1 gr. of extract of opium is contained in 22 min. of extractum opii liquidum.

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