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VETERINARY MEDICINES

THEIR ACTIONS AND USES

BY

FINLAY DUN

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EDINBURGH VETERINARY COLLEGE, AND
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PREFACE TO THE EIGHTH EDITION.

THE First Edition of *Veterinary Medicines* was published in 1854, while I was Lecturer on *Materia Medica* and *Dietetics* at the Edinburgh Veterinary College. The work continues a text-book at the British Veterinary Colleges, is used by Veterinarians and Agriculturists, and meets with increasing demand in the United States of America and in the Colonies.

The Seventh Edition, published in 1889, has for some time been out of print. The increased bulk of the present volume results from the introduction of the recently discovered antiseptics and antipyretics of the benzol series, and other new remedies; from details of various British and foreign experiments made with alkaloids and other medicines; and from fuller and more systematic treatment of the actions of various important drugs.

As in previous editions, the general actions and uses of *Veterinary Medicines*, and the more important principles and practice of *Pharmacy*, are dealt with in the Introduction. This preliminary section has been arranged on the plan adopted by Dr Lauder Brunton in his admirable work on *Pharmacology, Therapeutics, and Materia Medica*. The several drugs, discussed in alphabetical order according to their English names, occupy the bulk of the volume. Under each individual medicine the space allotted to preparation and properties has been curtailed, while careful revision has been made of the matter relating to the actions on the several domesticated animals, the curative uses, doses, and medicinal forms.

The Index of Diseases and Remedies, which in former editions was little more than a list of drugs usually prescribed in different disorders, has been considerably enlarged, and an endeavour has been made to indicate the nature of each disease, the conditions which dictate the use of particular remedies, and the manner in which they relieve or cure.

In preparing the present edition the following works have been consulted:—Dr Lauder Brunton's *Pharmacology, Therapeutics, and Materia Medica*; the late Professor Robertson's *Equine Medicine*; Professor Williams' volumes on the *Principles and Practice of Veterinary Medicine and Surgery*; and the *Journal of Comparative Pathology and Therapeutics*. Hertwig's *Praktische Arzneimittellehre für Thierärzte*, and Moiroud's *Traité Élémentaire de Matière Médicale et de Pharmacologie Vétérinaire*—for many years the standard works on Veterinary Pharmacology in Germany and France respectively—have contributed matter to former editions. Further valuable information has been derived from the *Lehrbuch der Arzneimittellehre für Thierärzte, von Dr Eugen Fröhner, Professor an der K. Thierärztlichen Hochschule zu Berlin* (1890); *Traité Thérapeutique et de Matière Médicale Vétérinaire, par M. Kaufmann, Professeur de Physiologie et de Thérapeutique à l'Ecole Vétérinaire d'Alfort* (1892); *Précis de Thérapeutique de Matière Médicale et de Pharmacie Vétérinaires, par Paul Cagny, Président de la Société Centrale de Médecine Vétérinaire* (1892); as well as from *Pathologie et Thérapeutique Spéciales des Animaux Domestiques, par MM. Dr Friedberger de Munich et Dr Fröhner de Berlin, traduit de l'allemand par MM. P. J. Cadiot et J. N. Ries* (1891).

FINLAY DUN.

GORGIE HOUSE, EDINBURGH,
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VETERINARY MEDICINES:

THEIR ACTIONS AND USES.

INTRODUCTION.

VETERINARY MATERIA MEDICA, in the extended sense of the term, treats of every agent, material or immaterial, which is used for the cure of disease or injury, or for the preservation of health, among the domesticated animals. The full consideration of so large and diversified a subject would, however, fill several volumes, and the present work is restricted to the description of medicines or drugs, their natural history characters, their pharmaceutical preparations, and their actions and uses among the domesticated animals.

Medicines or drugs, although derived from the mineral, vegetable, and animal kingdoms, possess many actions in common, and are prepared for use by similar chemical and pharmaceutical processes. Some general observations will, therefore, advantageously occupy two preliminary sections, the first devoted to Pharmacology—which treats of the actions of medicines—and to Therapeutics, or their uses in disease; and the second to Pharmacy, which deals with the preparation and dispensing of medicines. The description of the medicines themselves occupies the body of the volume.

SECTION I.

THE ACTIONS AND USES OF MEDICINES.

THE diseases and injuries of the domesticated animals half a century ago were not always treated scientifically and successfully. The laws of health, the causes and nature of disease, and the uses of medicines were imperfectly known. Treatment was apt to be "rough and ready," violent reducing remedies were frequently and injudiciously used. The beneficent curative effects of fresh air, diet, suitable surroundings, and good nursing were not fully realised. The general and medical management of animals have, however, alike improved. The treatment of disease has become more exact and simple, and more in accord with biological laws. It utilises such hygienic conditions as pure air and diet; it affords free scope for the natural tendency which most diseases exhibit to run a favourable course. Preventive treatment, moreover, receives attention alike from stockowners and practitioners. Disease, accordingly, is not only less prevalent, but it is also less serious, and the attacks are generally of shorter duration. Systematic hygienic measures in some countries have stamped out such diseases as glanders and farcy, specific ophthalmia, and canker in the feet of horses; while colic and inflammation of the bowels are not nearly so prevalent as they were thirty years ago. Plague, contagious pleuro-pneumonia, and anthrax in cattle are more effectually held in check; while in this country rabies in dogs can certainly be exterminated.

This higher standard of health amongst the domestic animals, and the more successful treatment of disease, have resulted in great part from the increasing knowledge of the actions of remedial agents, obtained mainly by **systematic experiments and observations** on the lower animals, as also on man himself. Numerous illustrations might be adduced of the practical benefits of such investigations. Magendie's experiments with the Java upas antiar and nux vomica demonstrated that these strychnine-containing plants violently stimulate the spinal cord, producing tetanic convulsions. In virtue of this stimulation of the cord

and its reflex functions, carefully regulated doses have been utilised for restoring disturbed co-ordination of the gastro-intestinal functions, and for relieving some forms of paralysis. Experiments on animals have demonstrated the action of digitalis as a cardiac stimulant, and hence have led to its use in strengthening and steadying the weak and over-taxed heart. Experiments with ergot of rye, and its active constituent ergotine, proving their power of contracting arterioles and capillaries, have suggested their employment for the arrest of hæmorrhage from internal organs. Belladonna, and its active principle atropine, diminish sensibility of the ends of the vagi and sensory nerves, and hence results their value in quieting cardiac irritability, diminishing excessive bronchial secretion, and relieving certain forms of pain. When the precise action of medicines is once recognised, their practical use is obviously rendered safer and more effective.

The study of bacteriology within a few years has done much to prevent disease both in men and animals, and is destined to do a great deal more. A number of diseases classified as zymotic, and comprising anthrax, glanders, tuberculosis, strangles, tetanus, with typhoid, eruptive, and malarial fevers, have recently been shown to depend upon the introduction into the body of microbes or micro-organisms belonging to the lower class of vegetable fungi, which in susceptible subjects rapidly multiply and produce chemical alkaloidal poisons and deadly albumoses. Pasteur, Koch, and others have investigated the life-history of many of these disease-producing microbes, the pathogenic conditions to which they give rise, and the methods by which their invasion may be averted or treated. But the disease-producing agent and its antidote are nearly co-related. The microbes, when cultivated artificially, when exposed to chemicals or heat, or repeatedly passed by inoculation through the bodies of certain animals, become weakened and lose their lethal properties. This attenuated virus or vaccin, when repeatedly injected, confers on the vaccinated animals more or less perfect immunity against poisonous doses of the unmitigated virus when this latter is subsequently introduced, whether accidentally or by experimental inoculation. In districts of France, Switzerland, and Austria, where anthrax abounds,

cattle and sheep for seven years have been vaccinated with attenuated anthrax virus, the percentage of accidents is said to be trifling, and the mortality amongst the vaccinated subjects is stated to be less than one-tenth of that amongst the unvaccinated stock herding with them. Sterilised cultivation of hog cholera virus is used in America as a protective against this disease. Immunity from fowl cholera and from some forms of septicæmia have been similarly secured. Pasteur, by repeated injection of attenuated rabies vaccin, has rendered dogs and other animals insusceptible to the action of lethal doses of rabies virus. Nay, more, dogs as well as men bitten by rabid animals, if promptly and repeatedly vaccinated, in the large proportion of cases are not attacked by rabies. Pigeons inoculated with small doses of snake poison for periods of three months withstand seven times the ordinary fatal dose of snake poison. Dr Willems, Mr Richard Rutherford, Edinburgh, and other veterinarians have inoculated cows with pleuro-pneumonia virus, have produced characteristic local and general phenomena, and have found that most animals thus operated on are insusceptible to subsequent inoculation, and do not take the disease when placed with animals suffering from it.

The manner in which these vaccins effect their protective powers has been variously explained; but the most satisfactory view is that propounded by Dr Sims Woodhead, who believes that small repeated doses of the cultivated organism or its products modify the functions of the cells on which they specially act, and thus confer upon them a tolerance against deadly doses of the same or allied poisons (*Bacteria and their Products*, by G. Sims Woodhead, M.D.) These bacteriological researches promise greatly to further the preventive, as well as the curative, treatment of many diseases. They indicate the means by which pathogenic organisms may be destroyed or robbed of their virulence. They give promise of the discovery of cultivated vaccins or appropriate drugs, which shall safely antagonise the virus of the great majority of those diseases depending on bacteria, or shall acclimatise the tissues, and enable them to withstand or destroy the destructive effects of the micro-organisms and the poisons they engender.

Further advances are destined to be made in the treat-

ment of other classes of disease. Drugs may be found which shall exert more definite effects on special structures and functions. The precise functions of the several nerve-centres in the brain, spinal cord, and elsewhere are becoming better understood, the manner in which they are acted upon by medicines is being carefully studied, and such investigations will certainly contribute to the more effectual treatment of disease. Drugs may be discovered which have power to increase, control, or diminish the formation of the ferments which preside over nutrition, and which become sources of disorder when in undue or inadequate amount, or of faulty quality. Antiseptics may be selected and prescribed in medical cases which shall partake of the certainty which they now exhibit when used in surgical cases.

CLASSIFICATIONS OF MEDICINES.

Medicines are drawn from the three great natural kingdoms, and are characterised by various physical, chemical, and botanical properties; but these properties do not afford sufficiently accurate or definite indications of their action on living bodies, and hence are not of much value for the practical classifications of medicines.

The **atomic weights of inorganic elements** have been used as a basis for classifying them and their compounds. The soluble salts of the heavy metals are generally active poisons, but classifications based on atomic weight are of little or no value in determining on what organs or in what way inorganic elements and their compounds act as medicines. Neither similar chemical composition, nor similar chemical reactions, necessarily confer similar physiological actions. Substances which crystallise in the same form have, however, similar actions, and on this isomorphous basis the elements have been divided into nine groups, in each of which it is noted that the intensity of the action increases with the atomic weight (Dr Lauder Brunton). The same base, united with different acids, produces salts which exhibit very different actions, as illustrated in the several compounds of sodium and potassium. Equally diverse physiological effects are produced by com-

pounds resulting from conjoining the same acid with different bases. Such irritant corrosive substances as caustic soda and sulphuric acid, entering into chemical combination, produce a neutral, comparatively mild saline. Organic, like inorganic, bases are notably modified by the acid radicles with which they unite. Thus, amyl-hydride is an anæsthetic; when oxygen is introduced, as in amyl-alcohol, or amyl-acetate, spasm is added to the anæsthesia; amyl-iodide notably increases secretion, while amyl-nitrite lessens arterial pressure. It is hence evident that the action of a compound medicine cannot be inferred from a knowledge of the action of the substances that combine to form it. On the contrary, a compound substance exerts special actions of its own, these depending on the proportion of its components, and upon its own physical qualities.

Very important investigations in recent years have been made by Professors Crum-Brown, Fraser, and Schroff, in artificially **modifying** the **chemical constitution**, and thus changing the **physiological actions** of drugs. Thus, when strychnine, brucine, and thebaine, which act upon the spinal cord as powerful convulsants, have a molecule of methyl added, they act upon the ends of motor nerves, and instead of convulsants become paralyzers. Indeed, methyl, when combined with other alkaloids, as quinine, morphine, and codeine, renders these also powerful paralyzers of motor nerves.

The study of the **natural orders of plants** affords some general information as to their physiological actions. Thus, the Ranunculaceæ furnish many acrid irritants, such as aconite, podophyllin, and stavesacre. The Solanaceæ yield narcotics, such as tobacco and dulcamara; while the sub-order, Atropaceæ, are paralyzers of involuntary muscles. The seeds of many Umbellifereæ yield carminative volatile oils. These general botanical characters do not, however, afford sufficient data for the accurate classification of drugs. Edible as well as poisonous plants occur in many natural orders. Plants of different orders and genera sometimes closely resemble each other, while plants of the same species may have very different properties. Thus, one species of *Strychnos* yields strychnine, which stimulates the motor centres of the spinal cord, inducing tetanic convul-

sions, while another yields curare, which paralyses the peripheral endings of motor nerves. But even the same drug sometimes yields antagonistic active principles. Opium yields the soothing anodyne morphine, the convulsant thebaine, and the emetic apomorphine. Calabar bean yields physostygmine, which paralyses the spinal cord, and calabarine, which stimulates it to convulsion. Jaborandi yields pilocarpine, which stimulates the ends of the secreting nerves, and jaborine, which paralyses them.

The **grouping of medicines** according to their **actions** has not hitherto been of much more practical value than their chemical or botanical classifications. The precise actions of many medicines are only now becoming definitely known. Many, moreover, have a variety of actions, and hence have to be included in several groups. Alcohol, for example, is stimulant, irritant, narcotic, and sedative, as well as tonic, antiseptic, and antipyretic. Opium is narcotic, anodyne, and soporific; but it also stimulates certain patients, and tetanises others.

Disregarding the classifications hitherto adopted, students and practitioners will find it advantageous to study the actions of medicines upon the chief organs and functions of the body. Adopting this method, Dr Lauder Brunton devotes a large section of his admirable work on Pharmacology, Therapeutics, and *Materia Medica* to an explanation of the actions of medicines on protoplasm, muscle, the nervous system, respiration, circulation, digestion, &c.; and following the same plan this introductory section will be subdivided as follows:—

Actions of Medicinal Agents.

Local and general actions :

Elective affinity between drugs and particular tissues or cells :

Effects on different classes of patients :

Modifying influences of Climate and Temperature, Habit, Idiosyncrasy, Disease, and Surroundings.

Curative Systems : Allopathy, Homœopathy.

On Protoplasm, Blood, and Low Organisms.

Antiseptics : Disinfectants : Deodorisers : Parasiticides :
Antiperiodics.

On the Surface of the Body.

Rubefacients : Vesicants : Pustulants : Caustics :
 Setons : The Actual Cautery :
 Astringents : Styptics :
 Demulcents : Emollients : Diluents.

On Muscles.

Muscular Poisons : Muscular Stimulants.

On the Nervous System.

The Brain. Cerebral Stimulants : Exhilerants.

Cerebral Depressants : Soporifics : Narcotics : Anodynes :
 Antispasmodics : Anæsthetics.

The Spinal Cord. Spinal Stimulants and Depressants.

Motor Nerves. Stimulants : Paralyzers.

Sensory Nerves. Stimulants : Local Sedatives : Local
 Anæsthetics.

On the Eye and other Special Senses.

Mydriatics dilate the Pupil.

Myotics contract the Pupil.

On the Respiratory Organs.

Errhines or Sternutatories : Respiratory Sedatives : Ex-
 pectorants.

On the Circulatory Organs.

Cardiac Stimulants : Vascular Stimulants :

 " Tonics : " Tonics :

 " Sedatives : " Sedatives.

On the Digestive System.

The Salivary Glands and Fauces. Sialagogues : Anti-
 sialics : Refrigerants.

The Stomach. Gastric Tonics : Stomachics : Bitters :
 Antacids : Emetics : Anti-emetics : Gastric Sedatives.

The Intestines. Purgatives : Carminatives : Intestinal
 Astringents.

The Liver. Hepatic Stimulants : Cholagogues : Hepatic
 Depressants :

The Pancreas and Spleen.

Worms. Anthelmintics : Vermicides : Vermifuges.

On the Skin.

Diaphoretics : Sudorifics : Anhidrotics.

On the Urinary Organs.

The Kidneys : Diuretics.

The Bladder : Lithontriptics : Urinary Sedatives : Tonics :
and Astringents.

On the Organs of Generation.

Aphrodisiacs : Anaphrodisiacs :

Ecboolics :

Agents acting on the Mammary Glands.

On Tissue Change.

Restoratives : Tonics : Hæmatinics : Alteratives :

Antipyretics : Febrifuges : Blood-letting.

Poisons and Antidotes.

Mode of Administration.

Doses : Manner of exhibition.

THE ACTIONS OF MEDICINES.

LOCAL AND GENERAL ACTIONS—ELECTIVE AFFINITY BETWEEN DRUGS AND PARTICULAR TISSUES OR CELLS—EFFECTS ON DIFFERENT CLASSES OF PATIENTS—MODIFYING INFLUENCES OF CLIMATE AND TEMPERATURE, HABIT, IDIOSYNCRASY, DISEASE, AND SURROUNDINGS.

Every medicine is possessed of certain **effects** or **actions** on **living animals**, as distinctive as its colour, taste, or chemical properties. Such actions, when exerted alike in health and disease, are termed **physiological actions**; when exerted in the cure of disease, they are termed **therapeutic** or **curative actions**. These actions cannot, however, be regarded as two-fold or distinct. The physiological action determines, and is merged in, the curative result. A horse eats some indigestible food, and consequently suffers from spasm of the bowels; a purgative exerts its physiological effects of increasing intestinal secretions and peristaltic movements; the irritant is thus swept away, and spasm and pain are removed. A dose of physic, prescribed for a horse with itching or swollen legs, pro-

duces the physiological effects of emptying the bowels, and clearing irritant matters out of the body, with the curative results of relieving or removing the itching and swelling of the limbs. A horse, after a day's unwonted hard work, frequently has his limbs stiffened, and the bursæ of his joints and tendons puffy. Diligent hand-rubbing and subsequent bandaging of the limbs mechanically and physiologically stimulate the activity of the blood-vessels and lymphatics, with the therapeutic effect of removing irritant waste products, and restoring the parts to their normal state.

Some medicines are chiefly **local** and **direct** in their action. A strong acid applied to the skin irritates and, it may be, destroys it. A hot fomentation or poultice in contact with a painful irritated surface soothes and relieves local congestion and pain. The several parts of the body, however, are intimately connected by nerves and blood-vessels, and impressions made on one spot are by reflex action speedily conveyed to other parts. Hence the primary effects of local irritants or local soothers are frequently followed by **secondary** or **remote** effects. In sore throat, the application of a blister directly irritates and inflames the external skin, but reflexly it relieves congestion, inflammation, and pain of the respiratory membrane. Still further and more remote effects sometimes follow. In horses, a large cantharides blister, owing to absorption of the irritant principles of the fly, occasionally produces febrile symptoms, and, moreover, stimulates the urinary passages by which the irritant is excreted.

The **general effects** of most medicines are produced only when they enter the body. They may be injected directly into either veins or arteries—a method rarely adopted, however, excepting for experiment, or in extreme cases. Injection is occasionally made into a gland or muscle, and frequently into the subcutaneous cellular tissue, whence the unchanged medicine is promptly absorbed by the blood-vessels or lymphatics. When inhaled through the pulmonary mucous membrane, volatile agents are quickly carried into the blood. Drugs, even when volatile, do not pass through the unbroken skin, except when it is acted on by an electric current, but are readily absorbed from abraded skin surfaces, from mucous membranes, and

still more rapidly from serous membranes. The most frequent and generally most convenient mode of administration is by the mouth, whence, speedily reaching the stomach or anterior part of the small intestine, medicines enter the circulation. From the lower portions of the alimentary canal absorption also takes place, although not so rapidly.

Medicines administered, as they should be, in a tolerably concentrated and soluble form, do not require to be reduced by mastication, or acted upon by the ferment-containing secretions of the digestive canal. But the digestion of mashes and many restorative foods is helped by the alkaline saliva, the ptyalin of which cracks starch granules and renders them soluble. The acid, pepsin-containing gastric juice dissolves albuminoids, as well as iron, mercurial, and other salts. The alkaline bile emulsionises fats and resins. The pancreatic fluid furthers digestion of starch, albumin, and fats. Specially refractory substances are more thoroughly reduced by the intestinal juices, which convert cane into grape sugar. The alkaline blood, flowing rapidly and with a specific gravity of 1050, which is higher than that of the other animal fluids, presents conditions eminently favourable for the absorption or endosmose of medicines. Different substances act differently upon the moist digestive membrane, and in various ways make their entrance into the circulation. Through the capillary vessels and absorbents which ramify on the surface of the stomach and small intestines, medicines, as they are dissolved, are carried by the mesenteric and portal vessels into the liver, which sometimes retains them and diminishes their action.

The more rapidly a medicine enters the circulation, as when it is introduced into a blood-vessel, is injected subcutaneously, or is placed in contact with an actively secreting serous surface, the more immediate and powerful are its effects. The short time taken for absorption, distribution throughout the body, and production of special actions, is illustrated in the rapidly fatal effects of such poisons as prussic acid. Professor Hering, of the Veterinary College, Stuttgart, found that yellow prussiate of potash injected into one of the jugular veins of a horse appeared in the other in twenty-five seconds, and was exhaled from the mucous and serous membranes in a few minutes; and

also that barium chloride injected into the jugular vein of a dog reached the carotid artery in seven seconds. Dr A Waller, of Geneva, found that when the foot of an albino rat was immersed even for a few seconds in chloroform containing one per cent. of atropine absorption occurred, and the pupil of the eye became dilated in from two to five minutes. Dr Blake observed that barium chloride and nitrate traversed the whole circulation of a dog in nine seconds, and that of a horse in twenty seconds.

Between certain organs, tissues, or groups of cells, and certain medicines, there appears to be a **special elective affinity**. From the common stream of blood each tissue takes up its appropriate nutrient materials, and, in like manner, it appears to select its own medicines. **The characteristic effects are not developed until medicines come into actual contact with the special organs**, or, it may be, the particular cells, on which alone they operate. Curare does not exert its paralyzing power until it reaches the intramuscular endings of the motor nerves. Magendie found that strychnine does not excite its notable tetanic convulsions until it is in contact with the spinal cord. Indeed, when a frog or other small animal, immediately after receiving a full dose of strychnine, has the spinal cord removed or broken down by a piece of whalebone, tetanic symptoms do not occur.

On the particular part on which they act—as, for example, on the nerve-centres or nerve-endings that control blood-vessels or glandular secretions—some **medicines exert stimulant**, others **depressant** or **paralyzing effects**. These effects, as already indicated in the case of drugs acting locally, frequently produce reflexly indirect or remote effects. The same medicine sometimes acts differently when given in different doses. Thus, alcohol and ether in small doses are stimulants, but in large doses are depressants.

Within the living body most **medicines** not only **effect changes**, but themselves coincidentally **undergo changes**, notably of **oxidation** or **deoxidation**. Thus, many salts of tartaric, acetic, and other organic acids are converted into carbonates. Morphine has its chemical constitution altered, and its soothing anodyne actions in part superseded, by nauseating and irritant effects. The activity of medicines depends materially on their solubility, the rapidity of their absorption, and the

period during which they remain within the body. Some drugs, as lead, mercury, silver, and digitalis, are apt to be retained for a considerable period, and hence have more or less continuous or **cumulative effect**. Unusual activity of such excreting channels as the bowels or kidneys hurries most medicines out of the body, and hence diminishes their action.

In a variable but usually short period, medicines, generally in a modified form, are **got rid of by** one or more of the **excretory channels**—the bowels, kidneys, skin, or pulmonary mucous membrane. Digitalis, for example, after exerting its action mainly on the heart and arterioles, is removed by the kidneys. Alcohol and its analogues are got rid of by the skin and kidneys, and also pass away through the respiratory mucous membrane. During their excretion medicines exert their in-contact effects on the excretory organ and passages. Thus, aloes and full doses of oils and neutral salts, after stimulating the secretion and movements of the bowels, are in part absorbed into the blood, and thence are returned into the bowels, causing further purgation. Nitre, and small doses of salines and ethers, chiefly removed through the kidneys, produce diuresis. Terebene and various balsams during their excretion by the pulmonary membrane or urinary passages exert their antiseptic and astringent properties.

The several species of veterinary patients are differently affected by many medicines. These differences, however, are in degree rather than in kind, and depend upon differences in organisation and function. On the circulatory, respiratory, and urinary systems, which nearly resemble each other in man and the domestic animals, medicines act tolerably uniformly. Thus, aconite, digitalis, and nitre produce very similar effects in men, horses, dogs, and cattle. Greater diversity, however, occurs in regard to medicines acting on the nervous, digestive, and cutaneous systems, which differ considerably in the several species of animals.

The more highly any organ or system of organs is developed, the more susceptible does it become to the action of medicines, and, it may be added, to diseases also. This general law explains why the highly-developed human brain is specially susceptible to the effects of such cerebral medicines as

opium and chloral, and why frogs, whose spinal system is developed at the expense of their brain, are so susceptible to strychnine, which acts specially on the cord. The human cerebrum, the seat of intelligence, is more than seven times the weight of the mesencephalon and cerebellum, which regulate motor energy. In the domestic animals the cerebrum is only five times the weight of the posterior parts of the brain, whilst the cord is relatively larger than in man. These differences of development explain how such medicines as opium, chloroform, and chloral cause in man blunted intellectual function and deep stupor, while in the lower animals, with less marked depression of brain function, they conjoin more marked deranged motor function and convulsions.

The Horse has a small stomach, and capacious, highly-vascular intestines, adapted for absorption of nutriment from bulky vegetable food. Nearly two-thirds of the water in the ingesta pass off by the bowels, while in man only 5 per cent. is got rid of by this channel, and the amount is still less in dogs and cats. Vegetable purgatives, notably aloe, appear more suitable than mineral purgatives, and act only slightly on the stomach, and chiefly on the small and large intestines. Except in very rare diseased states, and under the influence of large doses of aconite, attempts at vomition are not excited in horses. Tartar emetic, of which a few grains cause immediate emesis in dogs, has no such physiological effect either on horses or cattle. According to some authorities, this insusceptibility of the horse towards emetics is due to an inaptitude of the vagus nerve to receive and convey the special irritation, but more probably it is ascribed to imperfect development of the vomiting centre. Actual vomition in horses is hindered by the small stomach not being readily compressed between the diaphragm and abdominal muscles, and by the stout band of muscular fibres which surrounds its cesophageal opening. Most substances which act as emetics for men and dogs are supposed to produce sedative effects when given to horses in sufficient doses; but the many sedatives available in human and canine practice operate uncertainly and imperfectly on horses, for which aconite is the chief reliable sedative medicine. The kidneys of horses are readily acted on; in ordinary

circumstances they remove about one-seventh of the fluid ingesta, while the same organs in man drain away 54 per cent., and in dogs nearly 50 per cent. of the fluid discharges. Sudorifics are less prompt than in man, and are apt to act on the kidneys, unless the animal be well clothed.

In Cattle the peculiarities of the action of medicines are chiefly referable to the construction of their alimentary canal, and to their phlegmatic temperament. The stomach of these ruminants is quadrisectioned, is extensively lined with cuticular mucous membrane, and, as regards its first three divisions, is less vascular, and in function is less chemical and more mechanical than the corresponding portions of the alimentary canal of men, dogs, or horses. The first and third compartments always contain food, often in large quantity. These facts explain why cattle require large doses of all medicines, why considerable quantities of irritant and corrosive poisons can be given them with comparative impunity, and why purgatives, unless in large doses and in solution, are so tardy and uncertain in their effects. Several times a day, for about an hour at a time, in animals of this class, the solid food is returned from the first and second stomachs for more thorough mastication and insalivation. Imperfect and suspended rumination is the chief cause, as well as a common effect of stomach disorders in cattle. The kidneys and skin are less easily acted on than the corresponding organs in horses; and their dull, phlegmatic disposition resists the action both of stimulants and tonics. It is a very prevalent notion that medicines, when poured very slowly down a cow's throat, pass, like the ruminated food, direct to the fourth stomach. From observations made at the slaughter-houses on both cattle and sheep, I find, however, that neither animal can be induced to exert this voluntary effort in behalf of our medicines, which in all cases, no matter how slowly they are administered, fall partly into the first and second stomachs, whence they shortly pass onwards through the third and fourth stomachs, especially if given, as they always ought to be, with a considerable quantity of fluid.

Sheep closely resemble cattle in the way in which they are affected by most medicines; they usually require about one-fourth of the dose suitable for cattle, and are best drenched by

being backed into a corner, the head being steadied between the operator's knees, while the medicine is cautiously poured over.

On Dogs medicines generally operate much in the same way as on man; but to this rule there are some remarkable exceptions. Dogs, for instance, take six or eight times the dose of aloes usually given to human patients, but are seriously injured by half as much calomel or oil of turpentine as is prescribed for a man. The opinion generally held, that medicines may be given to dogs in the same doses as to man, cannot therefore be safely entertained without a good many reservations. In dogs the alimentary canal is short and straight, and purgatives consequently act with greater rapidity than in other veterinary patients. Another peculiarity is the facility with which they can be made to vomit. Indeed, vomiting in dogs is often naturally produced by their eating various grasses, by their swallowing nauseous or unpalatable matters, or by their overloading the stomach. To prevent dogs vomiting their medicine, it is well to keep the head raised for an hour after its administration; and this may be easily effected by attaching a chain or cord to the collar, and fixing it to any object at the requisite elevation. The kidneys are excited with more difficulty than in horses or cattle.

On Pigs the effects of medicines are similar to their action on men and dogs.

Dr Lauder Brunton points out several curious differences in the action of drugs on several of the lower animals. Morphine convulses frogs, but, even in large doses, has no effect on pigeons, except in reducing their temperature. Belladonna quickens cardiac action in man, dogs, and horses, by paralysing the vagus, which controls or restrains heart action. But in rabbits the vagus has hardly any appreciable effect in regulating the heart beats, and these animals accordingly take large doses without having the rapidity of the circulation increased. The rabbit's heart, not being controlled by the vagus, a marked difference also occurs in the action of amyl-nitrite on rabbits as compared with dogs. Such observations are not only most interesting in themselves, but greatly further the understanding of the actions of drugs.

Climate and Temperature modify considerably the actions

of medicines. Narcotics are generally believed to act more powerfully in warm than in cold climates. This fact, as well as other differences in medicines observed in hot as compared with cold climates, may depend upon slight differences in animal temperature, and in the varying amount of excretion effected by the skin and kidneys.

Moderate warmth favours chemical reactions and protoplasmic movements—two conditions intimately connected with the actions of medicines. “Alexander von Humboldt first observed that warmth not only acted as a stimulant to the heart, increasing the power and rapidity of its contractions, but noticed that warmth increased the rapidity with which alcohol destroyed the irritability of a nerve, and potassium sulphide that of a muscle. . . . Many, if not all, muscular poisons act more quickly with increased temperature. . . . Rabbits poisoned with copper or potassium salts also die more quickly when placed in a warm chamber than when left at the ordinary temperature” (Brunton). On the other hand, however, narcotic poisoning by alcohol or chloral is retarded when the animals are in a warm atmosphere.

Habit.—The continued use of a medicine sometimes alters the degree of its action. Caustics and irritants, which exercise only topical action, exhibit, on their repeated application, gradually increasing activity. But many medicines, when continuously administered, have their ordinary power considerably diminished. Thus, arsenic-eaters sometimes use with perfect impunity twelve or fifteen grains of arsenic daily—a quantity sufficient to poison three or four unhabituated persons. A like tolerance is observable among horses which have been accustomed to receive arsenic. Opium, and most general stimulants, when administered for some time, gradually lose their effects. Virginian deer, from habit, are said to thrive on tobacco; some monkeys, feeding on strychnine-containing nuts, are stated to become insusceptible to strychnine (Wood). The tolerance thus induced by the habitual use of a medicine occasionally depends on its retarded absorption or quickened excretion; sometimes, in the case of vegetable drugs, on the liver acquiring greater power for its arrest, excretion, or destruction; while frequently the tissues repeatedly acted on gradually become acclimated, and hence so far resistant.

Idiosyncrasies, probably the result of reversion to ancestral forms, which in the human subject render some poisons almost innocuous, and some simple medicines deadly poisons, are much less frequent and notable among the lower animals. Those of most frequent occurrence among veterinary patients are either an increased or a diminished susceptibility to the action of purgatives and diuretics. Most medicines act with greater certainty and effect upon well-bred animals, whether amongst horses or dogs, than upon coarsely-bred mongrels. The prescription even of a mustard blister or a colic draught demands consideration of the temperament and condition of the patient.

Diseases modify the actions of many medicines. The altered structure and functions of the diseased body modify the effects of most drugs; the increased temperature occurring in most febrile disorders is an important modifying factor. A congested or inflammatory condition of the alimentary canal, or even an overloaded stomach, retards absorption, and the consequent activity of medicines given by the mouth. Acute fever, on account of increased arterial pressure, is also unfavourable to absorption. When excretion is hindered, medicines, however, are usually retained longer in the system, and some accordingly act more powerfully. Conversely, when excretion is active, as in diuresis, diabetes, or diarrhoea, such medicines as opium, belladonna, and alcohol, being rapidly got rid of, do not manifest their full activity. Influenza, low fevers, and any considerable inflammation of mucous or cutaneous surfaces, withstand reducing remedies badly, and require for their successful treatment the early exhibition of restoratives, tonics, and stimulants. Even the comparatively slight and temporary requirements for the changing of the coat render horses in spring and autumn notably less enduring and less able to stand lowering treatment. Blood-letting and full doses of sedative medicines induce less depression in acute inflammation than in health; large quantities of opium and chloral hydrate have comparatively slight effect in tetanus, hydrophobia, or enteritis; while excessive doses both of purgatives and stimulants are tolerated in the apoplectic form of puerperal fever among cattle, and in other cases in which there is depression of nervous force.

The surroundings of the patient materially alter the action of remedies. Diseases, whether in horses, cattle, or dogs, occurring in large towns, and in filthy, overcrowded, and badly-ventilated premises, are notoriously liable to assume chronic, typhoid, and untoward forms, and are apt to defy even skilfully devised curative measures. Medicines can only act effectually when seconded by proper sanitary arrangements. Over-heated, imperfectly ventilated stables lower the vitality of their inmates, by retarding excretion, and favouring absorption of noxious exhalations. Such facts demand consideration alike in the treatment and prevention of disease. Frequently a horse with influenza, bronchitis, or pneumonia, is thrown back for days by being senselessly stripped and taken out of his box in cold weather. One meal of coarse, indigestible food, even of moderate amount, sometimes retards recovery from gastric derangements, and, indeed, from most debilitating diseases. Constipation and torpidity of the bowels interfere with the absorption, and hence with the satisfactory operation of all medicines. Exposure to cold seriously injures patients which have received full aperient doses of salts or of turpentine, or which have been freely dressed with mercurial ointment. Foul air and disordered digestion prevent the healing even of simple wounds. On the other hand, gentle exercise encourages the action of most eliminatives; quiet favours the effects of soothing remedies; generous diet seconds powerfully the benefits of restoratives, tonics, and stimulants. Inflammatory disorders usually bear more prompt and actively depleting treatment in winter than in summer, in the country than in the town, in well-bred animals in good condition, rather than in coarser subjects which have been indifferently nourished.

CURATIVE SYSTEMS: ALLOPATHY, HOMCEOPATHY.

The difficult question is frequently asked—**How do medicines cure disease?** Endeavour is made, guided by biological laws, to adjust or restore to harmony any irregularity or deviation from health which may have affected the organism or any of its parts. The complex composition and diverse functions of the bodies of the higher animals are liable, however, to be

altered and disturbed in many different ways, and such alterations or aberrations cannot be restored by any one curative system or formula. As already indicated, medicines have special actions on different organs or groups of cells, and affect them in very different ways, and hence would seem to produce their curative effects, not in one, but in many ways. The late Professor Headland taught that "the only general explanation we can give of the *modus operandi* of medicines in the cure of diseases is to say that they operate by various **counteractions.**" Two such systems of counteraction have been propounded—(1) the **antipathic**, whereby medicines were believed to overcome morbid conditions or symptoms by a superior and antagonistic force; (2) the **allopathic**, whereby effects are produced which, although they may sometimes be unnatural, overcome the disease. But diseases, it has been affirmed, may not only be cured by counteractions, but by similars. Upon the old saying that "like cures like," **Homœopathy*** is based, and its votaries declare that diseases

* Homœopathy (*ὁμοιος, homioios*, like or similar; and *πάθος, pathos*), was propounded by the German physician Hahnemann in his *Organon der Rationellen Heilkunde*, published in 1810. This system teaches that the cure of a disease is effected by infinitesimal doses of such medicines as would induce, if given to a healthy subject in large quantity, symptoms similar to the disease. Cinchona is declared to cure such fevers as ague and intermittents, because it produces some such febrile symptoms when given to healthy individuals in considerable doses; aconite is regarded as the appropriate remedy for reducing inflammatory fevers, because in large doses it produces symptoms which are thought, by homœopathists, to resemble those of inflammation; while strychnine is selected as a remedy for paralysis, because in large doses it appears to produce paralytic symptoms. This doctrine, if sound, would stamp most disorders as hopelessly incurable; for it is only in a few exceptional cases that any similarity can be detected between the symptoms produced by large doses of the remedy and those of the disease for which it is given. No known medicines, for example, are capable of developing symptoms such as those of thick-wind, roaring, pleurisy, strangles, distemper, or hydrophobia, yet fifteen or twenty remedies are prescribed homœopathically for each of these diseases. Glanders, farcy, and consumption are treated by aurum, arsenicum, and bromine; but none of these medicines develop symptoms similar to the diseases for which they are used. Again, the disciples of Hahnemann treat diseases the most dissimilar in their nature and symptoms by the same remedy. Thus, Mr Haycock, in his *Elements of Homœopathy*, employs arsenic as the appropriate remedy in mange, bronchitis, enteritis, diabetes, strangles, tetanus, rheumatism, ophthalmia, poll-evil, glanders, and thirty other diseases; whilst he prescribes aconite in thirty-two diseases, beginning with papular eruptions, including most affections of the respiratory and digestive organs, and ending with ophthalmia and

are to be treated by small doses of such medicines as in large doses produce symptoms similar to the disease to be cured. The pathological conditions which underlie and produce the symptoms, and which a rational cure generally aims if possible at removing, are ignored. The homœopathic dictum of *similia similibus curantur* does not bear investigation; at best it is only capable of narrow and occasional acceptance. The symptoms of ague and intermittents are certainly similar to those produced by cinchona bark, which is the accepted cure for ague, and the illustration on which Hahnemann founded his system. But many diseases exhibit no symptoms accurately similar, as the homœopathists insist they should be, to those produced by the medicine prescribed for their cure. Numerous

glanders. An "accurate similarity" between the symptoms of the disease and those of the remedy is, however, regarded as essential to the success of the homœopathic treatment; but where is the similarity between the effects of arsenic and these forty diseases for which it is prescribed, or between those of aconite and the thirty-two diseases in which it is considered so efficacious? These and many other such instances cannot be established without straining similarities which, to ordinary eyes, are imperceptible, or at best but very remote.

Mr Dudgeon's translation of the *Organon of Medicine*, accepted by English homœopathists as their standard authority, states that "the symptoms of each individual case of disease must be the sole indication, the sole guide to direct us in the choice of a curative remedy" (p. 120). Now, symptoms, although sometimes requiring special treatment, are but the visible signs and results of derangement and disease; whilst their removal, which is all that is aimed at in homœopathic treatment, does not always insure the removal of the conditions on which they depend. Thus, rheumatism, pleurisy, enteritis, worms, and many other disorders, frequently remain unchecked after their symptoms have been relieved. Instead of thus vainly attempting the removal of symptoms, it were therefore more rational to remove at once the morbid condition—the source of the evil. No curative system directing its efforts, as homœopathy does, merely against the symptoms of disease, can ever rest upon a safe or scientific basis; for it is notorious that, under varying modifying influences, the same diseases sometimes induce very dissimilar symptoms, and would consequently, according to this system, require dissimilar treatment. On the other hand, diseases essentially different sometimes manifest similar symptoms. Thus, stupor and vertigo result sometimes from an excessive and sometimes from a deficient quantity of blood sent to the brain; difficulty of breathing from too much as well as from too little blood circulating through the lungs; vomiting from irritation of the stomach, or from irritation of the vomiting centre; diarrhœa from crudities in the alimentary canal, or irritant matters in the blood. Now, in these cases, similar symptoms, although depending upon unlike morbid conditions, must, according to homœopathy, be combated by the same remedies, for it is written, "Diseases are cured by

drugs, moreover, cause symptoms wholly unlike those of the diseases in the treatment of which homœopathists use them.

The homœopathic selection of so-called appropriate remedies, on the presumption that "like cures like," is based upon a fallacy, while the minute, finely triturated, and subdivided doses are too attenuated to affect veterinary patients. The practice of homœopathy has, however, developed wholesome discussion, has suggested some useful experiments on the actions of medicines, has helped to show the evils of heroic and indiscriminate drugging, has taught the advantage of simple prescriptions, exemplified the power of nature to cure, when not too much interfered with, and demonstrated the powerful influence of diet and regimen in the successful treatment of disease.

such medicines as have the power of producing, in healthy individuals, symptoms similar to those which characterise the diseases themselves" (Haycock's *Elements*, p. 20). No provision, be it remarked, is here made for cases in which the same symptoms result from different or opposite conditions; and yet we not only find the same symptoms produced by very different diseases, but also by the most opposite remedies. Strychnine and prussic acid, for example, although totally dissimilar in their *modus operandi* and general action, both induce convulsions, and should therefore, according to the tenets of homœopathy, be equally suitable for the cure of the same convulsive diseases.

Not only are the principles on which homœopathy is said to be based untenable, but the details of the system are inconsistent and ridiculous. The homœopathic doses are so small that they are often incapable of detection either by the microscope or by chemical analysis, and are sometimes so inconceivably minute that the mind can form no idea of them. It is admitted, even by homœopathists, that millions of such doses may be swallowed by a healthy individual without inconvenience; but in disease the body is stated to become so susceptible to their action that much risk is incurred by their insufficient dilution! Medicines such as charcoal, sand, and calcium carbonate, which, in doses of several drachms, have only slight mechanical effects, when given in fractional parts of a grain are thought to produce very powerful effects, and cause many hundred symptoms. Charcoal, for example, is said, when given to human patients in very minute doses, to produce 930 distinct symptoms; oyster shell, 1090 symptoms; and the ink of the cuttle-fish, 1242 symptoms! The extraordinary powers supposed to be conferred on these and other medicines, even when given in doses of inconceivable minuteness, are chiefly ascribed to the magic influence of careful and continued triturations and often-repeated shakings, performed according to most precise directions. Some homœopathic authorities declare that there is little difference of activity between different dilutions of the same medicine; and it is said that, if the medicine be well selected, it matters little whether the tenth, hundredth, or thousandth of a grain be used (Gunther and Haycock). There is probably some truth in this observation, for, with most medicines, especially when administered to the lower animals, all the dilutions mentioned would be equally

ACTION OF MEDICINAL AGENTS ON PROTOPLASM, BLOOD, AND LOW ORGANISMS.

ANTISEPTICS—DISINFECTANTS—DEODORISERS—PARASITICIDES—
ANTIPERIODICS.

The mode of life of the tissues of the higher animals, and the way in which these tissues are acted on by medicines, have in recent years been strikingly illustrated by examination of these phenomena as they occur in the simplest animal structures. The complex albuminoid material termed **protoplasm**, which is the ever-present constituent of living cells, is coagulated and precipitated by heat, and dissolved by alkalies. It is precipitated by small quantity, and dissolved by excess, of most mineral acids. Organic alkaloids resemble acids in lowering the temperature at which heat coagulates albumin. Protoplasmic movements, as illustrated in the amœba, are retarded or arrested by cold. Heat, slight electric shocks, and common salt even in diluted harmless. The admixture of different medicines with one another is said to neutralise the effect of all; but if this be the case, homœopathic drugs must always be without effect (which is very probable), for all medicines contain adulterations and impurities which, though small in amount, must, if homœopathic reasoning be consistent, acquire great potency by the triturations above mentioned.

But homœopaths assert that, in spite of the errors which their opponents discover in the system, it is nevertheless very successful in the cure of disease. In judging, however, of homœopathy as a system of practical medicine, it must be regarded as made up of two distinct parts:—1st, The original and peculiar part of the system, consisting in the use of medicines selected in accordance with a law embodied in the axiom *similia similibus curantur*, and administered in infinitesimal doses, usually varying from one grain to one-millionth of a grain, and carefully prepared according to certain precise directions; and 2nd, Attention to diet and regimen—the only effectual and rational part of homœopathy, the true source of all its boasted cures, and that department of medical treatment which has always been insisted upon by rational and successful practitioners, both of human and veterinary medicine. The value of medicines given homœopathically has never been satisfactorily shown, and never can be so until two series of cases, as nearly as possible alike, be treated—the one in the usual homœopathic fashion, the other with the same attention to diet and regimen, but without the globules. In comparative experiments, made at the Edinburgh Veterinary College, as to the treatment of pleuro-pneumonia and other diseases, it appeared that those cases treated by diet and regimen alone were as speedily and effectually cured as those treated with the globules in addition, so long as these globules were given only in homœopathic doses.

solution first quicken them; but a temperature of 35° C., a stronger electric current, or prolonged exposure to a saline solution, tetanises them. Protoplasm has the power of absorbing and storing oxygen; and the chemical energy developed from this oxidation is capable of conversion into mechanical energy and movements. Protoplasm has also the power of carrying and transferring oxygen to other substances, and appears to contribute largely to the diffusion of oxygen, and interchange of gases, constantly occurring between the blood, the intercellular fluid, and the cells, and constituting what is termed internal respiration.

Leucocytes are affected in much the same way as amoebæ. Their movements are, besides, notably arrested by the cinchona alkaloids and beberine sulphate. Quinine injected into the circulation has also been found to diminish the migration of leucocytes from the blood-vessels.

The **red corpuscles** pass out of the vessels when an excess of sodium chloride is introduced into the blood, while still more rapid extravasation is produced by the rattlesnake poison. The size of the red corpuscles is increased by oxygen, hydrocyanic acid, quinine, and cold, and diminished by carbonic acid, morphine, and warmth.

The important blood constituent **hæmoglobin**, like protoplasm, has great capacity for taking up oxygen, thus becoming converted into oxyhæmoglobin, which holds, however, its added oxygen loosely, and parts with it readily, as it slowly circulates through capillary vessels. The hæmoglobin also combines with other substances as well as with oxygen—as with hydrocyanic acid and carbonic oxides, forming tolerably stable compounds; these, however, neither take up oxygen in the lungs, nor give it off in the tissues, which hence become asphyxiated. Addition to the blood of such drugs as alcohol, chloroform, quinine, morphine, nicotine, and strychnine, likewise, in various degrees, diminish the amount of oxygen absorbed, and of carbonic acid given off by the blood. “Uric acid and snake-poison had a contrary effect, increasing the absorption of oxygen and the evolution of carbonic acid. Curare appeared to lessen the absorption of oxygen, but increased the evolution of carbonic acid. Mercuric chloride lessened the carbonic acid, but increased

the absorption of oxygen. Arsenious acid and tartar emetic diminished the absorption of oxygen; but arsenious acid appeared also to lessen the evolution of carbonic acid, while tartar emetic appeared to increase it" (Dr Lauder Brunton).

Infusoria have both their rhythmical and ciliary movements increased by heat and diminished by cold. Weak saline solutions increase their movements; while strong saline solutions alter the amount of water they contain, and cause them first to shrivel, and subsequently to swell.

FERMENTS determine the healthy nutrition of plants and animals, as well as their decay and many of their diseases. They are exemplified by the yeast which raises bread and converts the starch and sugar of barley into beer or spirit, the rennet which coagulates milk, the filamentous fungus which causes ringworm, and the bacillus which induces the deadly anthrax. Ferments are divisible into two classes:—

1. **Organic ferments** or **enzymes** contain carbon, are hence organic, but are devoid of definite structure, and are not organised or living. They are exemplified by diastase, which causes germination in barley and other seeds, ptyalin from saliva, pepsin from the stomach, trypsin from the pancreas, with histozyme, a recently discovered ferment present in blood, and believed to be the chief agent in the reduction of albuminoids.

2. **Organised** or **formed ferments**, such as yeast, mycoderma vini, moulds, and bacteria, are living vegetable organisms of parasitic habit.

The reduction of **complex** carbon compounds **into simpler forms** is the life-work of both classes of ferments. Their effects are produced, it is believed, in one of two ways:—(1) By abstraction of water, as in the conversion of starch into sugar, or the splitting up of glucosides—changes chiefly effected by enzymes, and analagous to the effects of heat in conjunction with diluted mineral acids or alkalis. (2) The breaking up of the fermentesible body is sometimes effected by transfer of oxygen from its hydrogen to its carbon, as in alcoholic and lactic fermentations, and in putrefactive processes—a mode of reduction usually effected by the organised ferments, and probably analagous to the action of spongy platinum, which readily absorbs oxygen, and gives it off again to oxidisable substances.

The organised ferments, which are the causes of putrefaction and of various diseases, have been classified as—

1. **Yeasts, or sprouting fungi**, consist of ovoid cells, multiplying by budding, and represented by the *torula cerevisiæ*, *mycoderma vini*, and, according to most authorities, also including the aphthous patches of thrush found in the mouths of young animals.

2. **Moulds, or filamentous fungi**, occur in threads, which are agglomerated into masses of tufts, multiplying by budding and formation of spores, and exemplified by the common moulds which appear on moist objects, and by those which cause such skin diseases as favus and tinea.

3. **Bacteria, Microbes, or Schizomycetes**, are the lowest forms of vegetable life, but the most widely distributed, in air, earth, and water. They consist of round, oval, or cylindrical cells, so minute that they require high powers of the microscope to discover them. They multiply chiefly by division, occasionally by formation of spores. Their multiplication is effected with enormous rapidity, a single individual cell sometimes producing a million in twenty-four hours. Some are fixed, others are motile. For their formation and growth they require organic matter, moisture, salts, and a moderate temperature; some, further, need oxygen; some thrive without it. They speedily exhaust the nutriment obtainable from the substance on which they grow, or form in it matters inimical to their life; but where one species languishes and perishes, others frequently spring up and flourish.

Bacteria are divided into two groups—(1) **Non-pathogenic or saphrophytic**. Many of these feed and live on dead animal or vegetable matter, and their great function is the conversion of complex into simpler forms. They are exemplified by the bacillus of hay, the bacillus termo found in all putrid fluids, and the bacilli developing the saccharine and lactic fermentations. (2) **Pathogenic or parasitic** bacteria live on or within the bodies of living plants or animals, and when in large numbers interfere with nutrition and cause disease. Their pathogenic power is proved beyond all question by taking cultures from any of the specific diseased products, growing them in suitable media for several generations, and inoculating these on living

subjects, when the original disease is reproduced. But pathogenic and non-pathogenic are only relative terms. The organisms, usually harmless, under certain conditions become harmful; while those that are pathogenic by cultivation and otherwise sometimes lose their toxic power, and live and reproduce themselves amongst dead vegetable and animal matter. The bacilli of anthrax, hog cholera, and tetanus illustrate these varying states of activity and change of habit. Under different circumstances microbes, however, regain their former activity.

Both pathogenic and non-pathogenic bacteria are **divided into three classes**, distinguished by the forms they assume: (a) **Micrococci** or round cells, such as the sarcina found in the stomach; the cocci which arrange themselves in clusters or in chains, and cause strangles in horses, rinderpest in cattle, erysipelas and pus formations in all animals. (b) **Bacilli** or rod-shaped bacteria, as those of anthrax, glanders, tuberculosis, as well as the short coccus-like bacillus of pneumonia. (c) **Spirilli** or thread-like bacteria, as of relapsing fever in man and the comma-like organisms of cholera.

Dr T. Lauder Brunton states: "It is probable that bacteria are constantly entering the organs of man and animals from the lungs and digestive canal; but unless they are excessive in number, and virulent in their nature, they are quickly destroyed. When only a small number of pathogenic bacteria, such as the bacillus anthracis, is injected into the blood at once, they are destroyed in the organism, but when they are in larger numbers they have the best of the struggle, and the organism itself is destroyed." Fortunately in healthy subjects, under favourable conditions, the bacilli and their spores are attacked and destroyed by leucocytes, white blood corpuscles, connective tissue cells, and probably other healthy textures.

Both organic and organised ferments, in breaking up complex vegetable and animal bodies, frequently **produce substances of great activity**. The emulsin—the ferment of bitter almonds—gives rise to a hydro-cyanated oil. The myrosin of mustard seed develops the acrid mustard oils. The protoplasm of particular plants produce their respective alkaloids, some of which are active poisons. Certain mushrooms produce the poisonous alkaloid muscarine; putrefying yeast yields sepsine; from putre-

fied maize is obtained an extract which contains one substance which tetanises, and another which narcotises. Animal bodies invaded by bacteria undergo decomposition, and the bacterial cells, according to their kind, elaborate their respective alkaloids, some of which are poisonous. These cadaveric alkaloids are termed **ptomaines**. An analagous series termed **leucomaines** are formed during normal and also during abnormal physiological processes. Under healthy conditions they are excreted, but if retained they are injurious. In the healthy muscles of living animals, after active exertion, there are found alkaloids allied to xanthin and creatin. During digestion of fibrin by pepsin an alkaloid is formed. Boucharde has stated that the alkaloids formed in the intestines of a healthy man in twenty-four hours would suffice to kill him if they were all absorbed and excretion stopped.

The pathogenic, like the putrefactive bacteria, when they invade the bodies of higher organisms, **act as ferments**, cause disintegration of living tissues, and **formation of alkaloidal toxines**, and, besides, produce **globulins** or **albumoses**, often as deadly as the alkaloids. Special local effects are produced, notably congestion, inflammation, and necrosis; but the soluble poisons carried in the blood-stream further develop general effects. Thus, the anthrax bacilli cause local malignant œdema or pustule, and further lead to nervous collapse. The diphtheria bacillus causes special throat lesions, while the toxine it develops, circulating widely, impairs the functions of the great nerve-centres.

In relation to the prevention and cure of the diseases depending upon bacteria, it must be noted that these pathogenic organisms have their activity retarded or destroyed by exposure to high temperatures, by the action of chemical solutions, by being reproduced for several generations in the bodies of certain animals, and in other ways. Anthrax virus is thus attenuated by heat; rabies virus by being grown in the bodies of rabbits. These attenuated viruses are used as **protective vaccins**. The vaccins of anthrax and rabies, as well as those of swine and fowl cholera, when injected into the bodies of animals specially liable to these disorders, render the vaccinated subjects immune. This is demonstrated by the animals operated upon suffering

no harm when subsequently inoculated with doses of the unattenuated bacterium or its products, which would destroy unprotected animals. One class of these micro-organisms frequently modifies or arrests the action of others. Thus, the harmless earth bacillus has been found to protect mice and rabbits from anthrax, while a similar power is exerted by the products of blue pus. These important protective powers conferred by bacteria and their products appear to depend upon their exerting metabolic changes on the blood and tissues, with formation of special chemical agents. This immunity, like that produced by an ordinary attack of specific disease, may be more or less permanent. It may be so marked as to be hereditary. In some cases the blood of such immunes transfused into the veins of susceptible animals renders them also immune. Such investigations appear to foreshadow important developments in practical medicine.

Vaccins exerting a curative as well as a preventive effect may also be obtainable. This is a justifiable expectation, for human patients who have been exposed to the contagion of smallpox, if promptly vaccinated with cow-pox lymph, have the smallpox attack favourably modified. Perhaps still more to the point are Pasteur's experiments with rabies. He inoculated dogs and rabbits with lethal doses of rabies virus, and thereafter with repeated doses of vaccin. No serious results followed, although control animals inoculated with rabies virus, but not with the vaccin, died.

Another important matter connected with bacteria has recently been discovered. Brieger and Fraenkel have found that the bacteria of diphtheria produce not only a toxic, but also a **protective substance**. Drs Kempleres, experimenting with pneumo-cocci, have got a pneumo toxine and an anti-pneumo toxine. Koeh's investigations with tuberculin also point to the conclusion that both a pathogenic poison and its antidote are formed by the tubercle bacillus. Experiments may show that others of these pathogenic bacteria also develop their several vaccins or anti-toxines, and as the toxines have been isolated and cultivated, so, doubtless, also will be the respective anti-toxines.

The general method of **fighting these pathogenic bacteria**

at present at our command consists in strict isolation of animals affected by such specific diseases, and fully recognising and acting on the fact that infected subjects and their secretions are apt to distribute the virus. Remedial measures must be adopted early—if possible, before the bacteria have multiplied, and before the toxins are produced. Appropriate antiseptics must be given. In such cases as rabies, which have a long incubation stage, there will be time for the protective operation of vaccins, which appear to confer on the tissues a tolerance of the bacteria, and enable them successfully to cope with the intruders and their products. Every endeavour must be made to maintain in its fullest vigour both the part primarily attacked and the system generally, with the view that the healthy tissues may, if practicable, destroy the parasites and their products. The excreting channels, moreover, will be maintained in healthy action, in order that waste and diseased materials, as well as the organisms themselves, may be removed. Antiseptics will continue to be administered not only to the sick, but to any susceptible animals in contact with them, and disinfectants used so that the bacteria and their spores shall be destroyed, and the spread of the disease prevented.

Many agents inhibit or retard the action of ferments, and some effectually destroy them. These agents have been designated :—

ANTIZYMOTICS—remedies which **arrest fermentation**. They act chiefly in two ways :—(1) Chemically, by direct or indirect oxidation. Chlorine, iodine, bromine, and potassium permanganate act in this way. (2) Arresting proliferation or catalysis of ferments, as is the mode of action of corrosive sublimate and many other metallic solutions, of carbolic, boric, salicylic, and benzoic acids, and of temperatures above 200° Fahr. Antizymotics include antiseptics and disinfectants, and nearly allied to these are deodorants.

ANTISEPTICS are remedies which **arrest putrefaction**. They kill or prevent the development of those bacteria which produce septic decomposition.

DISINFECTANTS **destroy the specific poisons of communicable diseases**. Their special function is to kill, or arrest the development of those germs or bacteria which produce disease.

DEODORISERS or **deodorants** destroy smells. Some of the most disagreeable smells, and those most injurious to the higher animals, result from putrefaction, and their cause is hence removed by effectual antiseptics. Smells consisting mainly of sulphuretted hydrogen are neutralised by chlorine; those from ammoniacal gases by hydrochloric or nitric acids. Noisome odours may also be attracted and absorbed by freshly-burnt charcoal or dried earth.

Enzymes generally have their action arrested or are destroyed more readily than the organised ferments, amongst which there is much difference in viability. Microzymes are more sensitive than bacilli. The bacillus anthracis is more easily killed than some others. The **spores** of all species are **specially resistant**, and for their effectual destruction require prolonged exposure to tolerably strong solutions of potent antiseptics.

The action of **watery solutions of various drugs** on the several **enzymes** has been carefully examined by Wernitz, and his experiments corroborated and quoted by Dr Lauder Brunton. Corrosive sublimate stands pre-eminent in the certainty of its effects, even in very diluted solution. The action of emulsin was arrested by 1-65,000th part, of diastase by 1-50,000th part, of ptyalin by 1-52,000th part, of pancreatin by 1-21,600th part; but it took 1-1766th part to arrest the action of pepsin, and 1-720th part to arrest that of rennet. Minute quantities of copper sulphate, chlorine, iodine, and bromine, and also bleaching powder and sulphurous acid, readily destroy these organic ferments. Salicylic and benzoic acids and chlorinated lime are also effectual, usually in proportions of about 1-1000th part. Borax is effective generally with 1 to 100, although 1-3580th part arrests the action of the intestinal ferment invertin. Aluminium acetate, carbolic acid, and glycerine in the order mentioned are weaker still. Chloroform, thymol, eucalyptol, and mustard oils have little, if any, action, even in saturated solution. A temperature over 125° Fahr. weakens or destroys the enzymes.

Drugs act differently on different ferments. While 1-52,000th part of corrosive sublimate, as already indicated, arrests the action of ptyalin, 1 part in 720 is needful to arrest the action of rennet, which is, however, destroyed by 1-1000th

part of borax, 1 part of which in 100 is required to destroy ptyalin. For destruction of rennet, bromine and chlorinated lime are specially effective. Creosote, although it has small effect on the enzymes, in solution of 1 part to 500 destroys yeast cells, and, in solution of half that strength, kills bacteria. The mould fungi are destroyed by the same agents which kill yeast and bacteria.

Bacteria of different sorts exhibit some differences in their susceptibility to different antiseptics; indeed, the susceptibility somewhat varies in the same bacteria when raised in different media. It is more easy to prevent than to arrest development of bacteria. As already pointed out, the spores have much greater resisting powers than the fully-developed bacteria. The perfected cells are destroyed by exposure for an hour to a temperature of 150° to 168° Fahr., but the spores require more prolonged exposure at 212° Fahr. Moist heat, having a greater power of softening and penetrating the spore envelope, is more effectual than dry heat. Milk containing the bacillus of tubercle or other specific disorder may be rendered innocuous by five minutes' boiling.

Experiments bearing on the power of different substances to prevent the development of bacteria in various stages and solutions, to kill them, or to arrest development and reproduction of their spores, have been carried out by many good observers. The plan of procedure has generally been to add to carefully-prepared sterilised fluids in test tubes, known quantities of the disinfectant to be tested, and then introduce a drop of liquid containing bacteria or their spores. Such experiments show that the agents which most promptly and effectually arrest the action of enzymes also prove the most destructive to bacteria. Of **corrosive sublimate**, 1-5805th part kills the developed parasite; 1-25,258th part prevents the development of bacteria taken from meat infusions; but it requires 1-2525th part to prevent reproduction of spores in unboiled meat infusion, and still stronger solutions to penetrate and kill the spores. Chlorine, chlorinated lime, bromine, iodine, quinine, and beberine stand next in activity. Sulpho-carbolates and strychnine follow in order. Sodium sulphate is about 1-10th the strength of quinine. Compared with corrosive

sublimate, it requires twenty times the amount of thymol, salicylic acid, and potassium permanganate to prevent development of bacteria, and sixty times to prevent reproduction of spores. Sodium hyposulphate has very little action. Carbolic acid did not stand so high as expected. The fresh blood of an animal just dead from anthrax must be mixed with its own bulk of a 1 per cent. solution in order to destroy the bacilli, and enable it, without harm, to be injected into another animal. A half per cent. solution fails to destroy the bacilli.

Koch's experiments with the spores of anthrax bacillus constitute the most recent, extensive, and reliable tests of the value of **disinfectants**. Solutions of the several substances, of specified strength, were placed in tubes, their mouths stopped, as is generally done, by cotton wool; and threads steeped in fluids containing bacilli and their spores were carefully introduced. Some of these threads were removed from day to day, and subjected to microscopic examination. Even after one hundred days' exposure to the antiseptic, some threads still exhibited bacilli. Chlorine water freshly made, bromine 2 per cent. solution, iodine 1 part in 7000, corrosive sublimate 1 per cent. in water, were found effectually to destroy these anthrax spores with which they had been in contact one day. Formic acid, specific gravity 1.120, destroyed all spores after four days' exposure. In five days all spores were killed by 5 per cent. watery solutions of chlorinated lime and ferric chloride. One per cent. of arsenic in water, and the same proportion of quinine in acidulated watery solution, were effective in ten days. Oil of turpentine took five days, ether thirty days. The results with carbolic acid were disappointing; a 1 per cent. solution had not much effect on the spores, even when exposure was prolonged for fifteen days; and a 5 per cent. solution was required to secure their destruction in one day. Like salicylic, boric, and benzoic acids, sodium chloride, and many metallic solutions, carbolic acid was thoroughly effectual in destroying microzymes which had not formed spores, and from its volatility it is frequently more serviceable than fixed antiseptics. The infected threads, subjected to the influence of even the least active of those antiseptics, produced only scanty and retarded crops of bacilli. Such reliable antiseptics as corrosive sublimate, bro-

mine, or iodine, when dissolved in alcohol, ether, or oil, were not nearly so effectual as when dissolved in water.

The uses of antiseptics.—In surgery, zinc and iron chlorides, pitch and tar, tinctures of myrrh, benzoin, and other balsams have long been used empirically both in human and veterinary practice. But Sir Joseph Lister has explained and systematised the antiseptic treatment, and rendered it greatly more certain and successful. He studied fermentative processes, and the analogous actions of micro-organisms on living tissues; and in 1867 inaugurated the aseptic treatment of wounds. Two conditions, he insists, are essential in **dealing with wounds**, whether accidental or made by the surgeon: (1) **Nothing septic must be left in them**; and (2) **Nothing septic must be allowed to get into them**. Acting on these principles, wounds which for an hour or two have remained exposed, and into which the ubiquitous dust particles and organisms have been introduced, should first be thoroughly cleansed of mechanical irritants, and then washed, and, if need be, syringed with a watery solution of corrosive sublimate, zinc chloride, or carbolic acid. After experimenting with many antiseptics, Sir Joseph Lister now prefers a double cyanide of mercury and zinc. The wound thus rendered aseptic, and the removal of discharges, if need be, provided for, it is to be protected from ingress of organisms by antiseptic dressings.

Any wound from a clean knife, or howsoever produced, if it is perfectly aseptic, is as quickly as possible covered with the dressing. This consists of lint, tow, oakum, or other such absorbent substance, saturated with an effectual germicide solution of carbolic acid, which has the advantage of being volatile, of chloride or biniodide of mercury, or of boric or salicylic acids. These dressings are removed daily, or as required, and are continued till healthy granulations cover and protect the wound. Further, to prevent wounds from being inoculated by septic germs, the knives, probes, ligatures, sponges, drainage tubes, and other appliances used in connection with them, should lie in an antiseptic solution until required, while the operator must also repeatedly moisten his hands with a similar solution.

Wounds kept strictly aseptic heal quickly; if otherwise properly treated inflammation rarely appears, inasmuch as the

conditions determining irritation are avoided ; pain consequently is slight and of brief duration ; suppuration does not occur, its organismal causes being excluded ; blood clots are preserved from harmful decomposition, and are gradually filled up by young tissue ; portions of damaged structure without hurt are removed by absorption ; septicæmia and pyæmia cannot occur while micro-organisms and their products, which develop these infective diseases, have been destroyed or prevented entering the protected wound. Serious operations, such as the laying open of the cavity of the brain, chest, or abdomen, or the bursæ of joints and tendons, can be undertaken with greatly diminished risk when proper antiseptic precautions are adopted.

Carbolic acid is the antiseptic most frequently used in veterinary surgery. Its volatility carries it into the recesses of wounds, and thus in many cases increases its efficacy. It is applied, according to circumstances, in the proportion of one part dissolved in twenty to forty of water ; but besides watery solutions, liniments, ointments, and antiseptic lints are used. It is employed alone or in conjunction with corrosive sublimate. As an effectual non-poisonous antiseptic and parasiticide, Professor Fröhner and other German authorities strongly recommend **creolin**, which is a mixture of naphthalin, pyro- and para-kreasol, and other coal-tar products. **Salicylic acid** destroys all classes of ferments, but is not volatile ; it is used especially for the dressing of ulcers and eczema. Boric acid is non-volatile, non-irritant, and is often serviceable for superficial wounds, where frequent dressings are unnecessary, where the more active carbolic acid has for some time been persevered with, and where granulations and growth of skin require encouragement. The watery solution of sulphurous acid is cheap and effectual. Chlorinated soda solution is sometimes used. "Sanitas," which consists of camphorous bodies and peroxide of hydrogen, is a non-poisonous and valuable antiseptic. Iodiform readily parts with its 90 per cent. of iodine, conjoins antiseptic and local anæsthetic actions, and stimulates granulation. It is applied in ulcers and in chronic foul wounds. Such poisonous dressings require, however, to be used with some care for dogs, as they are liable to lick them. Iodine tincture, diluted according to requirements, proves a useful stimulant and antiseptic.

Antiseptics used internally are neither so certain nor so effective as when used externally. Bacteria within the living body are not so easily got at or destroyed; and, moreover, medicines such as corrosive sublimate and carbolic acid, which readily destroy the micro-organisms, are also liable to poison the patient. Dr Cash, however, has found that the continued administration of minute doses of corrosive sublimate render animals capable of resisting the deadly effects of the subsequent inoculation of anthrax. Professor Polli of Milan found that dogs, which for five days previously had received daily doses of sodium sulphite, suffered comparatively little inconvenience from the inoculation of fœtid pus, which destroyed, with gangrene and typhoid symptoms, dogs not previously protected by the antiseptic. Mr Crookes (*Third Report of the Cattle Plague Commission, 1866*) injected into the veins of a cow affected with cattle plague 105 grains of carbolic acid, dissolved in 6 ounces of glycerine and water. Not only were no bad effects produced, but the cow steadily improved and recovered. But even more to the purpose, as showing the efficacy of the administration of antiseptics, are the observations (also made by Mr Crookes) that cattle in plague-infected buildings, receiving daily an ounce of carbolic acid along with their food, and having carbolic and sulphurous acid fumes frequently liberated in their sheds, did not catch the contagious plague. Researches in this direction will probably lead to important results.

To prevent decomposition of the contents of the digestive canal, allay irritation and vomiting, and relieve diarrhœa and dysentery, such antiseptics as creosote, carbolic, salicylic, and sulphurous acids are administered. Alcohol, the ethereal oils, and other members of the fatty series of carbon compounds, are prescribed. Most of the bodies of the aromatic series are also antiseptics; but carbolic and salicylic acids are more active than salol, exalgine, thallin, resorcin, and naphthalin. Creolin is the antiseptic most frequently prescribed in Germany. The notable efficacy of mercurials in many gastro-intestinal disorders depends upon their antiseptic properties. In the treatment of phthisis in human patients, inhalation of spray, containing very minute quantities of corrosive sublimate, has recently been used with some success.

The uses of disinfectants.—Perfect cleanliness of the animals and their surroundings, with abundance of pure air and water, are the chief purifying agents requisite, so long as animals are in perfect health. When, however, **contagious** or **zymotic disease** occurs, it is necessary to destroy the specific micro-organisms produced, and prevent their diffusing and attacking healthy subjects. **Pure air** dilutes, but it also diffuses, and does not destroy these contagious organisms.

Water, like air, mechanically dilutes noxious matters, and hastens their oxidation. Sewage freely mixed with running water is hence rapidly decomposed and robbed of injurious properties. Decomposing organic and contagious matters, insufficiently diluted with water, instead, however, of being deprived of their activity, are apt to get distributed, and are liable to assume more dangerous forms. Hence, in purifying foul or infected places, solid accumulations should be mixed with some fitting antiseptic, and removed without the addition of water. Infected stables, sheds, market-places, trucks, or ships should be swept out, and, if need be, scraped; and dry or semi-solid filth, which proves so ready an absorbent of contagious virus, should be mixed with M'Dougall's disinfecting powder, and cleared away. The partially cleansed surfaces should then be well washed with carbolic soap and water, or corrosive sublimate solution; brickwork subsequently lime-washed, and woodwork sprinkled with crude carbolic acid in the proportion of two ounces to the gallon of water.

It is of paramount importance to attack the infecting micro-organisms as soon as they are produced, and before they have opportunity for distribution. Animals affected with contagious diseases should accordingly be immediately **isolated**, provided with attendants who shall have nothing to do with the healthy stock, their droppings at once disinfected, their skins and feet washed daily with some antiseptic, whilst antiseptic medicine should be given internally.

Sheds or stables occupied by infected animals should be fumigated several times a week with **chlorine** or **sulphurous acid**. The former is the more effectual, and is evolved gradually by treating bleaching powder with diluted sulphuric acid, or more freely by mixing common salt and black oxide of man-

ganese with sulphuric acid. Half a pound of sulphur, mixed with about one-fourth part of charcoal, and placed in a chauffer or on a shovel of hot cinders, fumigates a shed about 100 feet long and 20 feet in breadth and height. Neither chlorine nor sulphurous gas, properly managed, should cause pulmonary irritation, either to the animals or their attendants. **Carbolic acid** in its impure liquid form is conveniently applied with a brush over the doors, walls, and mangers; and M'Dougall's carbolic powder should be scattered over the floors and manure heaps daily. Rugs, pieces of carpet, or sacks, wetted with a strong solution of the volatile carbolic acid, should be hung about the premises.

The reporters to the Cattle Plague Commissioners adduce many striking cases showing the **efficacy of disinfectants**.* Mr William Crookes and others used carbolic and sulphurous acids on many farms during the prevalence of cattle plague, and these herds, although within centres of contagion, escaped. Nay, more, individual animals breathing an atmosphere of carbolic acid, and receiving daily doses of the acid with their food, resisted the contagion for weeks, although plague-stricken subjects were dying in adjoining standings. One herd of seventy-three animals in Cheshire was for months surrounded by cattle plague. The virus was eventually conveyed to them by one of the milkmen. Four of the cows milked by him sickened and died; twenty-eight younger animals, unprotected by disinfection, also caught it and perished; but disinfection, continuously applied, effectually arrested further spread of the disease. From the end of February until the middle of April no new cases occurred. The disease abating in the neighbourhood, the forty-one surviving cows were turned out to grass; within, however, a few days of their removal from the protecting influence of the disinfectants, they were, one after another, struck down by plague, and all died. Carbolic acid sprinkled about the boxes, sheds, and enclosures of the Jardin d'Acclimatation, in Paris, proved successful in preventing the spread of cattle plague in 1865. Similar treatment has secured the like immunity from attacks of contagious pleuro-pneumonia and

* Reports of the Commissioners appointed to enquire into the origin and nature of the Cattle Plague, 1866.

foot-and-mouth disease. Repeated instances have come under my notice where foot-and-mouth disease has been arrested, after a portion of the herd has been attacked, by washing twice a week the walls, floors, doors, and other woodwork of the infected premises with carbolic acid, confining the animals for several weeks to their sheds or boxes, and keeping them surrounded by and breathing an atmosphere abounding in the tar acids, freshly evolved by sprinkling M'Dougall's powder daily over the floors and the manure. By similar disinfection, the progress of influenza and of strangles in large studs has frequently been arrested. Professor Nocard has shown that, when a cow aborts, whether from mechanical and accidental causes, or from virus introduced from subjects which have previously aborted, further spread of the mishap may be prevented by corrosive sublimate injections into the uterus, washing the external organs with a similar solution, and disinfecting and burying or burning the aborted calf and placenta. In calves that have been with those aborting should have the external organs and top of the tail washed daily with the antiseptic solution.

Burning is the only absolutely safe method of dealing with the bodies of anthrax subjects, from which removal of the hides is dangerous, alike to persons employed or, it may be, to other animals. Cattle plague and swine fever cases should either be burned or deeply buried; while for the diseased organs of tuberculous patients the furnace is the only safe tomb.

A high temperature, as already indicated, destroys infective particles. Koch, as above stated, found that the bacilli of anthrax and swine fever, even when bearing spores, were deprived of pathogenic power when exposed for four hours to a temperature of 216° to 220° Fahr.; while exposure for five minutes to boiling water, or, better still, to **steam heat**, is equally effective. The power of steam depends—(1) on its latent heat; (2) on its moistening; (3) on its condensing; (4) on its penetrating. It is most effective when employed under pressure, and when its entrance into the chamber is occasionally interrupted, so that cold air in the interstices of bulky and non-conducting bodies may be displaced. Dr Russell, Medical Officer of Health, Glasgow, exposes all infected washable articles, for three-quarters of an hour in a chamber, to steam heat, along

with soap and soda, and finds that this treatment destroys bacilli of anthrax and swine fever, tuberculous pus, and also the ova of lice. This method should, where practicable, be adopted in the case of rugs and other articles used by infected animals. Leather straps being spoilt by steam should be removed from horse-clothing before it is steamed, but, without injury, are disinfected by carbolic or corrosive sublimate solutions.

Conveyance of contagion by attendants is prevented by sprinkling their clothes with weak carbolic solutions. After handling animals affected by contagious disease, or making post-mortem examinations of such subjects, the hands should be cleansed first with soap and water, and then washed with a 2 per cent. solution of carbolic acid, or with a solution of 12-15 grains corrosive sublimate to a quart of water, which very effectually destroys any adhering bacilli.

So soon as the premises in which animals affected with contagious disease have lived can be emptied, more **thorough disinfection** should be carried out. To this end, doors and windows having been closed, chlorine or sulphurous acid should be freely evolved, and the place kept shut up for several hours. Walls, floors, and woodwork should subsequently be scraped, and washed with corrosive sublimate solutions.

Different disinfectants are suitable for different purposes. When putrefying or contagious matters have been freely mixed with water, the best are mineral salts, of which the most effective and cheapest are corrosive sublimate; zinc chloride, in the familiar form of Sir William Burnett's disinfecting fluid; and iron chloride, the active constituent of Ellerman's deodorising fluid. For sewage disinfection, or where there is much water, aluminium sulphate, followed by lime, is also recommended. Sulphites promptly remove smells, and are most effectual when conjoined with the tar acids. The mixture of sodium sulphite and carbolic or cresylic acid, although effectual for deodorising, has a feeble power in preventing the putrefaction of night soil, and when remaining for a day or two freely dissolved in water they give off sulphuretted hydrogen. Common salt, although ineffectual in checking decay when once established, or of neutralising bad smells, is a cheap preserver of many animal substances. It preserves and disinfects skins. For conserving

for manure meat seized as unfit for human food, Cooper's salts, consisting of refuse commercial chlorides, are cheap and effectual. Iodine is volatile and penetrating. Mainly on Dr B. W. Richardson's recommendation, it is used in many sick-rooms and hospitals, conveniently dissolved in the light diffusible amyl-hydride. The solution contains 20 grains to the ounce; an ounce suffices for every four feet of cubic space; distributed by a spray producer, it volatalises rapidly; it leaves, when freely used, a film of iodine, and effectually destroys smells and noxious organic matter. Its expense, however, precludes its general use in veterinary practice.

The uses of deodorisers.—Bad smells, however unpleasant, are not necessarily prejudicial to health, and, although sometimes associated with, are perfectly distinct from, the micro-organisms of zymotic or contagious diseases. Objectionable smells are largely made up of sulphuretted hydrogen, phosphuretted hydrogen, and nitrogen gases, with sulphurous and ammoniacal compounds. Still more injurious are the noisome exhalations from the skins and lungs of animals. Some popular deodorisers only cloak and overpower, instead of neutralising or destroying, odorous principles. Of this description are fumigations with aromatic and balsamic substances, such as camphor, cascarilla, and lavender, the burning of brown paper, the sprinkling of scents and essences. Odours depending upon gases are readily removed by effectual chemical neutralisers: sulphuretted hydrogen, by chlorine; ammoniacal emanations, by hydrochloric or nitric acids. Smells from decomposing organic matters are usually most effectually got rid of by arresting decomposition by suitable antiseptics. Noisome odours already floating in the air may be attracted and absorbed by freshly-burned charcoal, dried earth, or cotton wool; or altered and broken up by such gases as chlorine or sulphurous acid. For destroying the intolerable smell from the cochineal dye-works, no deodoriser has been found so effectual as sulphurous acid. For deodorising the contents of privies, without detracting from the manurial value, a mixture of common salt and carbolic acid is effectual; or eight parts of calcined dolomite mixed with two of peat or of wood charcoal.

Powerful mineral antiseptics, such as the zinc and iron

chlorides, especially when used in concentrated solution, are not good deodorisers. They are apt to evolve disagreeable fatty acids. Not being volatile, they can only destroy the odorous particles brought into immediate contact with them. The like objection of being fixed, and hence unable to seek out the floating odorous matters, stands against the exclusive use of the permanganates in their handy form of Condy's fluid. Iodine, dissolved in amyl-hydride, although an expensive, is an elegant and effective deodoriser. In unoccupied places with closed doors, the iodised solution may be freely distributed by a spray producer. Cresylic and carbolic acids are good deodorisers, are volatile, but have the disadvantage, when used in concentrated form and in presence of much water, of evolving sulphuretted hydrogen. A mixture of dry sodium sulphite with carbolic acid is effectual, and moderate in cost, and should be placed in vessels distributed about the premises. M'Dougall's disinfectant powder is also good, especially when charged with an extra quantity of carbolic acid; animals appear to have no dislike to the tar-like odour, and nothing answers better for removing the smell and arresting the decomposition of stable or other manures. Chlorinated lime, in the familiar form of bleaching powder, although possessed of small antiseptic power, is a prompt and effectual deodoriser, can be employed either for solid or liquid impurities, gives off gaseous chlorine, and never causes any disagreeable combinations; but breaking up instead of preserving organic matters, it diminishes the value of manure with which it is mixed. It is applied as powder, or in solution containing from 2 to 5 per cent., to the walls, woodwork, and floors of the places requiring purification, or sheets soaked in the solution are suspended about the premises.

PARASITICIDES are killers of parasites, whether animal or vegetable. The group includes germicides, or killers of micro-organisms (p. 32), and vermicides, which will be subsequently noticed. They are referred to here as they mainly consist of antiseptics. The two varieties of ringworm produced by vegetable moulds are destroyed by metallic solutions, by phenol oils, and tincture of iodine. Scab and mange caused by various genera of accari are treated by sulphur ointments, solutions of carbolic acid, creolin, or arsenic, or by tobacco infusions. The

stronguli invading the bronchial tubes of young cattle and sheep, and causing hoose or husk, are destroyed by inhalation of diluted sulphurous acid, or chlorine, or by turpentine given by the mouth or intratracheally.

ANTIPERIODICS are remedies which mitigate or prevent the intermittent intensity of the symptoms of certain diseases. Such periodical recrudescence is less marked in the lower animals than in man, but is sometimes observable in the pyrexia of influenza in horses and distemper in dogs. These exacerbations usually occur in specific disorders, and are believed to result from the recurring development of fresh crops of micro-organisms or their products. Cinchona, quinine, and arsenic are the most effective antiperiodics.

REMEDIES ACTING ON THE SURFACE OF THE BODY.

RUBEFACIENTS — VESICANTS — SUPPURANTS — CAUSTICS — SETONS
 — THE ACTUAL CAUTERY — ASTRINGENTS — DEMULCENTS —
 EMOLLIENTS — DILUENTS.

Irritants, when applied to the skin, stimulate or inflame it, and by reflex action produce certain remote effects, when they are termed **counter-irritants**. They relieve or remove congestion, inflammation, and pain, and, by stimulating functional activity, promote repair. It is not always easy, however, to explain how these curative results are produced.

Heat and **cold** both relieve tension, and hence pain; but they produce their effects in different ways. Cold reflexly contracts afferent arteries, and hence lessens the quantity of blood going to an inflamed spot. Warmth dilates capillaries adjacent to the seat of inflammation, and hence lessens the current of blood going to it.

Irritation or inflammation of the skin surface, as indicated, frequently relieves or removes congestion, inflammation, and pain of adjacent or deeper-seated parts. To effect such purposes blisters are applied, in most animals, in sore throat, bronchitis, pleurisy, chronic abscess, inflamed joints, &c. Their curative results are thus explained: When the chest walls are blistered in a case of pneumo-pleurisy, so soon as the skin

becomes hot and tender, a stimulus is conveyed by the afferent nerves to the vaso-motor medullary centres, and thence is reflected down the vaso-motor nerves, causing the lung and pleural capillaries to dilate, and thus diminishing tension and pain. Dr Lauder Brunton mentions that "when cantharides collodion was painted repeatedly over the back of a rabbit for fourteen days, the vessels underneath the skin and the superficial layers of muscles were congested. The deeper layers of the muscles, the thoracic wall, and even the lung itself, were much paler and more anæmic than those of the other side." The blister is thus believed to act much in the same way as a warm poultice does, viz., it dilates the congested or inflamed capillary network. Counter-irritants may occasionally, however, act reflexly, as cold does, and by contracting arterial vessels, relieve congestion, inflammation, and pain. But whether the blister dilates or contracts the capillaries of affected parts, it certainly increases circulation through them, promoting cell growth and hastening absorption. It thus restores healthy action in most inflamed organs, in swollen glands and joints, as well as in exostoses, if not of too old standing.

The several classes of irritants used externally differ materially in the intensity and duration of their effects.

RUBEFACIENTS produce **slight redness** and **congestion**, and are represented by the medicinal ammonia solutions, mustard, iodine, mild preparations of cantharides, and arnica; by alcohol, ether, and chloroform, if prevented evaporating by oiled silk or other means; by turpentine and other volatile oils, as well as by smart friction and moderate heat. The laundress's smoothing-iron heated and pressed equably over the skin, either bare or covered with brown paper or flannel, proves a useful rubefacient in rheumatism and enlarged joints in delicate young animals. Owing to the colour of the skin and abundance of hair, reddening in veterinary patients is, however, less obvious than in man. **Friction** and **pressure**, as in kneading or shampooing, exert many of the effects of counter-irritants, and, moreover, assist in mechanically emptying over-loaded lymph vessels and veins. They thus relieve the swollen legs and joints of hard-worked horses.

VESICANTS are more active and deep-seated, inflame the true

skin, and **raise vesicles or blisters**, which contain a serous fluid consisting of about 78 parts of water, 18 of albumin, with a little fibrin, and 4 of salts. Steam and boiling water rapidly produce a large amount of effusion. Blisters, by whatsoever agent raised, after some days either dry up, or, when the inflammation has been considerable, secrete a muco-purulent fluid, which hardens, protecting the parts until the new skin forms. Cantharides, glacial acetic acid, turpentine, strong ammonia, and boiling water are the vesicants in most common use in veterinary practice.

SUPPURANTS actively inflame the deep-seated cutaneous tissues (especially the orifices of the sweat glands), and **cause pustules** and a purulent discharge. This is the effect of euphorbium, croton oil, tartar emetic, mercury biniodide ointment, and also of cantharides, mustard, and other active vesicants, when applied to the same spot repeatedly or in large quantity.

CAUSTICS combine with the water and albumin of the tissues, with which they are brought into contact, and cause the separation of a slough. Those producing extensive sloughing receive the title of **escharotics**. Caustics are exemplified by the concentrated mineral acids, glacial acetic, carbolic, and chromic acids, concentrated alkalies, antimony chloride, arsenic, bromine, and the soluble salts of the heavy metals.

Caustics are used to destroy parasites or virus in wounds, and for this purpose penetrating fluid caustics are sometimes preferable to solid. They expedite and complete the destruction of sloughing textures. They are employed for opening abscesses and forming issues, and for removing warts and other tumours, especially when so deep-seated and vascular that they cannot be safely extirpated by the knife. When employed for the arrest of hæmorrhage from accidental or surgical wounds, they receive the special title of **styptics**. When thus used, the blood is removed by a piece of lint or a sponge, and the part lightly pressed, so that the blood-vessels may be more readily seen, and the caustic applied to them with precision, and with as little destruction as possible of surrounding textures. A coagulum forms over the bleeding vessels, and the effect of the styptic may be seconded by equable pressure and application of cold. (*See* Astringents and Styptics, pp. 50-52.)

But besides these more direct and mainly chemical effects, they develop more complex and vital reparative effects. Applied, for example, to indolent or callous ulcers, they stimulate the trophic nerves and blood-vessels, promote healthy nutrition, and thus hasten healing. Lightly used, they condense soft, spongy, exuberant granulations, and stimulate adhesion in the walls of sinuses. These beneficial effects on morbid processes probably result, not only from direct action on the diseased tissues, but also from indirect reflex action on surrounding parts; in other words, from counter-irritation.

SETONS are sometimes substituted for blisters or firing, and are frequently preferred to firing on account of their being less apt to blemish. The seton consists of a piece of tape, cord, or fine twisted wire, and is usually inserted by means of a seton needle. To prevent it slipping out, the ends are tied together or knotted. It is usually ordered to be moved daily; and if severe effects are desired, it is smeared with blistering ointment. Setons act chiefly on the comparatively insensible subcutaneous cellular tissues. They are serviceable in combating chronic inflammation of joints, in relieving the lameness of tedious cases of bone spavin, and in strangles in well-bred horses, where they sometimes appear to prevent that atrophy of the muscles of the larynx known as roaring, and so frequently following strangles. Placed in the dewlap, they have also been much used as preventives for black-leg in calves and young cattle, and for splenic apoplexy in older animals; and the effects ascribed to them may result from their increasing the leucocytes which absorb or destroy the specific bacilli.

An **issue** or **rowel** acts in much the same manner as a seton. A wound is made in the skin with a bistoury or rowel scissors, and is kept open by the insertion of a pledget of tow, lint, or leather, which, to increase counter-irritation and discharge, is sometimes smeared with irritant dressings.

Acupuncture is effected by needles three to six inches in length, introduced, especially into fleshy parts, with a rotatory movement.

Aquapuncture, conveniently effected with a hypodermic syringe, introduces water or medicated solutions into soft,

painful, or irritable textures, and thus sometimes relieves nervous or rheumatic pain, and imparts vigour to wasting or paralysed muscles. Both are forms of counter-irritation.

THE HOT-IRON OR ACTUAL CAUTERY is still much used in veterinary practice as a counter-irritant. It is generally applied at a full red heat, and the higher the temperature the less the pain attending its application. It is employed for some of the purposes of active vesicants, and also of caustics. In the treatment of diseased joints, tendons, and ligaments, for which it is chiefly used, it amends by reflex action deep-seated, faulty nutrition. It does not, as was once currently believed, form a permanent bandage around the parts; for a short time indeed after the operation the skin is corrugated and tightened, but it soon resumes its natural elasticity, and does not embrace the subjacent parts more firmly than in health. The firing of healthy limbs, with the popular idea of strengthening and bracing them up, is now deservedly discountenanced, and any benefits apparently accruing from such an operation really result from the rest which it necessitates. In nervous, excitable horses, firing occasionally produces irritative fever, especially if several legs are done at the same time.

Dry cupping is occasionally employed as a derivant or irritant in the human subject, and is equally serviceable in the lower animals.

The uses of counter-irritants.—In influenza, bronchitis, and other depressing disorders of horses, in order to rouse the action of the heart and avert lung congestion, rubefacients, such as soap liniment or mustard paste, are sometimes rubbed into the chest, abdomen, or legs, and when the surface is warmed, as it generally will be in ten to fifteen minutes, the dressing is washed off. Counter-irritants are in common use in certain stages of inflammation of the joints, as well as of the eyes, air passages, intestines, and their investing membranes. They are more beneficial in laryngitis and bronchitis affecting the larger tubes, and in pleurisy, than in broncho-pneumonia or pure pneumonia. In the outset of inflammatory attacks, by reflex action, they lessen hyperæmia, chiefly, as above stated, by stimulating the dilated paralysed capillaries, thus favouring resolution. In more acute stages, when blood-plasma and red

and white globules are escaping through the walls of the distended vessels, fomentations and poultices are generally more suitable than irritants. When the urgency of the febrile symptoms has somewhat abated, counter-irritants are, however, again useful in promoting absorption of inflammatory products, and they frequently invigorate enfeebled, over-distended capillaries, and substitute higher formative for lower debased action.

Blisters act more powerfully on the skins of horses than of cattle, and require to be used with special caution for dogs, which are apt to bite and rub the blistered parts, and thus induce sloughing. For general purposes in canine practice, iodine is a most useful counter-irritant. The action of turpentine on the skin of horses is peculiar. Applied over a considerable surface, it produces such intense itching irritation that some animals for a short time become much excited, a result the more remarkable as turpentine acts but slightly on the more delicate human skin.

The choice of a counter-irritant and the mode of using it are determined by various conditions. Promptly to produce general revulsion, as in combating chill, rousing nervous depression, or overcoming such functional disturbance as occasions colic, mustard and other rubefacients are specially indicated. To act more permanently on parts in which nutrition has been more seriously impaired, as in chronic pleurisy or phlebitis, cantharides is the appropriate counter-irritant. Where bone, cartilage, or ligament has been chronically affected, still more profound and permanent effects result from the use of mercuric biniodide ointment, the hot-iron, or setons.

In inflammatory diseases of the chest in horses mustard is preferable to cantharides. In well-bred animals with sensitive skins about a pound of mustard flour made into a paste with water is rubbed into the sides and washed off in half-an-hour. In the heavier breeds with less sensitive skins and more placid temperament, tissue paper is laid over the mustard dressing, and the body-sweater loosely applied. Some horses show considerable restiveness, and even some considerable amount of pain. So soon, however, as tenderness and swelling are notable externally, as they usually are in from two to four hours, the

chest symptoms abate. No other remedy affords such prompt and effectual relief in these cases. Indeed, when the mustard fails to produce its external irritant results, the patient's chances of recovery are small. Professor Williams, however, disapproves of the use of all blisters in chest diseases, urging that, besides causing needless pain, they aggravate instead of alleviate the inflammation. He further states that they increase the liability to hydrothorax, while, when used in diseases of joints, he declares that the superficial inflammation they produce extends to the subcutaneous tissues, including even the periosteum and bones.

These charges are inconsistent with physiological observations, and are effectually disproved by the five following experiments, undertaken by Professor M'Call in February 1891:—

1. Post-mortem examination of the chest of a horse, which, three days prior to slaughter, had mustard as a counter-irritant applied. Inflammatory congestion of the skin and subcutaneous cellular tissue, with effusion very pronounced, but periosteum, ribs, and other tissues unaltered in colour or consistency.

2. Post-mortem examination of a chronically diseased hock-joint which had been pyropunctured, and thereafter blistered, about one week prior to slaughter. Inflammatory action produced in the skin, and markedly at the points of puncture with the irons on the superficial layer of subcutaneous tissue; but all structures deeper placed not in the least affected or altered in appearance.

3. Post-mortem examination of chronically enlarged fore fetlock joints of a horse, which, three days prior to slaughter, had been blistered with cantharidine ointment. Inflammatory action and effusion confined to skin and subcutaneous cellular tissue.

4. Post-mortem examination of a lady-toed worn harness horse, having a large splint or bony growth on the inside of each fore limb, with considerable thickening of the skin from brushing, and to which diseased parts cantharidine blisters had been applied three days prior to slaughter. Inflammatory action marked upon skin and cellular tissue, but no deeper.

5. Post-mortem examination of a horse which had a considerable growth of bone, involving the last row of small bones

of hock, and head of large metatarsal bone on the outside, and which had been line fired, and thereafter blistered with cantharidine ointment, three days prior to slaughter. Evidences of the effect of the counter-irritation well marked, but confined, as in all the previous cases, to the skin and subcutaneous cellular tissue, and leaving the periosteum, bones, and deeper structures to the unaided eye unaffected and unchanged in colour.

Before a blister is applied, the skin should be well washed with soap and water, and the hair, when long or thick, removed with a pair of scissors or a razor. The effect may be further hastened and increased by subjecting the part to smart friction, or the action of hot water, and by rubbing the agent well in, taking care to spread it over an amount of surface bearing some proportion to that diseased. Violent, deep-seated action is seldom desirable. Abundant discharges evidencing extensive tissue destruction are seldom requisite. Better curative results are usually attained by more moderate and continuous effects kept up by repeated applications.

Counter-irritants may generally be applied directly over the inflamed organ, when removal of fluid or inflammatory products is desired; but should seldom be applied very near to extensive acutely inflamed parts, or to tissues immediately continuous with them. An inflamed joint is usually better treated by placing the blister above and around rather than upon the acutely inflamed spot. According to the late Dr Anstie, the irritant, if applied over a posterior branch of the spinal nerve trunk, from which the irritated nerve issues, often produces reflex effects of a beneficial character.

When vitality is low, or the skin irritable, blisters are apt to cause sloughing. When inordinate local irritation has been produced, it may be abated by fomentations, while undue constitutional excitement is removed by diluents, a mash diet, and salines. On the next or second day after a blister has been applied, the part should be dressed with vaselin, oil, glycerine, or sugar of lead lotion.

ASTRINGENTS contract the living tissues. Many produce their effects by **coagulating** or **precipitating albumin**. These comprise alum, lime, and chalk, salts of the heavier metals, acids, and alcohol, with tannic acid, and such tannin-containing

substances as oak-bark and catechu. All caustics used in small quantity, or diluted solution, are astringent. Others, such as ergot, digitalis, turpentine, and other volatile oils and eucalyptus gum, have no coagulant power on albumin, but contract the tissues, in virtue of their action on the walls of the nutrient arterioles. Gallic acid has hitherto been regarded as an astringent, but recent experiments made by Dr Stockman, in the Pharmacological Laboratory of the University of Edinburgh, and reported in the *British Medical Journal* of December 1886, have shown that it has no claim to any special coagulant action, nor any effect in lessening, like ergot, the calibre of blood-vessels, either by peripheral or central action. Like all other acids, although in lesser degree, it possesses, however, the power of diminishing the alkalinity of the blood, and hence increasing its tendency to coagulate. The remote effects of vegetable, probably, indeed, of all astringents, have been over-estimated. So soon as their chemical affinities have been satisfied by union with a base or with albumin, they must evidently lose their power of coagulating or precipitating albumin; and it is therefore difficult to see how they can exert astringent effects, either upon the respiratory or upon the urinary mucous membranes.

Astringents are **used** to diminish excessive, and modify faulty, secretion, to combat congestion of cutaneous and mucous surfaces, and arrest limited recent superficial inflammation. These results appear to be obtained in several ways. Heinz has shown that they prevent leucocytes transuding and accumulating outside the walls of inflamed vessels. But, however acting, some change is effected on the vascular walls, not always, however, by narrowing the vessels, for such notable astringents as alum and tannic acid dilate vessels; while silver nitrate acts on the cement substance of the endothelial. Their efficacy is often well seen in circumscribed inflammation of the conjunctiva or fauces. Solutions of tannin, eucalyptus gum, or alum, in spray or gargle, or inhalations of turpentine vapour, mixed with air, arrest the inordinate secretion, and relieve the congestion of sore-throat and bronchitis. Their application in disorders of the digestive organs will receive special notice under that heading. As injections and suppositories, they are used in irritable and inflamed conditions of the vagina and

uterus. The uterus and rectum, when prolapsed, are washed with astringent antiseptics, in order to diminish their irritability and swelling, and facilitate their safe return. They condense exuberant granulations, lessen and amend the faulty discharges from wounds and ulcers, which they usually coat with a protective film of albumin.

STYPTICS are astringents specially used to **arrest effusion of blood** from injured surfaces or vessels. Some, like matico, tow, lint, or pressure, mechanically check blood-flow from superficial vessels; others, like most astringents and caustics, coagulate albumin, and thus plug the leaking vessels; others, like ergot, digitalis, ice, and ether spray, contract capillary vessels, while lead acetate probably acts in a twofold way, increasing coagulability of the blood, and also contracting arterioles. In serious hæmorrhages, it is further desirable that the patient be kept quiet, and that his food be given cold.

DEMULCENTS soothe, soften, and ensheathe parts with which they come into contact, act chiefly mechanically, and closely resemble emollients. They include gums, mucilage, linseed, cotton-wool and collodion, fuller's earth, starch, treacle, gelatin, albumin, fats, oils, glycerine, and milk. They take the place of the mucous and other natural demulcents, where these are defective or wanting. They **lubricate** or **defend** abraded or irritable parts from external injury, acrid secretions, and poisonous matters. When absorbed, they exert, although in modified degree, remote demulcent effects. They are employed in solution, spray, draught, or enema, to relieve dry, irritable, and inflamed conditions of the skin, respiratory, digestive, and urino-genital membranes.

EMOLLIENTS soften, soothe, and relax the parts to which they are applied. They resemble demulcents, and include many of the articles specified in that class, as well as those substances which absorb and retain heat and moisture. They are represented by fomentations, poultices, and spongio-piline, and by folds of lint, flannel, or woollen cloth, wrung out of hot water, and covered with waterproofing. (*See* Poultices and Fomentations.) Fats, oils, lanolin, vaselin, paraffin, with soap and other liniments, are also emollients. Fatty emollients rubbed into the skin soften and supple it; and when applied with

smart and continued friction, they also increase tissue changes, and hasten removal of deposits. In the form of watery vapour, simple or medicated emollients relieve irritability and congestion of the respiratory mucous membrane. In the form of clysters, they directly soothe the posterior portions of the alimentary tract, and by reflex action their good effects are propagated to adjacent parts. Not only do they reduce tension and relax tissues to which they are immediately applied, but, acting on adjacent vaso-motor centres, they dilate collateral blood-vessels; and mainly in these ways fomentations and poultices relieve irritation and inflammation of the throat, lungs, and other deep-seated organs. In the earlier stages of inflammation they effect resolution; in more advanced stages they promote supuration; in all stages they relieve heat, tension, pain, and spasm. Although serviceable for softening and cleansing wounds, they are generally unsuitable for those likely to heal by first intention or adhesion.

DILUENTS are allied to demulcents and emollients, are liquid or solid substances used along with more active agents in order to diminish their activity. Water is generally their basis, and they include most demulcent drugs. They beneficially dilute and hasten the excretion of pathogenic materials, and favour the action of diaphoretics, diuretics, and cathartics.

MEDICINES ACTING ON MUSCLES.

MUSCULAR POISONS—MUSCULAR STIMULANTS.

Muscles possess **extensibility** and **retractility**. Heat renders muscles less extensible and more retractile; cold, and section of an important nerve, have the opposite effects. Fatigue and acids, notably lactic acid, one of the products of muscular waste, increase extensibility. Very dilute alkalies diminish extensibility. **Irritability** is increased by heat and physostygmine; while it is diminished by cold, curare, and other substances which cause muscular paralysis. **Contraction** and **relaxation** of muscles, possibly consisting, like other forms of motion, in waves of vibration, appear to be connected with some chemical changes in the muscle resembling oxidation;

oxygen is used up, while sarco-lactic and subsequently carbonic acids are formed. These products, and the accompanying fatigue consequent on repeated violent contractions, are removed experimentally by washing out the muscle with a current of blood. A saline solution, notably potassium permanganate, by ready oxidation, causes similar results, which likewise follow the use of a mere trace of veratrine. In practice, removal of these waste products is hastened by shampooing the muscles or massage, the effects of which, in overcoming fatigue, are fully recognised. In like manner the thorough grooming and diligent hand-rubbing of the limbs of horses after a hard day's work lessens fatigue, as well as prevents subsequent stiffness and fulness of joints and bursæ.

Spasm consists of irregular purposeless contractions of voluntary and involuntary muscles, usually depending on faulty action of the higher co-ordinating centres. Spasm of involuntary muscles, as illustrated by that of the heart, blood-vessels, bronchi, or intestines is antagonised by nitrites, such as amyl-nitrite and nitrous ether (*see* Antispasmodics, p. 61).

“Rapid alternation of contraction and relaxation, or **tremor**, may affect either—(a) a few bundles of muscular fibres; (b) a single muscle; or (c) groups of muscles” (Brunton). Such tremors may occur when the muscle is at rest, or when it is in motion. This form of insubordination may probably result from the number of stimuli from the nerve-centre being either too few or too many. If the stimuli are insufficiently rapid, veratrine or calcium salts, which increase the duration of each individual contraction, are recommended. When a muscle, or its motor nerve, receives an abnormal number of vibrations, or is over-stimulated, instead of contraction being followed by relaxation, permanent contraction or **tetanus** ensues.

MUSCULAR POISONS are divided by Dr Lauder Brunton into the following six groups:—

1. Leaves the irritability of the muscle unaffected, but diminishes the total amount of work it is able to do. This group contains apomorphine, saponine, salts of copper, zinc, and other emetics. Antimony, arsenic, and large doses of iron have somewhat similar but weaker effects.

2. Diminishes the excitability of the muscle, as well as its capacity for work. This group contains salts of potassium, lithium, and ammonium, the cinchona alkaloids, chloroform, and alcohol, in large doses.
3. Diminishes the capacity for work, and produces marked irregularity in its excitability, and contains lead, emetine, and cocaine. Similar effects are also produced by ptomaines.
4. Alters the form of the muscular curve, as exhibited by veratrine, and to a similar, although less extent, by strontium and calcium salts.
5. Increases the excitability, as is notably done by physostygmine.
6. Increases the capacity for work. The drugs belonging to this group cause rapid restoration of the muscle after fatigue, and are represented by creatin, hypoxanthin, caffeine, and glycogen. These substances must hence be regarded, not only as nerve stimulants, but as direct muscular restoratives.

Voluntary muscles differ from involuntary, not only in structure, but in other particulars. Their contraction and relaxation are more rapid. They do not so frequently exhibit those rhythmical contractions, which are an inherent property of contractile tissue, and are independent of its nerve ganglia. The nerves in voluntary muscles terminate in end-plates, while the terminal twigs in involuntary muscles form a plexus round the fibres. Curare, in small doses, paralyses the motor nerves of voluntary muscles, but must be used in much larger doses to paralyse the nerves of involuntary muscles. On the other hand, small doses of atropine paralyse involuntary muscles, while much larger quantities are required similarly to affect voluntary muscles. Striking illustrations of the different effects on these two classes of muscle are recorded by "Szpilman and Luchsinger, who found that atropine produces paralysis of the motor fibres of the vagi supplying the œsophagus, only in those parts of it where involuntary muscular fibre is present. Thus, the œsophagus of the frog and the crop of birds consist of involuntary muscular fibre, and atropine destroys the motor power of the vagus over them. The œsophagus of the dog and

rabbit contains striated muscular fibre, and atropine does not paralyse the motor nerves. The œsophagus of the cat contains striated muscular fibres in its upper three-fourths, and non-striated in its lower fourth; atropine destroys the motor action of the vagus upon the lower fourth, but not upon the upper part" (Brunton). The paralysing effects of drugs upon muscles are believed to result from their disturbing the relations between the nerves and the muscular fibres which they excite.

MEDICINES ACTING ON THE NERVOUS SYSTEM.

On the Brain.—CEREBRAL STIMULANTS—EXHILARANTS—CEREBRAL DEPRESSANTS—SOPORIFICS—NARCOTICS—ANODYNES—ANTISPASMODICS—ANÆSTHETICS.

On the Spinal Cord.—SPINAL STIMULANTS AND DEPRESSANTS.

On Motor Nerves.—STIMULANTS—PARALYSERS.

On Sensory Nerves.—STIMULANTS—LOCAL SEDATIVES—LOCAL ANÆSTHETICS—ELECTRICITY.

The nervous system of the higher animals comprises:—

- I. The brain, which takes cognisance of external impressions, co-ordinates movements, and originates mental or psychical ideas. Relatively to other parts of the nervous system, the brain of man is more highly developed than that of other animals, and most drugs, accordingly, act upon it more powerfully than upon the less-developed brains of horses, cattle, or dogs. The cerebellum is chiefly concerned in the maintenance of equilibrium.
- II. The spinal cord, extending from the brain, conveys sensory impulses to the brain and medulla, from whence it receives and transmits motor impulses to muscles and glands. The cord, moreover, in several ways, transmits and regulates reflex movements. That part of the cord, or, indeed, of the nervous system, most essential to life, is the medulla, in which are situated the respiratory, cardiac, and other vital centres.
- III. Nerves of sensation, distributed to all parts of the body, convey impressions to the brain or cord.

IV. From the cerebro-spinal axis originate nerves which give motion to muscles, and convey other efferent impulses to glands.

Concerning the functions and diseases of the nervous system much has still to be learned, while the effects of medicines acting upon it have only recently been thoroughly examined, and still require much investigation.

ACTION OF MEDICINES ON THE BRAIN.

The brain of the higher animals comprises:—

- I. Motor centres, arranged along the two sides of the fissure of Rolando, and chiefly employed for the purposes of seeing food, masticating it, and moving the fore limbs.
- II. Sensory centres, for seeing, hearing, and taste, which are arranged in the posterior and lower parts of the brain; and others, for general sensation, which lie more interiorly in the hippocampal region.

Medicines affecting the brain act either directly on the **nerve-cells** or on the **general circulation**. Blood flowing freely through the brain increases its excitability; insufficient circulation diminishes excitability. Many medicines, such as alcohol and ether, act both directly on the nerve-cells and on the general circulation. They stimulate nerve-cells of all descriptions, wherever found, act on most of the brain-centres, and, according to the dose in which they are given, are stimulants or depressants. Full doses very frequently exert primary stimulant, and secondary depressant, effects. Such medicines as opium, alcohol, and ether, according to dose, are stimulant, narcotic, soporific, or anæsthetic.

The cerebro-motor centres have their **excitability lowered** by alcohol, chloral, and cold. The depression caused by cold, unless extreme, or applied for a long period, is followed, however, by reaction. Bromides of potassium and ammonium, without disturbing the relations of one centre to another, appear to have a marked effect in lowering general brain activity. Still more prompt and powerful are anæsthetics, which abolish all motor action. Atropine in small doses increases, but in large doses diminishes, motor excitability.

The motor centres have their **excitability increased** by mechanical irritation, as by the point of a needle, which produces epileptic convulsions. But similar convulsions also ensue when the vessels of the brain are surcharged with venous blood, as in asphyxia. Camphor causes excitement and constant movements, succeeded, in large doses, by clonic epileptic convulsions and death. The active principles of coculus indicus, cicuta virosa, and cenantha crocata, as well as cinchonidine and quinine, have similar convulsant effects. The action of these agents is not confined to the brain motor centres, but also extends to those in the medulla.

CEREBRAL STIMULANTS.—The functions of the brain generally are stimulated by a large group of agents, sometimes termed **brain stimulants** or **exhilarants**, and exemplified by the alcohols, ethers, and oil of turpentine. A moderate dose of alcohol, in a somewhat concentrated state, by stimulating the sensory nerves of the mouth, throat, and stomach, promptly exerts a reflex action on the vessels of the brain. Further, but less direct and powerful, brain stimulation ensues when the spirit enters the circulation and increases cardiac action. Where a large dose has been administered, the cerebral exhilaration is not, however, long continued; the normal relations between one centre and another are disturbed, delirium ensues, followed by impaired action and depression. Ammonia vapour, liquor, or carbonate, applied to the nostrils, reflexly stimulates the cerebral vessels, and presently acting upon the vaso-motor centres, also increases general blood circulation and pressure. Brisk exercise has much the same stimulating effect on the cerebral as on other arteries and capillaries. Mastication and sucking in young animals are shown by experiment to increase circulation in the carotids and cerebral arteries. The chewing of tobacco, betel-nut, or, indeed, anything else, smoking, and sipping stimulants, or even tea, coffee, or cold water, have similar effects in dilating the human cerebral arteries. Placing the head on the same or on a lower level than the rest of the body favours brain circulation, and hence wards off syncope.

The **functional activity** of the brain is **lowered** by large or repeated doses of stimulants, such as alcohol, which, after exhilaration, and, it may be, delirium, produce narcosis, sleep,

and sometimes death. Bromides of potassium and ammonium, without preliminary excitement or disturbed function, diminish brain activity. Accumulation of lactic acid, and probably other elements of tissue waste, appears to have an effect similar to that of the bromides in lowering the activity of the nerve-cells.

SOPORIFICS, or **HYPNOTICS**, are agents which induce sleep. Many of them lessen functional activity of the nerve-cells of the brain and spinal cord, while others besides impede the impressions transmitted through the nerves and special sense organs to the cerebrum. Full doses further depress the functions of the respiratory and vaso-motor centres in the medulla, as evidenced by slower respiration, dilatation of surface-vessels, and lowering of arterial tension. Sleep is caused by the using up of the potential energy of the cerebro-spinal system. Certain parts remaining, however, in a state of partial, unregulated activity, induce the phenomena of dreams, which occur almost as much amongst the domesticated animals as in man.

Hypnotics do not act so certainly on the lower animals as on man. Their effects do not appear to be so notably concentrated on the brain (p. 14). Dogs and pigs are, however, brought under their influence more readily than horses or ruminants. The most effectual are opium and morphine, chloral hydrate, croton chloral, hyoscyamus, cannabis indica, and bromides. **Opium** and **morphine** prove of special value, not only in depressing functional activity of the brain, but also in antagonising most descriptions of pain and irritation which interfere with sleep. **Bromides** diminish conduction of impressions, and hence notably quiet cerebral excitement. **Chloral** is a powerful hypnotic, but in large doses is irritant, and sometimes produces dangerous delirium and convulsions. It induces sleep mainly by its action on the brain, and its dilating vessels generally. Some recently discovered substances of the fatty carbon series possess marked hypnotic action. Paraldehyde, even in full doses, has none of the disadvantageous secondary effects of opium or chloral, causes quiet sleep in dogs, but is rather nauseous, and not one-third of the strength of chloral. Sulphonal is more active, but being insoluble, hypnosis is slowly established. It has been used specially in

cases of motor unrest. Large doses diminish excitability of the reflex functions of the spinal cord, and also of peripheral sensations. Hyponc, urethane, and amyline hydrate, recently brought into notice, are feeble hypnotics. Warmth to the body and legs, and the swallowing of comforting warm drinks withdraw blood from the brain, and hence favour the anæmia which occurs in sleep.

NARCOTICS are drugs which disturb the relation of the mental faculties with the external world. This disturbing effect is produced by full doses of alcohol, ether, chloroform, and most stimulants. After a variable amount of excitement, paresis of co-ordination ensues, and the animal staggers in its gait. Where the effect is still further developed, fatal paralysis of the respiratory centre occurs. Opium and Indian hemp produce little vascular excitement, and their narcotic effects are stated to be due chiefly to alterations in the relative functions of the different parts of the brain. Belladonna and its analogues produce active delirium, perpetual movements associated with debility, and depending, Dr Lauder Brunton believes, on the "combined stimulant action of these drugs on the nerve-centres in the brain and spinal cord, and their paralysing action on the peripheral ends of the motor nerves."

ANODYNES or analgesics are agents which relieve pain by diminishing excitability of nerves or nerve-centres. Pain may originate in the hippocampal region, which Professor Ferrier regards as the central seat of sensation, and some abnormal excitement of these nerve ganglia is believed to occur in hysteria. It may depend upon stimulation of the grey matter of the cord, through which painful impressions are conveyed. It may begin in the trunk of a nerve, but frequently its origin is in the peripheral endings of the sensory nerves.

Pain, thus produced in divers ways, requires diverse treatment. Its cause should, if possible, be discovered and removed. When merely local, it is combated by **local anodynes**, such as opium and belladonna, with their alkaloids; by cocaine, veratrine, carbolic acid, and other phenols; by menthol and thymol, local blood-letting, heat and moisture as applied by poultices or fomentations, and by cold, in the form of ice or cold water. Counter-irritants also reflexly act as analgesics.

When pain is not localised, **general anodynes** are administered, either by the mouth or hypodermically. Many act mainly as sedatives or paralysants of the hippocampal centres. Chloral hydrate, Indian hemp, hemlock, bromides, and anæsthetics are types of this class. But others, with less marked action on the brain, more notably diminish the conductivity of the sensory nerves, and are exemplified by atropine, and the drugs which yield it, and by cocaine, aconite, and veratrine. Opium and morphine, and indeed most effective anodynes, produce, however, their paralysant effects on all nerve-cells with which they come into contact, and hence act in both ways. Several of the newly-discovered bodies of the benzol or aromatic series conjoin antiseptic and anodyne properties. Such are salol, a salicylate of phenol; antifebrin, which controls many descriptions of pain; while exalgine is still more generally effectual. Salicylic acid and salicylates have a special power of controlling the pain of acute rheumatism and rheumatic fever. Electricity applied along the course of the stimulated nerves, and, in acute rheumatism, nerve-stretching, are sometimes tried. Dividing the nerve leading from the seat of injury, as is done in navicular and some other diseases of the horse's limbs, prevents perception of pain, but of course does not arrest local inflammation or other mischief. In horses, as in other animals, a dose of physic is often an effectual anodyne, probably owing to its relieving irritability of the cerebro-spinal centres.

ANTISPASMODICS are agents which prevent or remove **spasm**, which is an irregular, injurious contraction of voluntary or involuntary muscles. In the medulla oblongata, where it joins the pons, is a centre which, when stimulated, causes general spasms. These are excited by direct injury of the centre by irritating it with chemicals, by contact action of such poisons as strychnine, nicotine, picrotoxine, and ammonia, by rabies and other animal viruses, as well as by such a venous state of blood as is caused by asphyxia, or by sudden anæmia of the medulla from copious blood-letting. This spasm centre appears to be in an abnormal state in epilepsy, when its inordinate action is directly controlled by bromides. The tonic spasms of tetanus, strychnine-poisoning, and rabies are relieved by bromides and chloral hydrate.

But spasms are more frequently local than general. They are defined by Dr Lauder Brunton as "a kind of insubordination, in which the individual muscles or nerve-centres act for themselves, without reference to those higher centres which ought to co-ordinate their action for the general good of the organism. It may be due, therefore, to an excess of action in the muscles or local centres, or diminished power of the higher co-ordinating centres. As a rule, it is due to diminished action of the co-ordinating or inhibitory centres, rather than to excess of action in the motor centres. It is, therefore, a disease rather of debility and deficient co-ordination than of excessive strength." Local irritation is frequently the cause of spasm.

Excessive exertion develops in the muscles of locomotion, especially when employed in unworked work, waste products, which produce spasm or **cramp** (p. 54). Both cause and effect are frequently removed by smart friction. "In the intestine, cramp may be due to the presence of a local irritant, which ought, in the normal condition, to produce increased peristalsis, and thus ensure the speedy removal of the offending substance. From some abnormal conditions, the muscular fibres around the irritant contract excessively, and do not pass on the stimulus to those adjoining. From this want of co-ordination, painful and useless spasm occurs. In order to remove it we apply warmth to the abdomen, so as to increase the functional activity both of the muscular fibres and of the ganglia of the intestine. Peristalsis then occurring instead of cramp, the pain disappears, and the offending body is passed onwards and removed. Or we give, internally, aromatic oils, which will have a tendency to increase the ordinary peristalsis; or, yet again, we may give opium for the purpose of lessening the sensibility of the irritated part, or the nerves connected with it, and thus again bringing it into relationship with other parts of the body" (Brunton). In the treatment of colic in horses, these several modes of attack are usually conjoined. A diffusible stimulant such as ether or alcohol is given to increase the powers of the higher nervous centres, and thus bring the disturbed lower ones and the muscles into subordination; an opiate is associated to lessen local excitability; while a purgative is, besides, administered

in order to remove the indigestible food, which is usually the cause of the mischief.

The convulsions of **epilepsy**, as already mentioned, are warded off by bromides, while endeavour is also made to remove the conditions which lead to them by the administration of salts of arsenic, silver, zinc, and copper. **Chorea**, depending probably upon some lesion of the sensori-motor ganglia at the base of the brain, is treated by arsenic and copper salts, and where the patient is anæmic by iron and a generous oleaginous diet. **Spasm affecting the heart** is usually controlled by the judicious use of alcohol, ether, digitalis, or nitrites. These nitrites, exemplified by amyl-nitrite, nitro-glycerine, nitrous ether, and sweet spirit of nitre, are pre-eminently relaxers of spasm of involuntary muscles. They relieve the heart and blood-vessels in angina pectoris of human patients, and the dyspnœa of bronchitis, as well as the intestinal cramp of all animals. In overcoming spasm of particular parts, it is, as already indicated, important to exalt the power of the controlling centres of the brain and spinal cord by such stimulants as alcohol, ether, camphor, and bromo-camphor, and thus regulate and co-ordinate the lower disturbed centres. This twofold stimulation of the higher central and lower topical centres is also exerted by valerian, asafœtida, musk, castor, and volatile oils. Instead of exalting nervous excitability, another class of antispasmodics—such as borneol and menthol—lessen irritability, and paralyse motor, sensory, and reflex centres of the brain and cord, and thus often relieve spasm. Spasmodic diseases generally depending, as already indicated, on deficient and imperfect nervous power, restoratives, tonics, and good hygiene are essential factors in their successful treatment.

ANESTHETICS are remedies which **diminish and abolish sensation**. They are allied to anodynes, but act more promptly and fully. A state of brief and imperfect anæsthesia may be induced by checking or arresting circulation of blood through the brain and higher centres, as by copious blood-letting, pressure on the carotids, or inhalation of charcoal fumes, or other suffocating vapours. It may be produced locally by firm pressure, or ligature impairing circulation in the part. These methods, however, cannot safely induce such profound or pro-

longed unconsciousness as is requisite for the performance of surgical operations. But certain volatile drugs, brought into contact with the nerve-cells, reduce or arrest for considerable periods their functional activity, probably in virtue of chemical action.

Local anæsthetics produce paralysis of the peripheral endings of sensory nerves. They include cocaine, ether spray, carbolic acid, antipyrine, and iodoform, with cold and aconite. **Cocaine** is now generally preferred. The part is moistened with it, at intervals of five minutes, until the requisite insensibility is secured. Four or five such applications are usually needful. Cocaine proves particularly serviceable in diminishing irritability, and facilitating examinations of the eye and larynx, as well as for the performance of minor operations. **Iodoform** conjoins anæsthetic and antiseptic effects, and is used for operations connected with the rectum and vagina.

General anæsthetics, when inhaled, are carried in the blood-stream to the centres of the brain and cord, which they paralyse. They comprise nitrous oxide gas, chloroform, ether, and other substitution compounds of the methane (CH_4) and ethane (C_2H_6) series. **Nitrous oxide** produces its effects rapidly, induces a venous condition of the blood, with contraction of arterioles and rise of blood-pressure, and there is hence no risk of its causing syncope. In human practice, anæsthesia is sometimes induced by nitrous oxide, and subsequently maintained by chloroform or ether. **Chloroform** is generally used both in human and veterinary practice throughout Scotland, and by many practitioners in England. It is the most effectual and, rightly used, the safest known anæsthetic. It acts in smaller quantity, more rapidly, and with less excitement than ether. In America, **ether** was first employed, is most largely used, and is still preferred by many English practitioners, on the plea that it is less apt than chloroform to impair cardiac action. But it has the disadvantage of being more irritant, causing more excitement than chloroform, while it must also be given without admixture of air, and hence requires the use of an inhaler.

The **A. C. E. Mixture**, recommended by the Medical Chirurgical Society in 1864, consists of one part of alcohol, two of

chloroform, and three of ether. It is much used on the Continent of Europe, and is stated to be more stimulant than chloroform, and less likely to depress heart action; but it is more bulky, and its constituents evaporate unequally, so that more of the chloroform is inhaled during the later stages. A mixture of equal parts of ether and chloroform is used in various parts of France and Germany. The Austrian Government has advised one part of chloroform with six of ether in cold weather, and with eight of ether in warm weather. **Chloral hydrate** is given by the mouth or rectum, or by intravenous injection, and in this last form a solution of one to three of water is stated to be in general use at Alfort. But chloral hydrate and croton chloral are weaker anæsthetics than chloroform or ether, and, causing vascular dilatation, have the disadvantage of promoting hæmorrhage. **Butyl chloral hydrate** nearly resembles chloral hydrate, but exerts its anæsthesia on the fifth nerve, and parts supplied by it. **Methylene bichloride** (CH_2Cl_2), containing an atom more of hydrogen and an atom less of chlorine than chloroform, causes more rapid anæsthesia, but requires to be used in larger amount. The pure drug has also the disadvantage of being costly, and that usually sold is stated to be a mixture of chloroform and alcohol. **Methylal**, which has recently been used, acts quickly and effectually on dogs without apparent injurious after effects, and is also serviceable for local anæsthesia.

Anæsthesia is generally divided into **four stages**—I. Stimulant; II. Narcotic; III. Anæsthetic; IV. Paralytic.

I. **The stimulant stage** is characterised by symptoms of inebriation, more marked in the case of ether than of chloroform; excitation of cerebral and cardiac functions; vigorous animals struggle; the special senses and general sensibility are blunted. This stage usually continues from one to three minutes, but is shortened when the drug is given quickly in full doses.

II. **The narcotic stage** is marked by paralysis of the motor centres, the voluntary muscular system gradually becomes relaxed, the force and volume of the pulse are lowered, the functions of the higher brain centres are impaired, but reflex functions are slightly if at all affected. This stage, usually reached in from two to four minutes, is that suitable for

anodyne and antispasmodic effects, and for moderating violent and irregular labour pains.

III. **The anæsthetic stage** exhibits complete muscular relaxation, unconsciousness, and insensibility; the frequency and force of the pulse are decreased, the functions of the cerebrum and spinal cord are paralysed, the reflex contraction of the eyelid is abolished, but the centres of the medulla presiding over respiration and heart action are only slightly affected. This full insensibility may be safely maintained for an hour or two by small doses of the anæsthetic, and is the condition requisite for the performance of serious surgical operations.

IV. **The paralytic stage** occurs when the vitality of the medullary centres is abolished. It includes two distinct phases—the arrest of the respiratory centre, and the subsequent arrest of the cardiac centre. In dogs quickly anæsthisied, this stage is reached two to three minutes after full anæsthesia is induced; but where slow and gradual chloroform narcosis is produced, this interval may be more than doubled. The implication of **the respiratory centre** is indicated in the lower animals by irregular sighing or shallow breathing, instead of the stertor observable in man. Up to this point the animal is in no serious danger. But if anæsthesia is further pushed, the **heart centre is paralysed**, the pulse beats very quickly and stops, while usually within half a minute the heart action also ceases.

The action of anæsthetics has been very fully elucidated by two series of investigations undertaken at the instance of the Nizam of Hyderabad. The first series were made in the spring of 1888, under the supervision of Surgeon-Major Lawrie, and comprised 141 experiments, chiefly on dogs; while the second series, in the later months of 1889, under the direction of Dr Lauder Brunton, included 571 experiments, chiefly on dogs and monkeys, but also on horses, goats, cats, and rabbits. Chloroform, ether, and the A.C.E. Mixture were the agents used. The investigations demonstrate that the action of these anæsthetics is the same on man and on the animals mentioned; that lethal doses, whether of chloroform or ether, and whether poisoning be slow or rapid, arrest the respiratory before the cardiac action; that the heart is never primarily or directly affected, but in uncomplicated cases stops

two to six minutes after respiration. Consequently, as was taught by Simpson and Syme, and is insisted on by most Scotch practitioners, the careful observation of the respiration is *the* safeguard in the administration of anæsthetics. Although the patient is safe so long as the anæsthetic vapour continues to be eliminated by respiration, whenever the heart stops, unless artificial respiration is had recourse to within thirty seconds, the chances of resuscitating the animal are small. This important practical point was established by numerous experiments.

In the safe use of chloroform, and indeed of all anæsthetics in all animals, these investigations emphasise the necessity of narrowly **watching the breathing**, and, moreover, ensuring that nothing shall in any way interfere with it. The animal should be in the recumbent position—the head placed so that air passes directly into the lungs; no girths, straps, or pressure must interfere with respiratory movements. Monkeys, whose chests were encased in plaster of Paris casts, or whose abdomens were bound with bandages, died quickly. The paralysed tongue, dropping back upon the larynx of the unconscious patient, is liable to cause suffocation. Respiratory failure is also hastened by the subject having its limbs firmly bound; while struggling, or shallow, gasping breathing, by filling the lungs with the volatile vapour, intensifies its effects. Respiratory failure was accelerated, and heart failure followed rapidly, when chloroform administration was slow and prolonged, and when one-third of a grain of atropine was injected subcutaneously before inhalation. That chloroform has no direct paralyzant effect on the heart was further demonstrated by the injection in some cases of ten, in others of twenty minims into the jugular vein, when only ordinary and safe anæsthesia was induced.

Deaths occurring during anæsthesia, both in men and animals, have been ascribed to **syncope**, or **surgical shock**, and in order to elucidate this matter numerous experiments were made on dogs and monkeys. When full anæsthesia was produced, teeth were extracted, nails evolved, incisions made into the abdomen, portions of intestine ligatured, and the testicles sharply struck; but in no case was any marked effect produced on the heart action. To test the effect of chloroform on animals with **enfeebled heart**, dogs and monkeys were fasted, others were

freely bled, while others were given grain doses of phosphorous during several days, in order to produce fatty degeneration of the heart muscle. But neither syncope nor heart-shock were observable when these subjects were deeply chloroformed; as in other cases, the respiratory failure invariably preceded the cardiac failure; and when respiration was stopped by full doses, the animal, like others in perfect health, was restored by artificial respiration.

The post-mortem appearances of animals dying under anæsthesia consist in general congestion of the liver, portal system, kidneys, and spleen, which is also often puckered, and two or three times larger than usual. The left side of the heart is distended with arterial blood, the right side with venous; the lungs and trachea are normal.

Anæsthetics **are used** in painful, delicate, or protracted operations, as in castration of cryptorchids, removal of portions of hoof, and other such painful operations on the foot; herniotomy, excision of tumours; extraction of firmly-fixed teeth, especially in dogs and cats; reduction of dislocations, fractures, and hernia; mitigation of muscular spasm in tetanus, hydrophobia, and strychnine poisoning; facilitating the examination and treatment of tender or injured parts; for parturition, especially in the mare; and for painless death of injured, useless, or old animals.

Administration to horses may be made while the animal is standing, but more safely and effectually when he is cast and secured. A sponge or piece of lint, saturated with the anæsthetic, is placed in a tolerably close-fitting nose-bag, which is adjusted to the head. A conveniently constructed bag for the purpose has been patented by Messrs Carlisle & Bell of Carlisle. Many practitioners, when the horse is cast, place the lint, wetted with chloroform, over one nostril, that on the side farther from the ground being preferable, while, to prevent undue evaporation, a napkin is laid lightly over both nostrils. Endeavour is usually made to dilute the chloroform vapour with about ten volumes of air. But when too diluted it acts slowly and imperfectly, and the stage of excitement is prolonged and increased. Ether requiring to be given without admixture of air must be administered with an inhaler. Undue excite-

ment or struggling is overcome by giving the anæsthetic freely at first. So soon as the requisite degree of insensibility is reached, as is ascertained by testing with the finger the reflex condition of the cornea, small quantities of the drug suffice to maintain insensibility safely for an hour or more, provided a careful watch, as already indicated, is kept on the respiration. One to two ounces of chloroform properly given, without waste, will fully anæsthesise an adult horse or ox in from two to five minutes. Four times the quantity of ether is required. Young animals are more readily anæsthesised than old ones.

Dogs are very susceptible to the action of anæsthetics, but, with rational precautions, may be kept under their influence for an hour or longer. It has frequently been stated that chloroform is not so safe as ether; but the Hyderabad experiments disprove this. The dog should be fasted for three or four hours. The medicine is conveniently placed on a sponge or on lint, in a wire muzzle. Large or savage dogs are coaxed into a kennel, the entrance closed, and, from above, portions of cotton waste or blotting paper are introduced, saturated with the drug. Small dogs or cats speedily succumb when put into a box or tin pail, covered with a towel, on which successive quantities of the anæsthetic are poured. Rabbits, rats, mice, and birds, placed under a bell jar, with an opening at the top, are readily anæsthesised by putting in successive portions of blotting paper, soaked in chloroform.

When anæsthesia has been pushed too far, inhalation of the drug must immediately be stopped, and all impediment to breathing of fresh air removed. If natural breathing has ceased, artificial breathing must at once be adopted. Unless the lungs are surcharged with the anæsthetic, as when it has been given in large quantity and for some considerable time, the artificial respiration, properly employed within thirty seconds after natural breathing has ceased, will revive most animals in two or three minutes. In the Hyderabad experiments some animals were recovered fifty, but none sixty, seconds after natural breathing had stopped. In deadly narcosis occurring in ordinary practice, recovery, however, need not be despaired of so long as any cardiac movements continue, and artificial respiration should be persisted with for at least half an hour after natural breath-

ing has ceased. Hypodermic injection of ether or strychnine, or a continuous galvanic current, the positive pole being placed in the rectum, the negative in the mouth, are recommended in the hope of stimulating the motor centres of the medulla, and bleeding from the right jugular is enjoined to relieve the right heart.

ACTION OF DRUGS ON THE SPINAL CORD.

SPINAL DEPRESSANTS—SPINAL STIMULANTS.

The three prominent functions of the spinal cord are **conduction**, **reflex action**, and **origination** of nervous force. On these functions different drugs act in various ways. Caffeine, injected into the circulation, was found by Dr Hughes Bennett to paralyse the sensory columns of the cord, while morphine and chloral diminish its conducting power. Antagonising these are strychnine and other convulsant poisons, which so increase excitability that slighter stimulants cause increased effects. Reflex action is diminished by chloral and morphine, and is increased by strychnine and such other convulsants as nicotine and ammonia.

SPINAL DEPRESSANTS, such as methyl-coniine, **directly paralyse**; others, as aconite and digitalis, produce **paralysis indirectly**, by impeding circulation; others have been thought to act on those portions of the optic lobes known as Setschenow's centres, and thus exert an **inhibitory** or **restraining** influence. Pharmacologists classify spinal depressants as (1) those which **depress without marked previous excitement**, including hydrocyanic acid, methyl-coniine, saponine, physostygmine, turpentine, the alcohol group, ergot, emetine, salts of antimony, zinc, and silver; (2) those which **excite first and afterwards paralyse**, comprising the morphine group, ammonia, camphor, carbolic acid, chloral, nicotine, veratrine, arsenic, and mercury. Sulphaminol, a newly-discovered phenoloid, also belongs to this class, and is stated to reduce excitability of reflex functions and diminish peripheral sensation (*Year Book of Pharmacy*, 1890). Sulphonal, with hypnotic effects, also diminishes activity of the reflex functions, and is given in motor unrest.

Spinal depressants are prescribed to **lessen increased excit-**

ability of the cord, as in tetanus, chorea, and some forms of paralysis. By diminishing the conducting power of the grey matter of the cord, they impede the transmission of painful impressions. It is often, however, difficult to determine in what particular way the curative effects of agents like morphine and chloral are produced, inasmuch as they act in various methods on different parts of the nervous system, developing now depressing, and now stimulating, effects.

Some of these divers results are believed to depend on the **inhibitory** or **restraining** power which certain of the nervous centres exert on other centres. But Dr Lauder Brunton propounds a more satisfactory explanation of the nature of inhibition. He believes that **nervous stimuli consist in vibrations** in nerve-fibres or nerve-cells, analogous to the vibrations of light or sound. When two waves of light or sound fall upon each other so that their crests coincide, the intensity of the light or sound is increased; but when they fall so that the crest of one wave occupies the trough between the two preceding or succeeding waves, such two waves of light cause darkness, or two such waves of sound cause silence. Moving the one wave forward or backward upon the other intensifies or diminishes the vibrations of light or sound. "Supposing nervous stimuli to consist of vibrations like those of light and sound, the action which any nerve-cell would have upon the others connected with it would be stimulant or inhibitory according to its position in relation to them" (Brunton). If nerve-force, as believed, consists of vibrations similar to those of light or sound, the relative position of nerve-cells in action will often determine a stimulant or inhibitory result. If one nerve-current meets another in such a way that the waves of which they consist coincide, the nervous action will be doubled, but if they interfere the nervous action will be abolished. If they meet so as neither completely to coincide nor to interfere, the nervous action will be somewhat increased, or somewhat diminished, according to the degree of coincidence or interference between the crests of the waves. The relation of these waves to one another may be affected by the distance each travels and the rate of transmission.

This hypothesis seems to explain why different doses of

poisons sometimes **produce** very **different results**. The phenomena of strychnine poisoning thus appear to depend upon the nervous vibrations being thrust crest upon crest, when intense convulsions occur; while, from one or other wave dropping half a length behind, the interval of rest or relaxation follows. In like manner may be explained the similar effects of cold and heat. Cold retards transmission of vibrations, while heat accelerates them, and either agent may thus alter one of the waves, causing coincidence and consequent stimulation, or separation by a half or a quarter of a wave and consequent inhibition or restraint.

SPINAL STIMULANTS increase the **functional activity** of the cord. They apparently act much in the same manner as mechanical irritation or electricity. They seem to increase conductivity through the nerve-cells. Small doses heighten reflex excitability; large doses cause tetanic convulsions; but such convulsions, as already indicated, also result from large doses of drugs which exert a sedative or paralyzing action, as opium, morphine, and belladonna. Spinal stimulants include strychnine, brucine, and thebaine, as well as nicotine, calabarine, caffeine, absinthe, and ammonia. They are **used** in cases of **general debility**, in paralysis unaccompanied by inflammation, and to rouse sluggish action, as of the bowels.

ACTION OF DRUGS ON THE NERVES.

PARALYSERS—STIMULANTS—ELECTRICITY.

Nerves may be **acted upon** in various parts of their course; in the **nerve centres** in which they originate; in their **cords** or trunks; or in their **minute endings** distributed in muscles or glands. Motor nerves have their excitability more readily disturbed or destroyed than sensory nerves. Injuries of compound nerves frequently arrest motor function, but leave the sensory function slightly, or only temporarily, impaired. The nerve trunks are much less susceptible than the end plates, and are only acted upon by strong solutions directly applied to them. Many medicines, acting on the terminal nerve fibrils, also act on other parts of the nervous system. It is always, however, important to realise **the order** in which

different parts are **affected**, inasmuch as the primary action frequently modifies those which may be subsequently produced. Different effects are often caused by the same drug when given in different doses, and many medicines, such as alcohol and ether, first increase and subsequently diminish nervous irritability.

PARALYSERS of motor nerves have their most powerful representative in curare, which seems to destroy the conducting power of the minute nerve fibrils by acting on their cement substance at Ranvier's nodes. Numerous other agents also paralyse motor nerves, of which the best known are coniine, ammonium cyanide, and iodide, and the ammonium iodide compounds of ethyl, methyl, amyl, and phenyl.

Increased excitability of motor nerves is more difficult to measure than paralysis; but, like the latter, it occurs in the nerve-endings, and is produced by aconite, camphor, guanidine, nicotine, pilocarpine, and pyridine, and in warm-blooded animals by physostygmine. Alcohol, ether, and chloroform, applied directly to nerves, first increase and then diminish their irritability. Atropine applied in like manner diminishes irritability of the intra-muscular endings, and afterwards of the trunks (Brunton).

Sensory nerves are readily acted upon by many drugs; their local effects are comparatively easy to determine; but when the drug enters the circulation many structures are liable to be affected, and definite results are difficult to obtain. Much trustworthy information has, however, been got by experiments on frogs, chiefly by ligaturing the sciatic artery of one leg, injecting into another part of the body the drug to be tested, and by pinching, pricking, heat, or electricity, noting the difference in sensation between the poisoned limb and the ligatured unpoisoned limb. By these and other such experiments it is demonstrated that **nervous sensibility** is **diminished** by aconite, belladonna and atropine, carbolic acid, chloroform and chloral, veratrine, with opium and morphine. Hydrocyanic acid exerts topical paralyzing effects on sensory nerves. Notable reduction of the sensibility of sensory nerves is likewise effected by several members of the aromatic series of carbon compounds, such as exalgine (methyl acetanilide), and two additions to the 1891 Edition of the B.P., namely, antifebrin

(acetanilide), and antipyrine (phenazone). Diminishing excitability of sensory nerves, such agents **relieve** pain of most descriptions, and are accordingly anodynes (p. 60). Some exert marked paralyzing effects on the terminals of cutaneous nerves, temporarily destroy sensibility, and hence are useful **local anæsthetics**. Amongst these are cocaine, ether spray, cold, in the form of ice or freezing mixtures, carbolic acid, and kawa-resin (p. 64).

The **irritability** of sensory nerves is **increased** by topical irritants. Aconite, whether applied locally, or carried through the circulation, produces peculiar numbness and tingling of the tongue and lips, and indeed of all parts supplied by the fifth nerve. Veratrine causes similar sensations in the joints and extremities.

ELECTRICITY, in the forms of magnetism, galvanism, or faradism, is used in medical, and occasionally in veterinary practice. **Faradism** as a galvanic current momentarily interrupted is most generally employed. Batteries, coils, and appliances for veterinary purposes are now manufactured by Messrs Arnold, West Smithfield, London. Slight electric currents stimulate both motor and sensory nerves and muscles; more powerful or long-continued currents exhaust, paralyse, or tetanise.

Like nux vomica and other excito-motors, electricity **stimulates depressed nervous action**, controls disordered action, and hence improves impaired nutrition. For strains of muscles and ligaments, after the primary inflammation and effusion are relieved by fomentations and rest, faradism over the seat of injury further removes pain and stiffness. The current of suitable strength, applied for six or eight minutes, and repeated if needful twice daily, frequently benefits and sometimes removes muscular rheumatism, which is not uncommon in horses, and is also serviceable in chronic articular rheumatism, which has resisted other treatment.

Paralysis depends upon various conditions, functional and molecular, and hence demands very different methods of treatment. Electricity, however, is often useful alike in diagnosing its exact seat and extent, and also in abating or removing the depressed or disordered conditions on which it depends. Torpidity of the bowels, resulting from imperfect intestinal

peristalsis, is sometimes overcome by faradisation. In muscular wasting one electrode is placed over the principal local nerve-centre, or nerve of the wasted part; while the other is moved over the shrunk muscles so as to stimulate contractions, and the operation continued for ten or fifteen minutes twice daily. Cases of roaring have thus been successfully treated. One electrode is applied in the angle of the neck in the jugular furrow above the larynx, while the other is moved over the surface of the larynx and down the trachea. Only gentle, occasionally interrupted currents are used, are kept up for six or eight minutes, and are repeated twice daily. In cases of asphyxia from poisoning by chloroform or other causes, faradism of the phrenic nerves is sometimes adopted to stimulate the failing or arrested inspiratory movements.

Clonic spasms, represented according to their cause or site by trifling tremors or violent convulsions, are sometimes treated by electricity. The current may be applied to the faulty centre in the brain or spinal cord, to the nerve trunk, the conductivity of which is morbidly affected, or to the local centres which are acting abnormally. Chorea in dogs, especially when of the chronic paralytic type, has been benefited by electric treatment.

When insulated needles are placed in the tissues, and traversed by the electric current, decomposition of the tissues ensues, and this process of **electrolysis** is occasionally employed for the removal of tumours. Cauterisation is sometimes effected by heating a platinum wire by a current, now conveniently derived from one of Faures' portable accumulators.

Electro-therapeutics as applied to the domestic animals deserves more extended practical study. The primary conditions for its rational and safe employment consist in a thorough understanding of the instruments used, and a knowledge of the strength of currents and their proper distribution to the parts to be influenced.

ACTION OF MEDICINES ON THE EYE.

In the local treatment of the cornea and conjunctiva the fitting **astringents** are mercuric chloride and silver nitrate.

When the surface of the cornea is abraded, lead salts are unsuitable, as they form an insoluble albuminate, which may cause opacity; while alum and potassium permanganate are undesirable, on account of their tendency to dissolve the cement uniting the corneal fibrillæ. The **antiseptics** generally used are mercuric chloride and boric acid, the latter frequently conjoined with an equal quantity of sodium sulpho-carbolate. The **sedatives** preferred are hydrocyanic acid, morphine, atropine, and cocaine. The sensitiveness of the eye is increased by strychnine. It is diminished, and **local anæsthesia** produced, by cocaine, which, accordingly, is serviceable in some examinations, as well as in operations on the eyes. The lachrymal secretion is increased by such volatile oils as mustard and onion, and by physostygmine. It is diminished by atropine.

The iris is dilated by belladonna, atropine, and homatropine, with its hydrobromate added to the 1891 Edition of the B.P. Such dilators are termed **mydriatics**. The contractors of the iris are termed **myotics**, and are represented by calabar bean, and its active principle physostygmine, as well as by opium, muscarine, pilocarpine, and thebaine. Anæsthetics first contract, and in full doses, from circulation of venous blood, dilate, the pupil. "From ten to twenty minutes after a solution of atropine has been dropped on the eye, the pupil dilates, and the ciliary muscle becomes paralysed, so that the accommodation for near objects is no longer possible, and the eye remains focussed for distant objects. When a solution of physostygmine is dropped into the eye, the pupil contracts, and the ciliary muscle becomes spasmodically contracted, so that the eye is accommodated for near objects" (Brunton). Alike in both cases, the action is purely local. The dilatation caused by atropine is due to increased action of the dilator, as well as diminished action of the sphincter iridis. Local myotics act in two ways: physostygmine stimulates the muscular fibres of the sphincter iridis; while muscarine, pilocarpine, and nicotine stimulate the peripheral ends of the oculo-motor nerve.

Mydriatics are used to allay irritation, inflammation, and pain. In iritis they keep the iris off the surface of the lens, and thus prevent adhesions. Dilating the pupil, they facilitate examination of the edges of the lens for cataract. **Myotics** are

used alternately with mydriatics to discover the presence of adhesions of the iris, and break them down when they have recently appeared. From their lessening intra-ocular tension, they are employed in glaucoma, especially in the earlier stages.

Few observations have been made on the actions of drugs on the senses of hearing, smell, or taste in veterinary patients.

ACTION OF MEDICINES ON RESPIRATION.

ERRHINES AND EXPECTORANTS.

Respiration consists in the alternate enlargement and diminution of the cavity of the chest, whereby air is alternately inspired and expired. These movements, so essential to the life of all the higher animals, are chiefly presided over by a nerve-centre or group of ganglionic cells, situated in the medulla, posterior to the vomiting centre, and extending into the anterior part of the spinal cord. This centre is normally stimulated by venous blood, and inspiratory movements are thence co-ordinated. The diaphragm is drawn back, the intercostals and scapular muscles raise the ribs, and air rushes into the lungs, distending the elastic walls of the air-cells. In ordinary circumstances, almost passively, the chest walls, with little muscular exertion, again contract, and air is expired. Expiratory effort, although scarcely realised in ordinary breathing, is, however, evoked in coughing and sneezing, as well as in producing vocal sounds. Inspiration and expiration thus alternate, in healthy adult horses at perfect rest, from twelve to sixteen times per minute, in cattle about fifteen to twenty times, in sheep from thirteen to eighteen times, and in dogs from fifteen to twenty times per minute.

The **respiratory centre** is stimulated by heat, and by strychnine, ammonia, atropine, thebaine, apomorphine, emetine, substances of the digitalis group, and salts of zinc and copper. It is first excited and then depressed by caffeine, nicotine, quinine, and saponine. Its activity is diminished, with consequent slow and shallow respiration, by cold, chloroform, ether, alcohol, opium, physostygmine, and aconite. The **vagus** branches distributed to the lung, and all sensory nerves, when

slightly stimulated, are mainly **nerves of inspiration**, and when they are stimulated cause quickened shallower respiration. The **expiratory nerves** are the nasal branches of the fifth, the superior and inferior laryngeal, and the cutaneous nerves, particularly of the chest and belly. When these are stimulated, the respiratory movements become slower and deeper. "Atropine injected into the jugular vein seems to produce first a slowing of the respiration, due to its paralyzing action on the vagus ends, and afterwards a progressive quickening, as more of it is carried out of the lungs into the medulla. Physostygmine, muscarine, and veratrine have an opposite action, quickening the respiration at first, by their stimulating the vagus ends, and afterwards slowing it by their action on the medulla" (Dr Lauder Brunton). When respiration is paralysed, as in narcotic poisoning, subcutaneous injection of strychnine is sometimes useful.

ERRHINES or **sternutatories**, when applied to the nostrils, cause irritation, sneezing, and increased secretion. They include tobacco in a finely divided state, veratrum album, ipecacuanha, euphorbium, and saponine. Errhines, although now disused, were formerly prescribed to cause counter-irritation in diseases of the eye and head, and to expel, by inducing sneezing, foreign substances lodged in the nostrils, nasal sinuses, or respiratory passages.

EXPECTORANTS facilitate the removal of secretions from the **air-passages**. The healthy respiratory mucous membrane is moistened and protected by a thin, slightly adhesive solution of mucin, which is gradually moved outwards by the cilia. Cold applied to the surface of the body, dust and foreign particles, and microbes, as in cases of influenza, readily excite irritation of the respiratory tract, and alter the amount and character of the mucus.

While the irritated membrane is dry and vascular, as in the earlier stages of catarrh and bronchitis, the breathing of **warm, moist air**, diffused from a steam kettle or nose-bag containing a hot mash, beneficially dilates the congested vessels, and promotes secretion. In such cases, and notably in laryngitis, **heat** and **moisture** should also be applied **externally** by means of flannel or woollen waste wrung out of boiling water or oil,

covered with thin waterproofing, and kept in place by a properly adjusted hood. Further **counter-irritation** may subsequently be needful. In the dry stage of inflammation of the respiratory membrane, **expectorants** of a **depressant** type, lessening blood-pressure and increasing secretion, are indicated, such as antimonials, alkalies in small doses, ipecacuanha, lobelia, jaborandi, apomorphine, and potassium iodide, which last, moreover, increases and liquifies many other secretions. Frequently in chronic bronchitis, when the respiratory membrane is congested and blood stagnates in the lungs, good results follow the combination of depressant expectorants with such a heart and vascular tonic as digitalis.

The bronchial mucus, when superabundant, is diminished by opium, turpentine, and nearly all volatile oils. When the secretion becomes thick and adhesive, and irritating cough is hence provoked, **stimulating expectorants**, which increase blood-pressure and diminish secretion, are indicated. The most trusted of these are acids, ammonium salts, nux vomica, senega, squill, balsams, terebinthines, sulphur, sulphur oils, and saccharines. Oil of turpentine in a vaporised state, or the old popular remedy of the fumes of burning tar, prove effectual in moderating vascular congestion and profuse secretion in many cases of bronchitis. The **throat**, when in a **soft, relaxed** state, is generally but the visible indication of a similar condition extending throughout the respiratory tract. The appropriate treatment is a combination of terebene and an acid which may be given as an electuary, and exerts beneficial effects both topically and generally.

Expulsion of the respiratory **secretions** is produced by increased activity of the cilia, which are believed to be stimulated by ammonia solutions, and by increased activity of the respiratory centre, which, as already stated, is also stimulated by ammonia salts, as well as by ipecacuanha, belladonna, and senega.

Influenza colds, so common amongst horses, and notoriously catching, probably depend upon **specific micro-organisms**, attack sometimes the upper, sometimes the lower air-passages, not infrequently also produce gastro-intestinal catarrh, and sometimes extend from one of these sites to others. Occasionally

such seizures may be checked or mitigated in their early stages by moistening the parts first affected with **carbolic** or **sulphurous** acid solutions, applied in the form of spray gargle or electuary. The like treatment proves beneficial in later stages, by lessening congestion or exerting antiseptic effects. The washing out of the nostrils is conveniently done by an ordinary enema syringe, by an indiarubber ball fixed to a tube, or by Ray's nasal funnel.

COUGH is a modified, usually involuntary, respiratory act, whereby gaseous liquid and solid substances are forcibly removed from the air-passages. This sudden expulsive expiratory movement is produced chiefly in two ways. (1) Faulty mucus or other irritants, lodged in the pharynx or larynx, transmit impressions by various afferent sensory branches of the *vagus*, notably by the superior laryngeal, which is distributed to the larynx and trachea, and this being an expiratory nerve, excites the loud, barking, violent, explosive cough, characterising irritation of the upper air-passages. Irritation of the lower air-passages, where the nerves are chiefly inspiratory, gives rise to a short, suppressed, hacking cough. (2) Reflexly, cough is caused by impressions produced on surfaces other than the mucous respiratory tract, as by cold applied to the skin, or by pleural, gastric, or hepatic irritation.

Soothing **gargles** and **electuaries**, even if they do not actually reach the seat of irritation, frequently abate cough. Internal organs and their external openings act and react on each other. The throat participates in inflammation of the bronchi or lungs; while, conversely, its soothed or invigorated condition is usually extended to deeper-seated parts. Mechanically acting mucilaginous or saccharine substances may be rendered more effectual by combination with **morphine**, which exerts a twofold action—(1) diminishing irritability of the respiratory centre, and also (2) diminishing secretion of mucus. This latter result is still more notably effected by **atropine**. The combination of these two alkaloids is hence specially valuable where there is troublesome cough and profuse secretion of mucus. A somewhat different effect is obtained by conjoining morphine and apomorphine, which, with diminished excitability of the respiratory centre, produce increased respiratory secre-

tions, and this combination is hence serviceable where there is cough, and the membrane is dry, or coated with thick, sticky mucus.

A comfortable loose box, with abundance of pure **fresh air**, at a temperature of about 60° Fahr., in several ways benefits the patient suffering with respiratory disease. More perfect aëration of blood is secured, while the cool, pure air, moreover, contracts dilated vessels, combats congestion, and hence will often remove cough, especially when depending upon irritation of the larynx, trachea, or larger bronchi. But while in many stages of respiratory disease the breathing of cool air is grateful and beneficial, draughts and cold must be scrupulously guarded against, and the body and legs of the patient kept comfortably warm with extra covering, in order to promote free circulation throughout the surface vessels, and thus antagonise congestion of the internal organs. Experiments on small healthy animals show that ice applied to the surface of the belly immediately induces paleness of the respiratory membrane, speedily followed by congestion, and gradually developing venous lividity, accompanied by increased mucous secretion. Removal of the ice and substitution of a hot poultice gradually restore the parts to their normal state, and this acute congestion and gradual return to health may thus be alternately demonstrated. These effects of cold and heat strikingly illustrate the causation of inflammation of the respiratory organs, and also the effectual manner of relieving them.

Cough depending upon **gastric** derangement, not uncommon in young animals, is often relieved by antacids. Cough resulting from **bronchial filaria** is abated by the usual soothing remedies, and removed by turpentine administered in drench or intratracheally, and by inhalation of chlorine or sulphurous acid, diluted with air, and rendered still more effectual for destruction of the parasites when conjoined with carbolic vapour.

In **dogs** with bronchitis or pneumonia, in whom the breathing is difficult, relief is often obtained by giving an **emetic** of ipecacuanha and squills. Venous congestion is overcome, and the state of the bronchial secretions improved. These good effects may often be maintained by the subsequent use of frequently

repeated doses of ammonium carbonate, which is also serviceable earlier, and when the patient is too weak to justify the use of an emetic. In dogs recovering from acute attacks, or suffering from chronic bronchitis, **cod liver oil** is often useful, possibly on account of its furnishing readily assimilable nourishment for the delicate epithelial cells, and thus preventing their being shed as pus (Dr Lauder Brunton).

ACTION OF MEDICINES ON THE CIRCULATION.

STIMULANTS—TONICS—SEDATIVES.

Many agents act in various ways on one or more portions of the circulatory system. An able authority on the subject—Dr Lauder Brunton—divides them into agents acting on the heart and on the vessels, and again subdivides these two groups into three classes of stimulants, tonics, and sedatives.

HEART STIMULANTS increase the force and frequency of the pulse in conditions of depression. The most important are ammonia and its carbonate, alcoholic solutions, ether, chloroform, camphor, oil of turpentine, and other volatile and aromatic oils, with heat and counter-irritants to the chest. They exert their effects in somewhat different ways. The alcohol group mainly stimulate the motor ganglia. Guanidine, physostygmine, and camphor are believed to act chiefly on the heart muscle, exciting it to pulsate rhythmically. Ammonium liquor, carbonate, and spiritus aromaticus, with turpentine and other volatile oils, chiefly stimulate the vaso-motor centres. Alcoholic, etherous, and ammoniacal solutions, especially when given in tolerably concentrated form, immediately stimulate the mouth, throat, stomach, and other parts with which they come in contact, and thus their effects are widely reflexed, often anticipating and increasing the stimulation resulting from their actual conveyance in the blood stream to the heart and other organs.

Cardiac stimulants are used to counteract failure of the heart's action from shock, physical injury, overwork, or depression dependent on disease. Stimulants, when acting favourably, produce a more vigorous complete heart-beat—the

pulse, previously slow, is accelerated; or if quick, unequal, or weak, it becomes slower, more regular, and stronger. The heart pulsating more quickly, and propelling at each heart-beat a larger volume of blood, arterial pressure is increased. A combination of two stimulants, acting as indicated in more ways than one, is often more effectual than any single drug. Hence alcohol is frequently conjoined with ether, ammonia, or aromatic volatile oils. Heat used in the form of warm drinks, and also externally, as warm rugs, fomentations, or poultices, is a heart stimulant, especially when the applications are laid over the chest.

VASCULAR STIMULANTS dilate the peripheral vessels, and thus accelerate the blood-flow through them. They do not increase the action of the vaso-motor centre, nor the contractility of the vessels, but, on the contrary, diminish their contractility and cause their dilatation. Prominent amongst remedies acting in this way are alcoholic solutions, ether, nitrous ether, and ammonium acetate. The alcohol series, combining the twofold action of stimulating the heart and dilating arterial and capillary vessels, usefully **combat chill, equalise circulation,** and prevent or **relieve congestion.** Horses brought in chilled and exhausted—their skins dry and their coat staring—are frequently saved from congestion and inflammation of internal parts by the timely use of a stimulating drink, the good effects of which are further ensured by an extra rug and flannel bandages to the legs. More permanent dilatation of external vessels is effected by frequently repeated doses of nitrous ether and ammonium acetate, with which camphor may also be conjoined. In combating **chronic inflammation,** vascular stimulants are also serviceable, and their operation is further promoted by hot applications, friction, and counter-irritation.

HEART TONICS produce their effects more gradually and slowly than heart stimulants. All are muscle poisons, and exert fuller effects on the heart than on other muscles, on account of its receiving much larger supplies of blood. Although large doses induce violent, irregular heart action, repeated moderate doses prolong the diastole, and **render the contractions slower, but more regular and stronger.** They

further contract the muscular coat of the arteries, and hence are vascular tonics. On the muscular coats of the digestive canal they are also liable to act, producing nausea, spasms, and sometimes diarrhoea. Heart tonics comprise digitalis and its alkaloids, casca and its active principle, erythrophloëine, strophanthus hispidus, adonis vernalis, convallaria majalis, hellebore, squills, caffeine, nux vomica, and strychnine.

Digitalis is the heart tonic generally used, notwithstanding the disadvantage of its preparations being of irregular strength, and its so-called active principle, digitaline, usually consisting of five bodies, differing considerably in their actions. Digitalis is prescribed where the left ventricle, from weakness caused by **reducing disease**, or from **incompetence of the tricuspid and mitral valves**, is unable to drive the blood into the aorta. In hard-worked horses compensating hypertrophy gives increased propelling power, and hence sometimes mitigates the results of valvular disease. When **dilatation** occurs, and the mitral valves are insufficient to close the orifice, blood is liable to regurgitate into the left auricle, retarding the blood flow from the lungs, and leading to general venous congestion. Heart tonics, notably digitalis, relieve this condition by imparting to the contractions the needful regularity and strength; while, moreover, by slowing the beats, the ventricle is more completely filled. In dilatation of the right side of the heart, usually depending upon serious attacks of influenza, bronchitis, or emphysema, heart tonics are seldom so beneficial as in mitral disease. Where blood pressure is abnormal, it is usually desirable in vigorous subjects to relieve venous congestion by purgatives or diuretics before even the most cautious use of heart tonics is attempted.

VASCULAR TONICS cause increased contraction of arterioles and capillaries. They stimulate the vaso-motor nerves, and thus raise blood pressure, and also promote outflow and absorption of lymph. The most important are digitalis, iron, and strychnine, with friction of swollen, infiltrated parts, equable pressure of well-applied bandages, and exercise, which secures oxidation and muscular movements, favouring outpouring and removal of lymph and waste products. Vascular tonics are chiefly used to combat **local œdema**, resulting mainly from

changes in the walls of the capillaries, and more **general dropsy** depending upon tardy removal of lymph, from the lymph spaces or serous cavities, upon a watery condition of the blood, or upon vaso-motor paralysis. Dropsy resulting, as it often does, from anæmia is appropriately treated by iron salts.

The **inflammatory œdema** or lymphangitis attacking usually the lymph glands and vessels of the hind limbs of the heavier breeds of horses, and occurring chiefly in well-fed, hard-worked animals after a day's rest, is probably connected with imperfect oxidation, the consequent formation of sarcolactic acid, obstruction and congestion of veins, capillaries, and lymph vessels. The resulting acute inflammation is combated by hot fomentations, a smart purgative, and saline diuretics, while the tediously chronic œdema, which is apt to follow, is attacked by friction and other vascular tonics and stimulants.

CARDIAC SEDATIVES lessen the force and frequency of the heart's action. For such purposes aconite, veratrum viride, and antimonials are chiefly prescribed. In veterinary patients aconite is most effectual, especially when given in small doses, at intervals of two or three hours. It is chiefly used in antagonising violent **palpitating action** of the heart, or lowering the quick, full, bounding pulse, and other febrile symptoms of laryngitis, laminitis, acute lymphangitis, and other local inflammations.

VASCULAR SEDATIVES contract blood-vessels, lessen the flow of blood through them, and hence limit local inflammation, and arrest hæmorrhage. They are represented by ergot, lead acetate and opium, full doses of digitalis and other heart tonics, and topical application of cold. Ice or refrigerant lotions applied to circumscribed spots contract the capillaries, and even considerable arteries, and thus relieve congestion, inflammation, and pain. In like manner, ice, when swallowed, arrests bleeding from the stomach, reflexly checks bleeding from the lungs, and, moreover, acts as a cardiac sedative. When the bleeding vessels cannot be reached, either directly or reflexly, ergotine is injected hypodermically.

**MEDICINES ACTING ON THE DIGESTIVE
SYSTEM.**

On the Salivary Glands.—SIALAGOGUES—ANTISIALICS—REFRIGERANTS.

On the Stomach.—ANTACIDS—GASTRIC TONICS—STOMACHICS—BITTERS—EMETICS—ANTI-EMETICS—GASTRIC SEDATIVES.

On the Intestines.—PURGATIVES—CARMINATIVES—INTESTINAL ASTRINGENTS.

On the Liver.—HEPATIC STIMULANTS—CHOLAGOGUES—HEPATIC DEPRESSANTS.

On the Pancreas and Spleen.

On Worms.—ANTHELMINTICS—VERMICIDES—VERMIFUGES.

SIALAGOGUES are drugs which **increase the secretion of saliva**. This alkaline fluid comes from the secreting glandular cells, which are fed from adjacent lymph spaces, and these in their turn are replenished with fresh materials from the blood-vessels of the glands. The process of salivation is regulated by a **nerve-centre** in the medulla, and subsidiary nerve-centres in the several glands. By food or other substances moved in the mouth, by irritation of the stomach, or even of the eyes or nostrils, stimulation is conveyed by their respective nerves to these ganglia, and reflexly salivation ensues. In this way the presence of food in the mouth and the movements of the jaws naturally provoke salivation. In like manner, through different nerves distributed within the mouth, acids, alkalies, ethers, mustard, ginger, and other pungent substances reflexly increase secretion of saliva. Tartar emetic and other nauseants exert similar effects reflexly by acting on the stomach. Another group of sialagogues, consisting of jaborandi, calabar bean, and their alkaloids, with muscarine and nicotine, produce salivation when injected into the blood, stimulate the peripheral ends of the secreting nerves within the glands, and are termed **specific sialagogues**. Another group, such as mercury, tobacco, and potassium iodide, induce their effects, partly by acting reflexly on the membrane of the mouth, and partly by absorption and stimulation of the secreting nerves.

The saliva and bucal secretions moisten the mouth and fauces, and hence facilitate chewing and swallowing, and lessen or prevent thirst. The ptyalin of the saliva, moreover, helps the solution of starch, and the alkaline fluid, when swallowed, promotes secretion of the acid gastric juice, and thus further assists digestion. Graminivora secrete proportionally large quantities of saliva for the moistening of the dry food, on which they chiefly live. Horses in twenty-four hours secrete four to six kilogrammes. In all animals the fluid is more alkaline the larger the amount of the starch food. The diastatic power of the saliva of man exceeds that of other animals.

Antisialics are medicines which lessen the salivary secretion. Borax and potassium chlorate frequently remove the faulty irritable conditions of the mucous membrane, which lead to over-secretion. Opium and morphine diminish irritability of the nerve-centres, while atropine is the most effective paralyser of the peripheral endings of secreting nerves. The fermentative action of ptyalin is diminished by alcohol, alkalies, and acids, and checked by 1 per cent. solutions of carbolic acid. It is promoted by small quantities of quinine, strychnine, and morphine.

Refrigerants are agents which **allay thirst**, and **give a sensation of coolness**. **Thirst** is **locally manifested** by dryness of the mouth and fauces, and is believed to be under the special cognisance of a ganglia or thirst-centre, stated to be situated in the occipital lobes of the brain. Thirst is quenched by washing out the mouth with water, or lubricating the dry throat with bland mucilaginous fluids, sucking portions of ice, which horses with sore throats soon learn to do, or swallowing slowly slightly acidulated drinks, which, by stimulating secretion of saliva, moisten the parched membranes. But thirst also depends upon a **deficiency of fluid** in the body, or on the excess of soluble or saline substances in the blood—conditions which are remedied by ingestion of water or other diluents. The extreme thirst which occurs in horses in **polyuria**, or diabetes insipidus, is best controlled by the combination of iodine and opium, the former probably exerting its antiseptic effect, the latter perhaps lessening excitability of the thirst-centre.

ACTION OF DRUGS ON THE STOMACH.

The stomach performs three important functions—(1) it secretes gastric juice, which dissolves the proteids of the food, and thus secures their absorption and assimilation; (2) its churning movements reduce the food, and mix it with the solvent juices; (3) the products of digestion are absorbed, although not so rapidly as from the small intestines.

The stomach of the **horse** is small relatively to his size; the cardiac portion is lined with stratified epithelium, and is not available either for secretion of gastric juice or for absorption. The pyloric portion, which occupies about one-half of the viscus, is the active digestive part, and is lined with soft vascular vilous membrane, in which lie the gastric and lenticular follicles. These anatomical conditions retard and limit gastric absorption in horses, and lessen their susceptibility to the action of most medicines administered by the stomach. In **ruminants**, the first three compartments of the subdivided stomach are lined with cuticular mucous membrane, are chiefly occupied in the reception, maceration, and subdivision of the bulky fibrous herbage, which constitutes their principal diet. This thick epithelial covering, and the amount of food always lodged in these three stomachs, explain the tardy action of many medicines administered to ruminants, and their taking with impunity large doses of irritants. The fourth stomach is lined with vascular velvet-like mucous membrane, and secretes the gastric juice, while from its walls absorption takes place. The stomach and digestive organs of the **dog** and **hog** nearly resemble those of man, and are acted on in much the same way by most drugs.

Secretion of gastric juice is stimulated by gentle mechanical and chemical irritation, by introduction of suitable food into the stomach, by the swallowing of the alkaline saliva, and by administration of dilute alkalies, alcohol, and ether. When **indigestion** occurs from presumed insufficiency of the gastric juice, two modes of treatment are available—(1) dilute acids and a little spirit are given to stimulate secretion; but (2) where, from reducing disease or other causes, the stomach is enfeebled, a substitute for the gastric juice should be given in

the form of diluted mineral acid, conjoined, where the food is albuminous, with pepsin. Moreover in all such cases, the food must be readily digestible. For horses, well-prepared mashes are substituted for dry corn and hard fibrous hay; while young calves or foals, when their undiluted milk disagrees, should have it mixed with water, or, better still, with linseed tea, in order that the tough, intractable curd may be more easily broken down. In dyspepsia, **acids and bitters** are frequently conjoined, the latter being serviceable probably on account of their stimulating the movements of the stomach, and from their action on the liver. The cardiac functions, when tardy and insufficient, may be stimulated by nux vomica and strychnine.

The conditions promoting **absorption from the stomach** are not accurately known. They are intimately connected with the state of the liver and intestines. A dose of physic in all animals notably improves the faulty appetite and removes dyspepsia. The condition of the nervous system probably also affects absorption from the stomach. Professor Bouley found that when the vagi in a horse were divided, strychnine could be administered in full lethal doses without injurious effect. This result appeared to depend upon the movements of the stomach walls being diminished, whereby its contents were only slowly passed into the more rapidly absorbing intestine, and excretion of the poison accordingly proceeded as rapidly as its absorption.

ANTACIDS.—Certain forms of dyspepsia depend upon, or are aggravated by, undue gastro-intestinal acidity, which is counteracted by antacids. These comprise the alkalies—potash, soda, and ammonia; the alkaline earths—lime and magnesia; and carbonates and bicarbonates of these bases. The neutral salts which these alkalies form with vegetable acids, notably the tartrates and citrates, after acting primarily as salines, are converted in the blood into carbonates, and secondarily exert alkaline effects on the tissues and secretions with which they are brought into contact. It is thus that they are serviceable in rheumatism, eczema, some cases of pyrexia, and in counteracting acidity of the urine. As an antacid, the volatile ammonia is less permanent than the fixed alkalies. Potash and its salts

are more active than soda and its corresponding salts. Lime salts, being soothing and astringent, are indicated in diarrhoea; magnesia salts, being laxative, are appropriate where acidity concurs with torpidity of the bowels. Lithium carbonate, present in Baden-Baden and Bath mineral waters, is prized in human medicine as a solvent of urinary calculi and deposits.

Horses fed irregularly, or too closely restricted to dry food, frequently suffer from gastric acidity, instinctively lick the lime-washed walls of their stables, or eat earth, and are usually promptly relieved by antacids and suitable feeding. Calves carelessly managed manifest the same disposition to allay their discomfort by eating earthy matters. Antacids given before meals excite gastric secretion; given after meals they neutralise gastric and intestinal acidity. After producing local and direct effects on the digestive organs, they undergo absorption, and produce remote antacid effects on the blood and urine.

GASTRIC TONICS, sometimes called stomachics, **aid gastric digestion** and **increase the appetite**. Such results occur when, in experiments, the stomach walls are gently irritated, and are also produced by small doses of **mild stimulants** and **bitters**. In certain conditions of gastric irritation, tonics and stimulants are, however unsuitable, and small doses of mineral acids, or of gastric sedatives, such as bismuth or prussic acid, are prescribed.

EMETICS are agents which **cause vomiting**. This is effected by firm compression of the stomach between the diaphragm and the abdominal muscles, and by the simultaneous contraction of the longitudinal fibres which pass from the œsophagus round the gastric walls. When the stomach is thus compressed from behind, and drawn forward, the familiar spasmodic movements of retching result. When, concurrently, however, with these movements, the cardiac orifice is dilated, the contents of the stomach are thrown up, and vomiting occurs. Dr Lauder Brunton, in the *Practitioner* for December 1874, thus describes **the phenomena of vomiting**:—"Uneasiness is felt; the inspirations become deeper; several swallowing movements are made, which sometimes carry down sufficient air to distend the stomach moderately. After several deep inspirations, there suddenly comes one which is deeper still. Then, instead of

this being followed by expiration, the glottis shuts to prevent the escape of air; the diaphragm again contracts still more deeply into the abdomen, and pulling the ribs together, the abdominal muscles forcibly contract; the left half of the stomach is drawn upwards, and the cul-de-sac flattened out; the cardiac orifice dilates, and the contents of the stomach are forcibly expelled. The pylorus remains firmly contracted, and allows but little escape into the intestines."

The movements of vomiting are modified respiratory and ruminating actions, and are presided over by **nerve-centres** in the medulla. The ganglia regulating respiration and vomiting lie close together. Certain cells probably take part in both actions, and are acted upon by the same agents. "Emetics usually quicken the respiration considerably before they produce vomiting, and, if injected into the veins, they not only quicken the respiration, but prevent the condition of apnœa being produced by vigorous artificial respiration. On the other hand, the desire to vomit may be lessened, to some extent, by taking frequent and deep inspirations, and narcotics which diminish the excitability of the respiratory centre also lessen the tendency to vomit" (Brunton).

That the vomiting centre, rather than the stomach itself, is the prime factor in the production of emesis, is evident from Magendie's famous experiment of removing the stomach of a dog, attaching to the severed œsophagus a pig's bladder filled with fluid, which, when tartar emetic was injected into the veins, was compressed between the abdominal muscles and the diaphragm, and emptied of its contents by vomiting.

When the fauces of men, dogs, or other animals which vomit readily, are tickled with a feather, or when the interior of the stomach is irritated mechanically, or by a solution of mustard, the stimulus is conveyed by afferent nerves to the vomiting centre by which the special motor impulses are correlated. Many other parts of the body, through their afferent nerves, have communication with the vomiting centre, and hence vomiting is produced, not only by irritation of the fauces and stomach, but by irritation of the brain, lungs, liver, and gall ducts, the intestines, kidneys, and bladder, sometimes even by pain or injury of the extremities.

Dogs, cats, and pigs vomit as readily as men. Indeed, in dogs, vomiting is induced by most disagreeably-tasted, nauseous, or acrid substances, and sometimes is brought on purposely by eating *triticum repens* and other emetic grasses which instinct readily enables them to discover. But **horses, ruminants, rabbits, and guinea-pigs rarely if ever vomit, and are insensible to the action of powerful emetics.** In horses emesis only occurs from extreme distension and spasm of the stomach, from dilatation of the lower part of the gullet, from rupture of the intestines, and from the action of large doses of aconite, which, however, induce retching and discharge of excessive secretion of saliva rather than true vomiting. The insusceptibility of horses to the action of emetics is due apparently to some undiscovered peculiarity of the nervous mechanism concerned in vomition in most other animals. The horse's inability to regurgitate matters from the stomach, even when attempts to vomit are excited, depends upon several conditions—on the smallness of the stomach, which prevents it, even when tolerably full, from being grasped and squeezed between the abdominal muscles and the diaphragm; on the strong horse-shoe like band of fibres which guards the cardiac orifice; and on the greater length of that portion of the œsophagus between the diaphragm and stomach, which folds on itself, and thus more securely obstructs the cardiac orifice when the tube, under the influence of emetics, is shortened by the contraction of its longitudinal fibres. The contents of the horse's stomach, even if discharged upwards, owing to the position and length of the *velum palati*, would pass out by the nostrils, and not by the mouth. As cattle naturally ruminate, it might be supposed that they might also readily perform the analogous act of vomiting; but the substances which cause emesis in other animals have no such effect on cattle or sheep. This mainly depends upon the large size of the subdivided stomach, which cannot be grasped and compressed between the abdominal walls and diaphragm. In horses and ruminants, the arrangement of the digestive organs thus practically preventing vomiting, the vomiting centre would not be required; if it ever existed amongst earlier races, it has become dwarfed or entirely disappeared, as seems evident from the notable tolerance which

these animals have of tartar emetic. Professor M'Fadyean suggests that in ruminants the power to vomit has perhaps been merged into the habit of rumination.

Emetics are divisible into two classes:—

- (1.) Those which mainly act **locally** on the pharynx or stomach, such as copious draughts of tepid water, bitter infusions, solutions of salt, mustard, alum, and ammonium carbonate, with copper and zinc sulphates.
- (2.) Those which act **generally** through the circulation, such as tartar emetic, ipecacuanha and emetine, apomorphine, senega, and squill. Muscarine and digitalis are general emetics, although not used medicinally.

Emetics acting locally stimulate the vomiting centre reflexly from the stomach. Those acting generally may be carried direct to the vomiting centre; but many are also attracted to the stomach, are excreted through the gastric mucous membrane, and thus, in part at any rate, act reflexly. Tartar emetic injected into the blood is believed thus to act in both ways. The effects of local emetics are not of long duration, ceasing usually when the cause of irritation is expelled, and causing little depression. The effects of general emetics are of longer duration, and are followed by more nausea, depression, and increased secretion of saliva and sweat, as well as of mucus, alike from the digestive and respiratory tracts.

Emetics **are used** on dogs and pigs for removing from the stomach foreign bodies, acrid, irritating, undigested food, and poisons. Where prompt and effectual results are desired, as in cases of poisoning, copper and zinc sulphates are most suitable. By relaxing the longitudinal fibres of the gullet, and exciting anti-peristaltic movements, they are also serviceable in expelling obstructions from the fauces and upper part of the œsophagus. They expel bile from the liver, gall ducts, and gall bladder, and force inspissated mucus and small gall stones into the intestine, thus relieving jaundice resulting from obstruction. By clearing out both the stomach and biliary system, they remove biliousness, and, used at the outset, they thus mitigate distemper, and other febrile attacks, and sometimes arrest epileptic seizures. In animals which vomit so easily as the dog, it is better that irritants lodged in the anterior

parts of the digestive tube, or circulating in the gastro-hepatic system, should be promptly got rid of by the mouth, rather than make the longer and more tedious route through the intestines, running risk of absorption, and thus probably doing further mischief. By stimulating the respiratory as well as the vomiting centre, they beneficially promote secretion and expectoration in the dry stage of catarrh and bronchitis, and sometimes in congestive as well as spasmodic asthma. In respiratory disorders, ipecacuanha and squill are often conjoined, and, where there is cardiac depression, ammonium carbonate is prescribed, alone or in combination. Relaxing muscular fibre, they were wont to be given to assist in the reduction of dislocations, but for such purposes anæsthetics are greatly more effectual. Their paralysing effect on muscular fibre explains why emetics in excessive doses often fail to cause vomiting.

Emetics are **contra-indicated** in gastric inflammation, cerebral congestion, and hæmorrhagic conditions, and require cautious use in pregnancy and hernia.

A safe and **convenient emetic** for a medium-sized dog consists of a teaspoonful each of common salt and mustard dissolved in a tea-cup of tepid water. More prompt and certain effects are produced by two or three grains of copper or zinc sulphate dissolved in a couple of ounces of warm water, rolled in a piece of meat, or mixed with other food. More continued depression follows the administration of three grains tartar emetic and ten grains ipecacuanha, given dissolved in three or four ounces of tepid water. Apomorphine is one of the most prompt and certain of emetics, acts by whatever channel it enters the body, and produces full effects on dogs in doses of one-tenth to one-fifth of a grain.

To **check vomiting**, which occasionally proves troublesome in dogs, three methods of cure are indicated—(1) the removal, by appropriate means, of the irritation of the fauces, bronchi, stomach, or other part which excites the reflex act; (2) lessening irritability of the gastric nerves by swallowing small pieces of ice, by icing all food, and administering hydrocyanic acid and morphine; (3) quieting over-activity of the irritable vomiting centre by morphine, atropine, chloral, or potassium bromide.

ACTION OF DRUGS ON THE INTESTINES.

PURGATIVES—CARMINATIVES—INTESTINAL ASTRINGENTS.

PURGATIVES or **CATHARTICS** cause intestinal evacuations in one or more of these three ways—(1) by accelerating the peristaltic movements of the bowels; (2) by increasing secretion from the intestinal mucous membrane; (3) by limiting absorption of the intestinal fluids.

Intestinal movements are dependent on the ganglia of Auerbach's plexus, situated between the outer longitudinal and inner circular layers of muscle. **Secretion** is believed to be influenced by Meissner's plexus, lying in the sub-mucous coat; but these ganglia, immediately regulating intestinal movements and secretions, are controlled by cerebro-spinal centres and nerves, notably by the vagi, which, when irritated, cause increased peristalsis, and by the splanchnics, which, although containing both stimulant and inhibitory fibres, generally diminish intestinal movements. When all the cerebro-spinal nerves going into a portion of intestine are divided, copious fluid discharges pour into the intestine; but Dr Lauder Brunton and Dr Pye Smith, who thoroughly investigated the subject, found that the nerves which specially restrain secretion are the inferior ganglia of the solar plexus, with the superior mesenteric offshoot from them. The blood supply of the intestine is mainly regulated by the splanchnics, but also in part by the lumbar portion of the cord.

Purgatives vary in the **degree** and **method** of their action. Some, like castor oil, act tolerably uniformly on the whole tract; podophylon operates mainly on the duodenum; jalap and salines chiefly on the small intestines; the several species of rhamnus or buckthorn and aloes mostly on the large.

Purgatives are frequently classified as follows:—

Laxatives or **aperients**, such as small doses of oil, magnesia, sulphur and treacle, with fruits, roots, and green vegetable food.

Simple purgatives, such as full doses of oils, aloes, various species of rhamnus, produce more copious, softened, or fluid evacuations, and act mainly by increasing the intestinal secretions.

Drastic purgatives, such as croton oil, colocynth, elaterium, gamboge, and podophyllin, greatly increase both peristalsis and secretion; violently stimulate intestinal contractions, causing more or less pain; promptly produce copious, frequent fluid discharges; and in large doses may cause serious intestinal irritation and inflammation.

Hydragogues, such as elaterium, gamboge, croton oil, and other drastic cathartics, with large doses of the more active salines, excite copious intestinal secretions.

Cholagogue purgatives, such as mercurial preparations, aloes, podophyllin, and euonymin, remove bile, and will receive special notice later.

Saline purgatives consist of neutral salts of the alkalies and alkaline earths, such as magnesium sulphate and citrate, sodium sulphate, potassium tartrate, and bitartrate.

The salines have been specially investigated by Dr Matthew Hay (*Journal of Anatomy and Physiology*, vol. xiv.) His admirable observations show that, without causing much increased peristalsis, they notably increase the alimentary secretions, and impede absorption. They do so chiefly in virtue of their specific irritant and bitter properties. They act especially on the small intestines, but only slightly increase the secretion of bile or pancreatic fluid. When the accumulated fluid mechanically distends and stimulates the intestine, some extra peristalsis is excited. Saline solutions weaker than 10 per cent. provoke little or no secretion in the stomach, and not much in the bowels. A 20 per cent. solution given to dogs or men rapidly increases secretion, which reaches its maximum in one to one and a half hours. But the larger the amount of fluid given with the saline, the more prompt will be the purgation. Magnesium and sodium sulphates are in part decomposed, their acid being more rapidly absorbed than their base. No increase of secretion is produced, as was formerly taught, by the acid or salt, when, after absorption, it is excreted into the intestine; nor do either of these salines excite intestinal secretion when injected into the blood, or subcutaneously. More inorganic than organic matters are removed by salines from the blood. The amount of fluid secreted has been measured by Dr Lauder Brunton, who experimented on cats

with concentrated solutions of Epsom salt tied into a loop of intestine. In four hours he found that from 42 to 56 minims of serous fluid were outpoured for every inch of surface acted on. In cattle or horses upwards of 12 square feet of intestine must often be directly stimulated by even a moderate dose of physic. A secretion of 50 minims to the inch would give a discharge of nine pints of fluid. Such considerations illustrate the depurative and febrifuge effects of an active cathartic.

The **intestines of the horse** are voluminous, presenting about 90 square feet of vascular mucous membrane. Purgatives and other irritants hence require to be used with much caution. For a day previous to the exhibition of a purgative, the animal, if possible, should be restricted to mash diet or green food. The dose should be moderate, and its effect may be accelerated and increased by administering it while the animal is fasting, by occasional gentle exercise, until it begins to operate, and by the repeated use of clysters. This last auxiliary, when properly employed with sufficient perseverance, is indeed so effectual in promoting the action of the bowels that one of the most successful of army veterinarians was wont to trust almost entirely to its use, seldom giving, except in extraordinary cases, any purgative medicine whatever. In serious, obstinate impaction of the large intestines, a flexible tube, six feet long, should be screwed on to a Reid's pump, and copious enemata introduced into the colon. (*See Enemata*).

For **horses**, aloes is the best cathartic. Linseed and castor oils are tolerably good, but less certain; while croton is much too drastic, unless in small amount, and largely mixed with some bland oil. Salines in cathartic doses are irregular, and sometimes act with unexpected violence. Senna, colocynth, buckthorn, and other drugs used as purgatives for men and dogs have little effect on horses.

With a warm mash the previous night, and subsequent abstinence from solid food, a moderate dose of aloes given in the morning, assisted by further mashes and occasional draughts of tepid water, purges most horses in ten or twelve hours. Without this desirable preliminary preparation, purgation seldom occurs within eighteen or twenty hours. In acute febrile cases absorption is usually tardy, and is helped by

combining the purgative with a small dose of such a sedative as aconite, calomel, or tartar emetic. A horse should never have purgative medicine when his strength is reduced and his pulse small and weak, when in the advanced stages of inflammatory disease of the air-passages, never without extreme caution in influenza and other debilitating epizootics, and seldom when the bowels themselves are congested or inflamed. I have known horses affected by bronchitis die from superpurgation, induced by three and four drachms of aloes; and similar susceptibility to the action of moderate doses is also observable in influenza, purpura hæmorrhagica, and laminitis.

In **cattle** and **sheep** the magnitude of the *quadrisectioned* stomach, the large amount of food which it always contains, the relatively small size of the true digestive compartment, and, compared with the horse, the shorter length and smaller capacity of the intestines, explain the tardy, uncertain action of purgatives and some other drugs. For these ruminants saline cathartics are preferable, and their action is materially hastened by encouraging the drinking of water, rendered palatable by sweetening it with treacle. In obstinate constipation, or torpidity of the bowels, gamboge, croton, and calomel are often useful. Purgation may usually be produced among cattle in from twelve to sixteen hours; but cases frequently occur where, in spite of all treatment, the bowels remain unmoved for several days. The best purgatives for **sheep** are common and Epsom salts and castor oil, in doses of about one-fourth of those given to cattle. Calomel and croton are apt to act too violently. As sheep drink sparingly, their medicine should be given with a liberal quantity of fluid.

The dog, on account of his small stomach and short alimentary tube, and the concentrated nature of his food, is peculiarly susceptible to the action of purgatives. Jalap, with a little calomel, or a mixture of equal parts of linseed and castor oils, is most generally approved of, and usually operates in from five to eight hours. Aloes acts more slowly and uncertainly, while saline medicines are apt to cause vomiting, or, if retained, to purge with undue violence. Indeed, any purgatives, when unpalatable, acrid, nauseous, or bulky, are apt to be expelled by vomiting.

Pigs are acted on by cathartics much in the same way as men and dogs, and are best physicked by administering, from a shallow spoon or bottle, three or four ounces of Epsom salt dissolved in water, or a like amount of linseed or castor oil. During the operation they must be held by the ears by an assistant, whose grip will not be released by the squealing of the patient.

The uses of purgatives are numerous. No medicines are applied to so many important purposes.

(1.) **They empty the alimentary canal** of undigested food, fæces, bile, some poisons, and worms. Sweeping away partially digested food, they diminish the amount of blood-making materials, and thus diminish plethora and obesity. In horses fully two-thirds of the fluid ingesta, under ordinary circumstances, are removed by the bowels, and this large amount is greatly increased when physic is given. They remove noxious gases and fluids, ptomaines, and other intestinal toxic matters which are the direct causes of dyspepsia, colic, and diarrhœa; and which, moreover, secondarily or reflexly produce nervous depression, skin irritation, and other local hyperæsthesias.

Constipation is usually dependent in great part on deficient peristalsis, and hence, when of frequent occurrence, is often advantageously combated by conjoining a little nux vomica with the cathartic. Horses too closely restricted to dry food frequently have habitual constipation, and in such cases the diet should be varied with an occasional mash, a little linseed cake or green food, while water *ad libitum* should be allowed at least four times daily. The bulky and comparatively indigestible nature of the horse's food induces copious alvine evacuations, which are normally evacuated at intervals of four or five hours. Impaired intestinal action or obstruction, hindering or arresting these frequent evacuations, causes more serious and rapidly fatal results in horses than in men, dogs, or ruminants, in whom the bowels naturally act less frequently, and sometimes remain unmoved for several days without causing much harm. But torpid and obstructed bowels in horses are now usually relieved in one to two hours by the hypodermic injection of a grain of physostygmine, with which two grains of pilocarpine may be conjoined. Constipation, troublesome in

dogs kept in the house, or on the chain, is best treated with a dose of oil, and prevented by attention to diet.

Diarrhœa, at its outset, is usually most effectually removed by a dose of oil, given with a little laudanum—a prescription which removes the cause of irritation, and quiets the excessive peristalsis. When diarrhœa depends, as it sometimes also does, on diminished absorption of fluid matters from the bowels, a little ether proves serviceable in quickening absorption.

Removal of bile will be specially referred to under Cholagogues (p. 104), of worms under Anthelmintics (p. 106).

(2.) Purgatives, notably salines, or hydragogues, shortly determine an abundant **outpouring of the fluid parts of the blood** into the intestine, and thus purge the blood of waste products, relieving febrile attacks, and lowering blood-pressure.

The blood, thus left in a state of concentration, speedily recuperates itself, absorbs water and lymph from the tissues, thus relieving œdema, dropsies, and lymphangitis. To secure this special action in its fuller degree, such salines as Epsom salt and alkaline tartrates are specially effective, and their efficacy is increased when they are prescribed in tolerably concentrated form, and given when there is comparatively little fluid in the alimentary canal. When the catharsis caused by a saline has almost ceased, another concentration of the blood occurs, slighter, but of longer duration than the first, and which has also an influence in relieving dropsies and other complaints.

(3.) Purgatives lower the **fever temperature**, but how this effect is produced is not definitely known. For such purposes salines are specially useful. They diminish the force of the circulation, and may in this way lessen the production of heat, and, moreover, hasten removal from the body of waste or other deleterious matters, which are a frequent cause of increased temperature. In animals in health purgatives do not, however, produce any appreciable lowering of temperature. (*See* Antipyretics, p. 132).

CARMINATIVES are agents which **assist the expulsion of gases** from the stomach and intestines. These gases are chiefly air, nitrogen, from which the oxygen has been absorbed by the

stomach walls, and carbonic acid which is thence excreted, both processes occurring in much the same manner as in respiration within the lungs, but in greatly limited degree. When digestion is in any way interfered with, the contents of the stomach are liable to undergo excessive or irregular **fermentation**, giving rise to large quantities of carbonic acid and hydrogen, which unite with sulphur, sometimes derived from the food, sometimes from the bile, and produce the noisome sulphuretted hydrogen. Formation of these gases is favoured by accumulation of mucus on the walls of the stomach, or by venous congestion of the organ, both of which conditions interfere with the natural absorption of oxygen and excretion of carbonic acid. These gases cause uncomfortable distension, and often provoke spasm and pain. (*See Antispasmodics*, p. 62).

Carminatives are closely **allied to antispasmodics**, and include the aromatic oils of the umbelliferæ, labiatæ, and other orders, with ginger, mustard, and peppers, alcohol, ethers, and chloroform. Carbonic acid gas is neutralised by ammonia preparations, sulphuretted and carburetted hydrogen, and by solutions of chlorine or chlorinated lime.

They are **used** to remove flatulence, spasm, and pain, whether resulting from direct intestinal irritants, or, secondarily, from chill or other causes. Their effects mainly depend upon their controlling irregular peristalsis. They stimulate contraction of the distended stomach, and thus promote escape of gas, either by the cardiac or pyloric sphincters. Regulating, in like manner, intestinal peristalsis, they displace and expel gases from other parts of the canal. They are usefully conjoined with purgatives. In cattle, owing to the large amount of food in the first stomach, it is sometimes difficult to remove accumulations of gas, either by carminatives or antispasmodics, by the use of a gag fixed into the mouth, which frequently reflexly provokes relaxation of the cardiac sphincter, or even by introduction of the probang. Where these means fail, and distension is so great as to interfere with breathing or circulation, it is necessary to remove the gas by an opening made into the rumen, either with the trochar and canula, or with a tolerably large knife. In serious distension, threatening rupture of the large intestines, in horses, the gas is occasionally liberated by

puncture of the cœcum or colon with a small long trochar and canula. In the maize-growing States of America, horses and mules greedily eating the green Indian corn sometimes have enormous tympanites, which, defying other treatment, is sometimes thus successfully relieved by operation.

INTESTINAL ASTRINGENTS diminish excessive or unduly fluid intestinal evacuations. They are specially used to antagonise various forms of **diarrhœa**. Some, like opium and chloral, lessen the excessive peristalsis on which diarrhœa generally in great part depends. Some, like antacids, neutralise acids which provoke both peristalsis and increased secretion. Some, like creosote, check fermentation and putrefaction, and thus arrest formation of irritants. Others, like catechu and tannin-containing substances, coagulate albumin, and consequently dry up both discharge of mucus and of blood. Others, like copper and iron sulphates, usefully conjoin antiseptic and astringent actions. Coto-bark and its alkaloids, although devoid of astringency, exert antiseptic effects, and besides, by increasing absorption, remove superfluous fluid from the intestines. Mineral acids and metallic salts are specially indicated when the mucous membranes are relaxed and flabby.

Dr Lauder Brunton and Dr Pye Smith made a series of experiments with various agents, with the view of discovering any which would arrest the copious secretions of cholera. Into isolated ligatured loops of intestine magnesium sulphate was injected, while the drug experimented with was either introduced along with the saline or injected into the veins. "Sulphate of atropine, iodide of methyl-atropine, chloral hydrate, emetine, morphine, sulphate of quinine, tannin, and sulphate of zinc, were all tried locally, with negative results. Chloral and morphine, injected subcutaneously, also gave negative results" (*Report to the British Association, 1874*). The conclusion arrived at was that most cases of diarrhœa, whether continuous or alternated with constipation, were best checked by castor oil, administered with a few drops of opium tincture. Where the diarrhœa still persists, opium in moderate doses is given. Where active peristalsis occurs after eating, drinking, or the excitement of quick work, as in some nervous horses and dogs, liquor arsenicalis is prescribed. Undue relaxation

of the bowels, occurring in irritable horses during active work, is mitigated by careful attention to diet, by using the best food in digestible form, allowing water in small quantity at a time but frequently, and withholding water for several hours previous to putting the animal to quick work.

ACTION OF MEDICINES ON THE LIVER.

HEPATIC STIMULANTS—HEPATIC DEPRESSANTS—CHOLAGOGUES.

The liver is the largest gland in the body. It not only secretes and excretes bile, but part of the bile, mingled with the food materials, is again taken up from the intestine and again excreted, and this circulation through the liver and back to the intestine is accomplished within five minutes. The liver, moreover, forms glycogen, and is concerned with the general metabolism of the body, the breaking up of the blood globules, and the formation of urea. It further acts upon peptones, and probably upon ptomaines and waste products (which, accumulating in the blood and tissues, prove injurious, and indeed poisonous), and forms them into sugar, glycogen, and simpler forms, which are stored, as it were, "in a coal-bunker," as Dr Lauder Brunton aptly puts it, for the production of heat and muscular energy. This important power of the liver to destroy poisons, elaborated in the vital processes or introduced from without, is illustrated in Lautenbach's experiments. One-twentieth of a drop of nicotine does not kill a frog, but half that dose suffices when the liver has been removed. These and other observations demonstrate that the blood, recruited by the materials from the intestinal canal, in passing through the capillaries of the liver, has various injurious waste products modified, and, along with the antiseptic bile, excreted into the intestine, and thence got rid of.

The bile has various functions. It promotes absorption and assimilation of fats. Containing a diastatic ferment, it transforms starch and glycogen into sugar. It moistens the intestinal walls, and excites contractions of their muscular coat, thus acting as a natural laxative. It exerts antiseptic effects on the intestinal contents. The action of various

medicines upon the liver have been ascertained chiefly by Röhrig, Rutherford, and Vignel, who curarised fasting dogs, ligatured the common bile duct, and inserted a canula through which the bile secreted was discharged and collected. Numerous drugs were experimented with, usually by injection into the duodenum. As food increases the secretion of bile, the experiments were made on fasting animals. These experiments demonstrate that medicines acting upon the liver are divisible into three classes:—

(1.) **HEPATIC STIMULANTS increase the functional activity** of the organ and the formation of bile, and are represented by dilute nitro-hydrochloric acid, sodium phosphate, salicylate, and benzoate, corrosive sublimate, turpentine, podophyllin, euonymin, colocynth, colchicin, and ipecacuanha. Some of these drugs augment the quantity of bile without altering its quality; others, like sodium salicylate, increase the quantity and fluidity; others, such as toluylendiamine, increase the solid parts, rendering it so viscid that it cannot readily pass through the bile ducts, and hence becomes reabsorbed, and may produce jaundice. Podophyllin is a powerful hepatic stimulant, in small doses, but loses this effect when given in large doses, in which it causes purgation; and similar results occur when other hepatic stimulants are given in such doses as actively to move the bowels. Many aromatic bitters slightly increase bile secretion. Healthy dogs with biliary fistulæ, liberally fed with fats and oils, were found to secrete more bile than when freely fed on albuminoids or carbo-hydrates.

(2.) **HEPATIC DEPRESSANTS diminish the quantity of bile** secreted by the liver. Professor Rutherford found that calomel, castor oil, gamboge, and magnesium sulphate lessened the secretion probably by lowering blood-pressure in the liver; while these and other purgatives besides diminish secretion by sweeping out of the intestine bile which might otherwise be reabsorbed, and partially digested food which might furnish fresh bile. In this way cholagogues are also hepatic depressants.

(3.) **CHOLAGOGUES remove bile from the body mainly by increasing intestinal action.** Superfluous bile cannot be got rid of by a hepatic stimulant alone, which increases the

secretion, nor even by a hepatic depressant, which diminishes secretion, for, as already indicated, excess of bile is apt to lodge in the small intestine, and become reabsorbed. Effectually to get rid of it, the bowels must be freely moved, preferably by a purge, which will produce sufficient mucous secretion to wash out the small intestines. The drugs which effect this are calomel and other purgative mercurial salts, given with a cathartic, such as aloes, jalap, podophyllin, or sulphates of potassium and sodium. Their effects are increased by active exertion. In dogs and other animals that vomit, emetics effectually remove bile by compressing the liver between the diaphragm and the abdominal muscles, diluting the bile with abundant mucous secretion, and promptly discharging it by the mouth as well as by the usual downward channel.

Owing to the low blood-pressure in the portal vein, and also the low pressure at which bile is secreted, there is little *vis a tergo* to overcome obstruction in the gall ducts, and hence the bile flow is rather liable to stagnation, with consequent increased reabsorption. This is apt to occur in human patients living largely on albuminoid food, and not taking sufficient brisk exercise. It also occurs in cattle forced for exhibition, and in all animals as a concomitant of intestinal catarrh. It is frequent amongst horses suffering from influenza, and the circulation of bile accounts not only for the yellow membranes, but also, in great part, for the dulness and langour characterising such complaints. The removal of this superfluous bile, with the waste products it has helped to neutralise, in these cases is suitably effected by half a dose of physic, or by some calomel or grey powder, followed by or conjoined with salines. The nitro-muriatic acid and iron salts, which experience shows to be subsequently serviceable, owe their good effects, in part at least, to their action on the liver. In jaundice, the late Professor Robertson was wont to prescribe a purgative, followed by salines, and subsequently administer twice daily a bolus of inspissated ox bile, alternating this with aromatic spirits of ammonia.

The pancreas has been termed an abdominal salivary gland, but its secretion not only converts starch into sugar, but also digests proteids, and breaks up and emulsifies fat. Not much

is accurately known regarding the action of drugs upon it Its secretion is increased when ether is introduced into the stomach, and diminished in dogs by atropine and vomiting. Calomel and salicylic acid check decomposition of pancreatic juice.

Few investigations have yet been made regarding the action of drugs on the **spleen**.

MEDICINES WHICH KILL OR EXPEL WORMS.

ANTHELMINTICS—VERMICIDES—VERMIFUGES.

ANTHELMINTICS are agents which **kill or expel intestinal worms**. They include **vermicides**, which kill the parasites, and **vermifuges**, such as purgatives, which, without necessarily killing, detach them from the walls of the canal, and wash them away with the mucus in which they are usually embedded.

The parasites most frequently infesting the alimentary canal are—bots, the larvæ of the *œstrus bovis*, found in the stomach of the horse; various species of *tænia*, *ascarides*, *oxyures*, and *strongyli*, occurring in the intestines of most animals; and fluke-worms, which invade the liver, gall-duets, and intestines of sheep, and occasionally of cattle and deer.

The appropriate **vermicides** are—

1. For **bots**, green food, a combination of aloes, asafoetida, turpentine, and ether.

2. For **tænia** or **tape-worms**, areca nut, filix mas, kamala, koussou, pomegranate root bark, turpentine, chloroform, and potassium picrate.

3. For **ascarides** or **oxyures**, popularly known as **round worms**, the remedies used are tænicides, with santonin, bitters, arsenic, and strontium salts.

4. For **strongyli** or **thread-worms**, turpentine and essential oils, tannin, and tannin-containing substances, with enemeta of common salt, ferric-chloride, or lime water.

5. For **fluke-worms** (*Fasciola hepatica*) infesting the liver and gall-duets of sheep, and occasionally of cattle and other animals, the treatment consists in maintaining the patient's strength by good feeding; furnishing common salt and soluble iron salts, which exert general tonic effects and some limited

vermicide action, and giving a dose of physic, which hastens the removal of flukes which have migrated into the intestines. Prevention is ensured by keeping the flock on sound pastures, free from the developmental forms of the parasite.

Bots in horses complete their larval stage in spring, and their discharge is then readily promoted by the laxative fresh green grass. During autumn or winter they are dislodged with difficulty, and unless numerous, and causing much irritation, their removal is seldom attempted; but animals seriously infested with them require liberal feeding. A considerable number of the larvæ may be dislodged by giving, after twelve hours' fast, two drachms each of aloes and asafœtida, dissolved in hot water, to which is added, when cold, half an ounce each of oil of turpentine and ether. The mixture is administered in gruel or linseed tea, and repeated on several consecutive days.

Tape-worms of the three species infesting horses are usually destroyed by the above prescription. Drs Friedberger and Fröhner place first on their list of tænicides three to five drachms of ethereal extract of filix mas. Professor John Gamgee (*Veterinarian's Vade Mecum*) recommends two drachms of asafœtida, a drachm each of powdered savin and calomel, with thirty drops of the oil of the male shield fern, made up with treacle and linseed meal, given at night, and followed by a purge next morning. Mr Robert Littler, of Long Clawson, both for tape and other worms, gives for three or four consecutive mornings a ball containing two drachms of copper sulphate, and follows this with a purgative dose of aloes. Whatever remedies are used, it is essential that the bowels be emptied as thoroughly as possible by twelve to fifteen hours' fasting, or by a gentle aperient, in order that the vermicide shall be brought into contact with the head or scolex.

Dogs in some localities, in the proportion of fifty to every hundred, are infested with **tape-worms**. The most effectual remedy is areca nut; about half a nut, or 15 to 20 grains, is the dose for an animal 25 to 40 lbs. weight. Amongst other remedies are the root-stalks, scales, and rootlets of the male shield fern, now reputed the most certain remedy for tape-worm in man, and best given in the form of ethereal extract; the pomegranate root bark; the flowers of the Abyssinian

kouso, followed by a purge; the American remedy, emulsion of the pumpkin seed; and kamala, a Euphorbiaceous plant effectually used in India. A drachm of turpentine and two ounces of castor or linseed oil is frequently used. Whichever tænicide is prescribed, as in other patients, fasting is enjoined for twelve to twenty hours, or only a little milk or gruel is allowed; at intervals of fifteen minutes a couple of doses of the vermicide are administered; the patient, if in vigorous health, is still restricted to a moderate amount of milk or gruel, and next day receives another dose of the vermicide; an hour later has a dose of ether, shortly followed by a draught of oil, by which the head of the parasite should be discharged.

Sheep, and especially lambs, are victimised by the *Tænia expansa*, which grows very rapidly, and sometimes does widespread mischief. Areca nut, or etherial extract of filix mas, in the dose suitable for large dogs, is most suitable. Poultry and other fowls harbour various species, and areca nut followed by a laxative is generally successful.

The ascarides are more readily removed than tape-worms, and by the same remedies. British practitioners usually treat the *Ascaris megaloccephala* (which chiefly occurs in the small intestines of horses) with drenches containing one to two drachms of aloes, and half a drachm each of chloroform and turpentine, given fasting on two consecutive mornings, and repeating the treatment a week later. German authorities recommend three or four doses of one drachm of tartar emetic, conjoined with bitters, and given in pill or electuary, at intervals of three hours, or a drench of arsenic, aloes, or absinthe, thrice daily, either prescription being followed by an aloetic purge.

The *Oxyures curvula*, met with in the colon and rectum of the horse, are removed by any of these prescriptions, and when confined to the rectum are still more readily dislodged by enemata of quassia decoction or other bitters, lime water, or solution of common salt.

The *Ascaris marginata*, the most common lumbricoid of dogs, is attacked by three to five grains of santonin, the active crystalline principle of artemesia or worm-wood. Turpentine and oil, gentian and other bitters, aconite and various other medicines also remove these round worms. The effect of vermicides,

as already indicated, is greatly increased by first emptying the intestines by fasting, or by a purgative, in order that the drug may act more directly on the parasite. Occasional doses of salines and mineral tonics remove superfluous mucus, which shelters the worms. The spread of parasitism is prevented by isolating infested animals, and keeping sound animals in uncontaminated, clean quarters, and supplied with pure water and sound proper food.

The **Strongyli** include many species, two of which infest the horse, and, embedding themselves in the mucous membrane usually of the large intestines, are difficult to expel. The *S. contortus* invades the fourth stomach of sheep and goats, and not infrequently concurs with the *S. filaria*, infesting the bronchi. Other species attack dogs, cats, pigs, and poultry; while the *S. pergracilis* is the cause of grouse disease. Empyreumatic coal-tar oils and potassium picrate are the remedies used.

Some serious and fatal cases of parasitism, unfortunately, are beyond the reach of anthelmintics. **Trichinæ** get immured in the muscles; the palisade worms develop aneurisms; the *Strongylus tetracanthus*, which causes the death of many Welsh ponies, becomes incised in the mucous coat of the colon and rectum, and is thus protected from the action of medicinal agents. Several species of *Uncinaria* burrowing in the mucous coat of the bowels of dogs and cats produce a pernicious anæmia (Friedberger). The treatment of such cases is limited to a dose of aloes, with mashes, nutritive food, and tonics, to sustain failing strength; Professor Cobbold discountenanced turpentine.

MEDICINES ACTING ON THE SKIN.

DIAPHORETICS—SUDORIFICS—ANHIDROTICS.

The skins of the domesticated animals, besides being protecting envelopes, perform the important functions of respiration, excretion, and secretion of sweat and sebaceous matters. They thereby **remove daily** about 1-67th of the weight of the body, about 1.30 per cent. being solids, of which one-fourth are **inorganic matters**, and three-fourths are **organic**, consisting chiefly of fats, fatty acids, and about one-tenth of urea.

Sanctorius' experiments show that of eight parts of food taken into the healthy body, about three parts leave it in the *fæces* and urine, three by the lungs, and two by the skin. On account of its constant and large secretion of fluid, the skin is an important factor in regulating animal temperature. It is an important breathing apparatus, excreting carbonic acid and absorbing oxygen. The proportion of carbonic acid removed by the skin as compared with the pulmonary membrane is as 1 to 200; the amount of oxygen absorbed as 1 to 180. The azotised matters got rid of vary greatly with the food consumed and with the activity of the kidneys, and range in man from 14·25 grains to 107 grains per hour.

So important are these **purifying functions** that when they are impaired by covering one half the body of horses, dogs, or pigs with a gelatin varnish, the temperature falls, and there is much weakness. When these animals are wholly enveloped in varnish, or when one-eighth of the body of a rabbit is similarly coated, the temperature rapidly falls, blood is imperfectly arterialised, and the animal gradually dies asphyxiated (Landois and Stirling's *Physiology*). The poisonous action of retained perspiration is illustrated by Röhrig's experiment of the injection of $3\frac{1}{2}$ centimètres of freshly-filtered human sweat into the external jugular of a rabbit, which was nearly killed, the temperature promptly rising from 99·2 to 104·3, the pulse mounting from 192 to 315, the respirations from 85 to 105.

The sweat glands, placed in the subcutaneous adipose tissue, number 2000 to 3000 on every square inch of the surface of men and horses. They eliminate all the sensible and most of the insensible perspiration. Their activity is regulated by the special centres which are situated in the anterior horns of the grey matter of the spinal cord, and send nerve-fibres to the fore extremities, along with the anterior roots of the last cervical nerves, and to the posterior extremities with the dorsal and lumbar nerves. The amount of natural perspiration depends mainly upon the dryness and temperature of the air. Sweating in men and horses begins, even while they are at rest, at a little over 80° Fahr. It is chiefly determined—(1) by increased circulation of blood through the cutaneous vessels; and (2) by increased activity

of the sweat glands. The taking of food, the drinking of warm water or other bland fluids, the administration of strong tea and coffee, and active exercise, by raising arterial pressure, increase blood circulation through the cutaneous vessels, and promote perspiration. The sweat glands are stimulated by various aromatic and volatile substances which are excreted by them. The sweat centres are stimulated by ammonia salts, ipecacuanha, opium, camphor, nicotine, and antimony salts, by mental emotions and nausea, by a venous condition and high temperature of the blood, and reflexly by warmth to the surface, warm drinks, alcohol, and pilocarpine.

Diaphoretics and **sudorifics** are agents which **increase** the **skin secretions**. They include (1) agents which stimulate the sudoriferous glands, or nerves connected with them, comprising jaborandi, physostygmine, and warmth to the surface; (2) agents which increase superficial blood supply, including such vascular stimulants as alcohol, ethers, and ammonia acetate solution, vaso-dilators such as amyl-nitrite, sweet spirits of nitre, and such nauseants as ipecacuanha and tartar emetic. Diaphoretics are somewhat less prompt and certain in veterinary than in human patients. Horses are made to perspire more readily than cattle, while the skin of horses and cattle is more easily acted upon than that of sheep, dogs, cats, or pigs. In all animals the readiest way of promoting copious cutaneous secretion is by heavy clothing, warm diluents, and keeping the animal in a dry atmosphere of about 70°, and administering small and repeated doses of ammonia acetate solution, or sweet spirit of nitre. General stimulants in small doses raise arterial pressure, and hence usually increase skin secretion. When, however, blood-pressure is high, as in the early stages of acute inflammation, sedatives, such as aconite, or blood-letting, by reducing the action of the heart and blood-pressure, notably increase cutaneous secretion. Friction or grooming with suitable brushes beneficially excites the action of the skin in all animals. Warm and vapour baths, at temperatures varying from 100° to 120° Fahr., are useful diaphoretics (p. 150).

Hydropathy affords a ready means of producing diaphoresis in the lower animals, as well as in man. The patient may be enveloped in a sheet saturated either with cold or tepid water.

Over this are placed three or four large horse-cloths. The legs should be subjected to similar treatment, or rolled in warm bandages. After the patient has been thus clothed for half an hour or an hour, he will steam and perspire very freely. The sheet and rugs should then be removed, and the animal dried by hand-rubbing, and comfortably clothed. This practice has been successfully adopted both with horses and cattle. Blood is thereby withdrawn from internal organs, healthy action is imparted to the skin, and beneficial reflex influences are exerted on internal parts. The evil effects of chills are thus counteracted, colds are cut short, and rheumatism, especially in gross subjects, removed. Hydropathic treatment should not, however, be adopted unless with due consideration, and under competent supervision. Protracted or violent diaphoresis, howsoever produced, proves debilitating. It removes from the body an undue proportion of its solids, and especially of its saline matters.

Diaphoretics are used for the following purposes:—

(1.) They **restore checked cutaneous secretion**, and hence equalise irregularities of circulation, counteract congestion of internal organs, and lower exalted temperature. They are hence often serviceable in cutting short chills, colds, and simple febrile attacks, especially amongst horses.

(2.) They **remove injurious waste products**, and other morbid matters, which are apt to accumulate, particularly in febrile, inflammatory, and rheumatic disorders. These depurative services are especially valuable when the eliminating functions of the kidneys, bowels, or pulmonary membrane are impaired. In such cases the skin may be made to undertake a vicarious duty, and excrete waste matters usually disposed of by other channels.

ANHIDROTICS are drugs which **lessen cutaneous secretion**. Their effects appear to be induced (1) by diminishing the activity of the sweat glands; (2) by lessening excitability of the sweat centres; or (3) by acting on the circulation, usually by stimulating the respiratory centre, and thus overcoming that venous condition of the blood which in weakness and disease is a frequent cause of sweating. It is in this last manner that belladonna and atropine, picrotoxine, jaborandi, ipecacuanha,

nux vomica, and salts of zinc check sweating; but belladonna and its alkaloid, moreover, are effective by their paralysing the terminals of the secreting nerves of the skin.

MEDICINES ACTING ON THE URINARY ORGANS.

ON THE KIDNEYS: DIURETICS.

Diuretics are agents which **act on the kidneys** and **increase secretion of urine**.

The kidneys have a threefold action:—

- (1.) They remove from the body excess of water.
- (2.) They excrete waste products, chiefly nitrogenous bodies and salts.
- (3.) They retain and reabsorb water.

These functions are mainly performed by three separate portions of the kidney:—

- (1.) The Malpighian corpuscles or glomeruli, mainly by a process of mechanical transudation, eliminate water, containing some solid matters.
- (2.) The uriniferous tubules of the cortical substance, and the epithelial cells lining them, mostly excrete unused or waste materials dissolved in a limited quantity of water. Urea and other such nitrogenous waste products in the blood are the natural stimulants of this secreting function.
- (3.) The constrictions in the tubules retard rapid outflow of water, and favour its reabsorption after it has washed out the waste products, as notably occurs in birds and reptiles, and in many mammalia in hot weather.

The amount of urine is liable to considerable variation, depending mainly on the nature of the food, the quantity of water drunk, and the proportion of fluid removed by the bowels and skin. Horses during the twenty-four hours pass from two quarts to two gallons, or on an average about ten pints. Secretion is augmented during digestion, and is largely increased by such food as heated oats or musty hay, and by vetches, especially when animals are unused to them. Professor

Frederick Smith, of the Veterinary School, Aldershot, recently made a series of examinations of the urine of horses, and finds the specific gravity range from 1035 to 1040, and that every ounce contains about 12·39 grains of urea, or a total of upwards of five ounces in the twenty-four hours (*Veterinary Journal*, September 1887). Cattle pass in the twenty-four hours from two to three gallons of urine, which contains more potassium hippurate and sulphate and common salt, but less urea and less calcium carbonate than that of the horse. Of the fluid ingesta, the kidneys of the horse remove about 14 per cent., of dogs nearly 50 per cent., of man about 54 per cent. The two kidneys do not act in perfect unison; while one is mostly removing concentrated excrementitious matters, the other gets rid of greatly more diluted urine, and this service is alternated.

The urinary **secretion is increased** by a variety of conditions, notably by raising the pressure of blood in the Malpighian corpuscles, by cardiac stimulation, as also by contraction of the blood-vessels of other vascular areas, as when cold diminishes cutaneous activity. Irritation of the medulla in the floor of the fourth ventricle experimentally produced by mechanical injury, or naturally produced by circulation of venous blood, greatly increases secretion, owing, it is believed, to stimulation of the special vaso-motor centre which regulates the renal arteries. Subsidiary centres are also found in the spinal cord, and in the solar and mesenteric plexuses, all of them contributing in the regulation of the secretion of the kidneys.

The proportion of the several urinary constituents is altered by different conditions. Urea, uric acid, and hippuric acid are increased by nitrogenous food, by common salt, phosphoric acid, leucin, and glycol, and are also augmented during the early stages of most acute diseases. They are diminished by alcohol, turpentine, arsenic, and large draughts of water. Horses at rest pass a maximum of uric acid and a minimum of the less perfectly oxidised hippuric acid, but these proportions are reversed during and immediately after exertion, when disintegration of albuminoid tissues freely uses up oxygen and increases production of carbonic acid.

Albumin is not a normal constituent of urine, but occurs in convalescence from most febrile disorders, temporarily in horses receiving excess of albuminous food, and also in hæmoglobinuria (azoturia) in horses, and red water in cattle. It appears where contraction of the renal arteries has been induced by digitalis or strychnine; and is likewise produced by full doses of cantharides, which also causes hæmaturia. Such exudation of albumin, which is more apt to appear suddenly and temporarily in horses than in man, is lessened by administration of tannin, and by arbutin, the active principle of uva ursi, and also by keeping the bowels and skin in proper action, clothing the patient comfortably, but avoiding active diuretics. Bile constituents are occasionally found in the urine of the lower animals, but sugar is rarely present.

Classifying diuretics as refrigerant, hydragogue, and stimulant, Dr Lauder Brunton presents the subjoined tabular view of their probable modes of action:—

Raise arterial pressure.	Generally.	Increased action of the heart :	{ Digitalis Alcohol	{ Digitalis. Erythrophlœum. Strophanthus. Squill. Convallaria. Strychnine. Caffeine. Cold to surface.
		Locally in kidney.	Contract efferent arterioles of glomeruli, so as to raise pressure in glomerulus, or lessen absorption in tubules or both :	{ By action on vaso - motor centres. By local action on vessels or nervous structures in the kidney itself.
Dilate afferent vessels :	{ Paralyse vaso-motor nerves, or involuntary muscular fibre or stimulate vaso - dilating nerves.			
			Act on the secretory nerves or secretory cells of the kidney itself.	Increase water excreted :
Increase solids excreted :	{ Liquor Potassæ. Potassium Acetate, &c. Other Saline Diuretics.			

The selection of a diuretic must in great part depend upon the purpose for which it is given. A **diuretic ball**, commonly used for horses standing for several days in the stable, or affected with swollen or itching legs, is made with half an ounce each of nitre, resin, and soft soap, and may be repeated daily for four or five days. The same ingredients dissolved in a pint of water make a diuretic drink for the cow. For a medium-sized dog, Stonehenge advises six grains of nitre, a grain of digitalis, and three grains of ginger, made into a pill with linseed meal and water. Another useful combination for dogs consists of thirty drops of sweet spirit of nitre and five grains saltpetre in a little water. Diuretic effects are best ensured by conjoining several drugs, by giving small and repeated doses, by encouraging the animal to drink water, thin gruel, or other bland fluids, and otherwise promoting excretion of the medicine by the kidneys rather than by the skin or bowels.

Diuretics are used—

(1.) **To increase the proportion of water** in the urine, thus preventing deposition of its solids in the kidneys or bladder, and mechanically washing out such solids when they have been formed. Along with medicinal diuretics, diluents in such cases are freely supplied.

(2.) **To hasten expulsion of waste products** and poisonous matters from the body, as in febrile or rheumatic disorders, or where the kidneys are acting tardily. In these, as in other cases, a combination of diuretics is desirable, and digitalis, turpentine, or oil of juniper is often usefully conjoined with nitre. In human practice caffeine is prescribed.

(3.) **To remove excess of fluid** from the tissues or serous cavities. When the dropsy is connected with cardiac disorder, digitalis, and other drugs which act generally on the vascular system, are indicated, their efficacy being rendered more certain by combination with some saline diuretic, such as nitre. Copaiba is added to the prescription when the liver is affected. In dropsy connected with chronic kidney disease, nitrous ether and oil of juniper are preferred; but must be used with extreme caution.

As adjuvants, where venous congestion occurs, a purgative is

often useful. Calomel augments secretion of urea, and hence promotes secretion of urine. In excessive or too frequently repeated doses diuretics are apt unduly to stimulate the kidneys and urinary organs, and provoke strangury inflammation and hæmaturia.

MEDICINES ACTING ON THE BLADDER.

LITHONTRIPTICS—URINARY SEDATIVES, TONICS, AND ASTRINGENTS.

The movements of the urinary bladder are mainly regulated by a centre in the lumbar portion of the spinal cord, but in all the higher animals there is also a presiding centre in the brain, which may be set in action either voluntarily or reflexly. Most drugs influencing the bladder appear, however, to come into actual contact with it, and produce their effects reflexly. Some horses have great objections to urinate while in harness; others will not while the rider is in the saddle. As with other animals, the desire to urinate is suggested, and the act facilitated, by seeing or hearing other animals staling, or even by the sound of flowing water. If, as is often the case, the horse is in the habit of being whistled to when urinating, the act will be encouraged by whistling to him.

Hard-fed and hard-worked horses are liable to suffer from urinary deposits, which are sometimes found in the kidney, but more commonly in the bladder, and in male animals in the tract of the long curved urethra. **In horses**, as in other herbivora, **urinary deposits** consist mainly of calcium and magnesium salts, sometimes derived directly from hard drinking waters, from earthy matters mixed with fodder or grain, or from lime salts abundant in clovers and other fodder, and which unite with the carbonates produced by oxidation of the vegetable acids also present in the food. These calcareous deposits are sometimes in a finely-divided pulverulent state; sometimes they are aggregated into one or more masses or stones. Whether occurring as sediment, gravel, or stone, they cause more or less difficulty, straining, and pain in urination; the stream is interrupted, and from irritation of the lining membrane of the urinary passages it usually contains excess

of mucus; while the portions last discharged are often turbid. When such symptoms depend upon the presence of a stone in the bladder, medical treatment is unavailing. No medicine can be given in sufficient amount or sufficiently concentrated to dissolve calcareous urinary deposits within the body. Hence a stone which cannot be naturally discharged can only be removed by a surgical operation. When not too large it may be extracted by lithotomy; or, when large or of awkward shape, it may first be reduced. Calcareous sediment can usually be got rid of in great part, or entirely, by giving liberal supplies of barley water, linseed tea, or other diluents, which mechanically wash out the urinary organs. Very readily in the mare, and with a syringe and flexible catheter in the horse, the bladder may be filled with tepid water, and deposits thus washed out. Successive quantities of water may be introduced until they come away tolerably clear.

LITHONTRIPTICS are defined as remedies which prevent deposit of solids from the urine, or cause their resolution. In veterinary patients, as already indicated, they cannot resolve solid deposits, although they may mechanically remove them, and may check their formation. Such preventive treatment in the case of horses mainly consists in furnishing abundant, regular, and pure supplies of drinking water. Waters rich in calcareous matters are theoretically more liable to deposit such earthy constituents, especially under conditions where their carbonic anhydride is diminished. A weekly mash, containing any simple saline, somewhat lessens the tendency to these urinary deposits; and it is further important to remove any conditions which interfere with regular urination or any obstructions to the outflow. It is accordingly desirable, several times a week, thoroughly to wash out the horse's sheath and prepuce with soap and tepid water, and thus get rid of accumulating sabulous matter.

Bulls and **oxen**, and still more frequently **rams** and **wethers**, when liberally supplied with albuminoid food, and having little or no exercise, are liable to deposits, chiefly of **ammonio-magnesian phosphates**, in the bladder and tortuous constrictions of the urethra. Amongst feeding sheep, fatal uræmic poisoning is thus produced. The patients must be turned up,

and endeavour made by manipulation to displace the deposits which block the course of the urethra. Where these means fail to effect a passage, the vermiform appendage may be cut off, when a full stream of urine will be discharged, and with it a considerable amount of deposit. Prevention is effected by withholding or reducing the allowance of cake and corn, supplying soft laxative food, raising the sheep and moving them about at least thrice daily, so as to encourage urination, and prescribing potassium carbonate.

Dogs, when freely eating animal food, suffer occasionally from deposits of **uric acid** and **acid urates**, the tendency to which is combated by suitable diet, diluents, and salts of potassium and lithium, both of which form soluble salts with uric acid, but the lithium having a lower atomic weight, unites with a larger proportion of uric acid.

VESICAL AND URINARY SEDATIVES are agents which **lessen irritability** of the bladder and urinary passages, and thus remove straining and pain. Diluents, such as linseed tea or other mucilaginous drinks, are often serviceable. Irritability caused by the presence of calculi is diminished by administering calcium carbonate. In cystitis, rugs wrung out of hot water and laid over the loins, and hot fomentations to the perineum, afford much relief. Irritability of the nerve-centres is soothed by opium, belladonna, and hyoscyamus. Chronic inflammatory conditions are relieved by such astringents as uva ursi, buchu, and Pareira brava. Copaiba, sandal-wood oil, and terpenes are excreted in considerable amount by the kidneys, and exert their antiseptic and astringent effects throughout the urino-genital tract. Relaxed and hæmorrhagic conditions were treated by the late Professor Robertson by sulphuric acid and iron sulphate, alternated by salicylic acid.

VESICAL AND URINARY TONICS are agents which increase the contractility of the involuntary muscular walls of the bladder. Some, like potassium bromide, strengthen the detrusor urinæ muscles, and thus prevent retention; others, like strychnine and cantharides, strengthen the sphincter vesicæ, and thus prevent involuntary escape of urine. Belladonna acts upon the regulating nerve-centres, and is believed to lessen their sensibility.

MEDICINES ACTING ON THE ORGANS OF GENERATION AND THE MAMMARY GLANDS.**APHRODISIACS—ANAPHRODISIACS—ECBOLICS.**

The **sexual function** is regulated by two nerve-centres which influence and react on each other.

(1.) The cerebral is believed to lie in the crus cerebri, is stimulated reflexly by the special nerves of smell, sight, or hearing. (2.) The spinal centre, situated in the lumbar region, regulates the dilatation of the arterials and the compression of the efferent veins in the erectile genital tissues, thus producing turgid rigidity. Erection is also produced reflexly by local irritation of the genital organs, as well as by irritation of the bladder, prostate, and lower intestines.

APHRODISIACS are agents which **increase sexual appetite**. Deficient sexual activity usually depends upon want of general vigour, and hence cannot be amended by the old popular remedy of switching the animal's hind parts with nettles. The more rational and effectual treatment consists in the administration of tonics—notably of iron and of strychnine, which latter, in addition to its general action as a nervine tonic, has also a special effect in stimulating the sexual centres. Cantharides produces aphrodisiac influences mainly by irritating the urinary mucous membrane, and hence is an unsafe remedy. Alcohol, although stimulating the cerebral sexual centre, appears to paralyse the lumbar vaso-motor centres, and hence interferes with the proper performance of the generative act.

ANAPHRODISIACS are agents which **diminish the sexual passion**. They may act locally on the organs themselves, as is the effect of applications of ice or cold water; or generally on the genital nerve-centres, as do potassium iodide and bromide, purgatives, digitalis, hemlock, and camphor. A spare diet and steady work exert anaphrodisiac effects. Irritation of the genital lumbar plexus is produced reflexly by distension of the bladder with acrid urine, by accumulation of filth around the prepuce, by ascarides, and even by fæces in the rectum. Removal of such causes of irritation accordingly diminish undue sexual excitement.

ECBOLICA.—The involuntary muscular fibres of the uterus have the power of rhythmical contraction, but are besides controlled by higher nerve-centres, one set of which are in the lumbar portion of the cord, and the other in the brain. Experiments have demonstrated that stimulation of the cerebellum, crura cerebri, corpora striata, and optic thalami produce uterine contractions. One set of nerves going to the uterus induce circular contractions, with protrusion of the cervix and dilatation of the os; while another contract longitudinally, causing retraction of the cervix and closure of the os.

Ecbolics cause expulsion of the contents of the uterus. They include ergot, hydrastis, savin, and thuja; but ergot is the only one in general use. It induces uterine contractions even when all nervous connections have been divided, but it also acts on the special centre. It is occasionally **used** in veterinary patients—particularly in the bitch—to hasten parturition when no obstruction is present, but when expulsive power is deficient. As it induces persistent contraction of the uterus, with consequent arrest of placental circulation, it must be used only sparingly and cautiously during parturition. It is serviceable, however, subsequently in promoting contraction and checking hæmorrhage. Prompt contraction of the flaccid uterus, with arrest of dangerous bleeding, is best secured by subcutaneous injection of ergotin, and also by injection of warm water.

The local irritation of metritis and leucorrhœa is also relieved by injection of water, used as warm as the animal can bear it, and rendered still more effectual by addition of Condry's fluid, chlorine solution, or carbolic acid. Suppositories of opium and belladonna may be subsequently introduced.

AGENTS ACTING ON THE MAMMARY GLANDS.—An ample stream of well-nourished blood passing through the mammary glands is essential for the abundant secretion of good milk. Animals which are to milk well must accordingly be fed well. Their diet must contain a sufficient proportion especially of albuminoids and fatty matters, which furnish the casein and cream of the milk. There are no drugs of much practical value as **galactagogues**, or **increasers of milk**. Jaborandi exerts only a temporary effect. Many drugs, however, pass into the

milk, communicating to it their flavour and medicinal properties. Ethereal oils promptly taste the milk of any animal to which they are given. Fixed oils and salines administered to milking mothers, purge the sucking offspring. Acids, diuretics, opiates, and other active drugs given to suckling mothers frequently exhibit notable effects on their susceptible progeny.

By careful selection of good milking bovine tribes, and by suitable feeding and milking three times daily, the milk yielded by first-class dairy cows is many times that obtained from cattle in their normal or semi-feral state, which furnish only sufficient for the rearing of one calf. But the highly developed mammary organs of these improved dairy animals become increasingly liable to disease, and less amenable to treatment. Acute inflammation frequently attacks one or more quarters of the udder, causing much constitutional disturbance, and necessitating the administration of a smart purgative, and of febrifuges. A large udder when it becomes inflamed, in order to relieve its dependent position and weight, must be suspended by a broad web passed over the back and loins. The web will conveniently support the light poultice of spent hops, which is often advantageously applied. In the web, holes are cut for the teats, so that milk, which, if allowed to remain, increases irritation, may be removed four or five times daily. A teat-syphon is generally useful to withdraw the milk with a minimum of pressure in handling. The inflamed parts are dressed with belladonna, which paralyses the vaso-motor nerves, thus diminishing lacteal secretion; and also relaxes muscular fibres, thus relieving tension, loosening the sphincters of the teats, and hence facilitating removal of milk. These desirable results are sometimes obtained by the hypodermic injection of atropine.

With the view of hastening the drying of cows, belladonna is sometimes applied topically to the udder, and is also administered; but the desired object is more practically attained by restricting the cow to dry food, milking her at gradually lengthening intervals, and, where the result has to be quickly secured, giving besides a dose of physic.

REMEDIES ACTING ON TISSUE CHANGE.

RESTORATIVES—TONICS—HEMATINICS—ALTERATIVES—
ANTIPYRETICS—BLOOD-LETTING.

The various structures of healthy animal bodies are continually undergoing reconstruction, change, and devolution. Fresh materials or **restoratives**, in sufficient abundance, and containing in suitable proportion the constituents of the several tissues, are required. By digestion and assimilation, the food materials are prepared for their special uses. But these complex nutritive processes sometimes become deranged. Some fault occurs in the digestive enzymes; some want of activity or co-relation overtakes the presiding nervous centres; some delay takes place in the prompt and effectual removal of waste products by the bowels, kidneys, or skin. Hence arise muscular and nervous depression, expressed in dulness, debility, and diminished capacity for exertion. For such weakened, relaxed, unfit conditions, the appropriate remedies are **tonics**. Within the living organs and tissues themselves, further subtle reparative processes continuously occur, and certain drugs, termed **alteratives**, in an imperceptible way modify these remoter tissue changes in a manner not always fully explained. The maintenance of a tolerably uniform temperature is essential to the performance of normal tissue changes in warm-blooded animals. In fever, however, the temperature is increased, and the remedies employed for its reduction are **antipyretics**, or febrifuges.

RESTORATIVES.—The bodies of all animals, especially when in a state of activity, are undergoing disintegration and waste, and their growth and repair hence require continual recuperation. **Food** must be provided in sufficient amount, of suitable quality, and with its several constituents in fitting proportion, to furnish appropriate nutriment for every tissue. **Water** constitutes four-fifths of the total weight of most animals, is being constantly removed by the lungs, skin, kidneys, and intestines, and, unless restored at short intervals by suitable fluids, thirst and impaired health ensue. Not only are water

and watery fluids requisite for the normal nutrition of the tissues, and for dissolving and carrying away their waste products, but in sick animals they besides aid in the removal of the products of disease. Even more continually imperative is the need of **pure air** to oxygenate the blood, maintain internal respiration and normal tissue change, and remove waste products. The bodies of all the higher animals require, either in the form of food or as restorative medicines, varying supplies of their many constituents—phosphorous, specially for blood, bone, brain, and nerves; sulphur, for the skin and bile acids; fats, for cell-growth generally; iron, for the blood globules; salines, for the healthy restoration of the blood and most other parts.

Essential as are these requirements in health, they are even more so for **animals affected by disease**. Food then requires to be given with especial care, and in an easily digested form, for in all serious diseases the digestive functions are impaired, and require rest. In many febrile complaints, alike of horses and cattle, the ordinary grains and dry fodder, being imperfectly digested and assimilated, are apt to produce or aggravate gastric derangement. Animals affected by febrile and inflammatory disorders should therefore be restricted to mash, gruels, and such soft food, to which extra nutritive value can be given as required by addition of milk, eggs, meat extracts, or beef tea. Food should never be allowed to lie long before a sick animal. If not promptly cleared up, it should be removed, and in a couple of hours, or less time, a fresh supply offered. During and after debilitating diseases, patients fed, as they should be, on small amounts of rapidly-digested fare, obviously require such food more frequently than in health. With returning appetite a convalescent occasionally greedily eats more than is good for him, and against this contingency well-intentioned attendants require to be warned. Many relapses of colic and lymphangitis occur by allowing horses, so soon as they will eat, to return at once to their full allowance of dry corn and hay.

Unless when affected with diarrhoea, dysentery, or diabetes, animals do not injure themselves by taking too much **water** or **watery fluids**, but are often rendered uncomfortable, while

recovery is retarded by undue restriction. A supply of water should always be within the patient's reach. Cold water never does harm, and is more palatable and refreshing than when given tepid. Salines, chalk, and such simple medicines, sometimes supplied in the drink offered to sick horses, require to be sparingly added, and, if they render the water at all distasteful, must be administered in some other way.

Much mismanagement occurs with regard to the **ventilation and temperature** of the habitations of sick animals. Even for horses or cattle accustomed to comfortable boxes, a temperature of 60° to 65° Fahr. is sufficiently warm. Avoiding draughts, cool air should be freely admitted. No restorative or tonic is so effectual as cool, pure air, and it is especially needful in diseases of the respiratory organs and in zymotic cases. **Sunlight** is also an essential factor of health, especially in young animals. It increases the capacity of the blood and tissues for oxygen, and favours healthy excretion.

A **comfortable bed** greatly conduces to the restoration of most sick animals. A sick, exhausted horse, who to his disadvantage would continue to stand if kept tied in a stall, will often at once lie down and rest if placed in a comfortable box. In febrile and inflammatory attacks, and during recovery from exhausting disease, alike in horses and cattle, a **warm rug** or two, and **bandages** to the legs, help to maintain equable temperature and combat congestion of internal organs; but at least twice daily these rugs and bandages should be stripped off, the skin wiped over, and the clothing at once reapplied. In fever, when the skin is hot and dry, great comfort results, a more natural moist state of skin is secured, and more active blood purification and restoration ensue, from sponging the body several times a day with tepid water acidulated with vinegar, quickly drying, and at once putting on the clothing.

Attention to **the position** of the patient is frequently an important factor in the treatment of disease. The debilitated horse allowed to lie long on his side is apt to suffer from congested lungs. The horse with badly broken knees is advantageously placed in slings, in order to relieve the bruised, lacerated parts from irritating weight and pressure. The cow,

in the unconscious stage of milk fever, if permitted to lie on her side, speedily becomes tympanitic, and her chances of recovery are seriously impaired. In this and other cases, in which she has to lie even for a few hours, she must be propped in a natural position on her broad breast-bone.

Mechanical and physiological rest are great restoratives. The pain accompanying most injuries and diseases, and greatly aggravated by performance of the natural functions of the part, instinctively enjoins as much rest as possible. Mechanical rest is frequently secured by splints and bandages, applied in all animals in cases of fractures of long bones of the limbs, and serious muscular and tendinous strains. Slings are also of similar service in horses suffering from fractured limbs, open joints, and occasionally in laminitis. Wounds are maintained in a restful state by removal of foreign bodies, and being kept aseptic. An inflamed part, when practicable, should be raised above the level of surrounding parts. Any pressure likely to interfere with circulation should be removed. To relieve irritation, pressure, and tension, the inflamed udder of the cow is suspended. In irritable and inflammatory states of the digestive organs, the simplest and most digestible food is given, and as little duty as possible exacted from the stomach and bowels. When the kidneys are diseased, their work should be lightened, and the skin and bowels got vicariously to undertake the chief excretory services. Emollients and demulcents, as well as opium, belladonna, and other agents which paralyse the endings of sensory nerves, exert their curative effects mainly by ensuring physiological rest. But when acute disease has passed away, the gradual use of an affected part generally does good. **Exercise** in such circumstances proves a health restorer, improving appetite, and promoting most of the bodily functions.

The **medicinal restoratives** in common use are as follows: Linseed, in the form of gruel, tea, or cake, proves a soothing, palatable, digestible laxative combination of food and medicine. Cod-liver oil, especially in dogs and cats, conveniently supplies assimilable fatty matters. Iron salts, possessing tonic and hæmatinic, as well as restorative properties, are specially serviceable in anæmia; phosphates are prescribed for ill-

thriving, weakly young animals; salines are indicated in skin eruptions and itching, often met with amongst hard-worked, liberally-fed horses; artificial pepsin and pancreatin are sometimes administered to dogs and calves when the natural digestive ferments are deficient or faulty.

Tonics.—When digestion is enfeebled; nutrition impaired, circulation languid, or waste products not promptly removed, there is apt to ensue weakness, want of energy, and unfitness for work—conditions treated for the most part by tonics. They are defined as remedies which **impart tone** or **strength** to the parts on which they specially act. They are allied to nutrients and restoratives. They resemble stimulants; but their effects are more slowly and gradually produced, are more permanent, and not succeeded by subsequent depression. While stimulants usually call forth strength previously latent, tonics frequently give strength. They are also allied to astringents, but do not exhibit the same chemical power of coagulating albumin and condensing tissues. The same drugs, in different doses, often appear, however, in two or more of these classes. Alcohol, for example, is nutrient, tonic, and stimulant. Iron salts, according to their dose and the state of the patient, are nutrient, tonic, and astringent, but, used improperly, are sometimes irritant.

Tonics exert their curative effects in one or more of the following ways:—

1. By influencing primary digestion, usually increasing gastric secretion. In this manner gentian and other bitters are chiefly serviceable.

2. By promoting secondary digestion, thus improving the chemical condition of the blood and various fluids. The most important members of this class are hæmatinics, noticed below.

3. By acting on other special organs and structures, notably on the heart, nervous centres, or liver.

In using tonics it is accordingly essential to discover what part or organ is primarily and chiefly at fault. When digestion is enfeebled, gastric or intestinal tonics are prescribed (p. 90). When the pulse is soft and weak, with a tendency to local congestion and œdema, cardiac and vascular tonics are used (pp. 83, 84). When nervous functions are imperfectly

performed, nervine tonics are appropriate (pp. 72, 73). In the early stages of tuberculous disease of the mesenteric glands in cattle and sheep, and also in farcy in horses, copper sulphate is often useful, probably on account alike of its tonic and antiseptic properties. Cold, in the form of baths, douches, and sponging, proves a valuable tonic, applicable for general as well as local purposes, relieving irritability, bracing up soft, flabby textures, and equalising circulation (p. 149).

HÆMATINICS, or blood tonics, constitute an important group of tonics, which increase the quantity of red corpuscles and hæmoglobin in the blood. "The red blood corpuscles are probably formed in the spleen, the medulla of bones, the liver, and possibly other parts of the body, from leucocytes, which lose their nucleus, take up hæmoglobin, and alter their form to that of the red corpuscles" (Brunton). These red corpuscles are in great part destroyed in the liver and spleen, and it hence appears probable that disorder of these organs is an essential cause of anæmia, which is very common amongst all badly-reared young animals. In order to restore iron and fatty matters which are deficient in anæmic blood, daily doses of soluble iron salts are prescribed, while easily assimilated fatty matters, such as boiled linseed, or linseed cake, are given to horses and cattle, and cod-liver oil to dogs. An improvement of general health is further effected by judicious feeding and comfortable quarters. The anæmia resulting from debilitating disease requires similar treatment. To ensure their good effects, tonics are generally given in moderate doses, two or three times daily, for six or eight days, and throughout their administration the bowels should be kept in a regular normal state.

ALTERATIVES are drugs which influence the amount and kind of tissue change going on in different organs and cells. Their results are usually readily recognised, but the way in which they are produced is sometimes difficult to explain. "They produce," Dr Lauder Brunton states, "no marked corresponding changes in assimilation, circulation, or excretion. It is uncertain how they act; it is possible that they may alter in some way the action of enzymes in the body, but it is also possible that they act by replacing the

normal constituents of the tissues, and forming compounds which tend to break up in a different way from those which are ordinarily present. Thus, chloride of sodium, and nitrogenous bodies such as albumin are amongst the most important constituents of the body; and we find that among the chief alteratives are substances which will replace chlorine, sodium, or nitrogen in many compounds. Thus, we have iodine and iodides, and nitric or nitro-hydrochloric acids, which will displace or replace chlorine. We have chlorine itself, and chlorides, which may alter the proportion of chlorides to other salts in the blood and tissues, and thus modify the solubility of various constituents of the tissues. We have salts of potassium and calcium, which may replace those of sodium; sulphur and sulphides, which may replace oxygen; phosphorous, hyposulphites, antimony, and arsenic, which may replace nitrogen; mercury and its salts, which may replace calcium. Besides these, we have organic alteratives, regarding the action of which we can at present form no hypothesis, unless they influence the processes of digestion. Nitro-hydrochloric acid, taraxacum, and small doses of mercurials probably act either by modifying the digestion of food in the duodenum and jejunum, or by modifying the changes which it undergoes in the liver after absorption" (*Pharmacology, Therapeutics, and Materia Medica*).

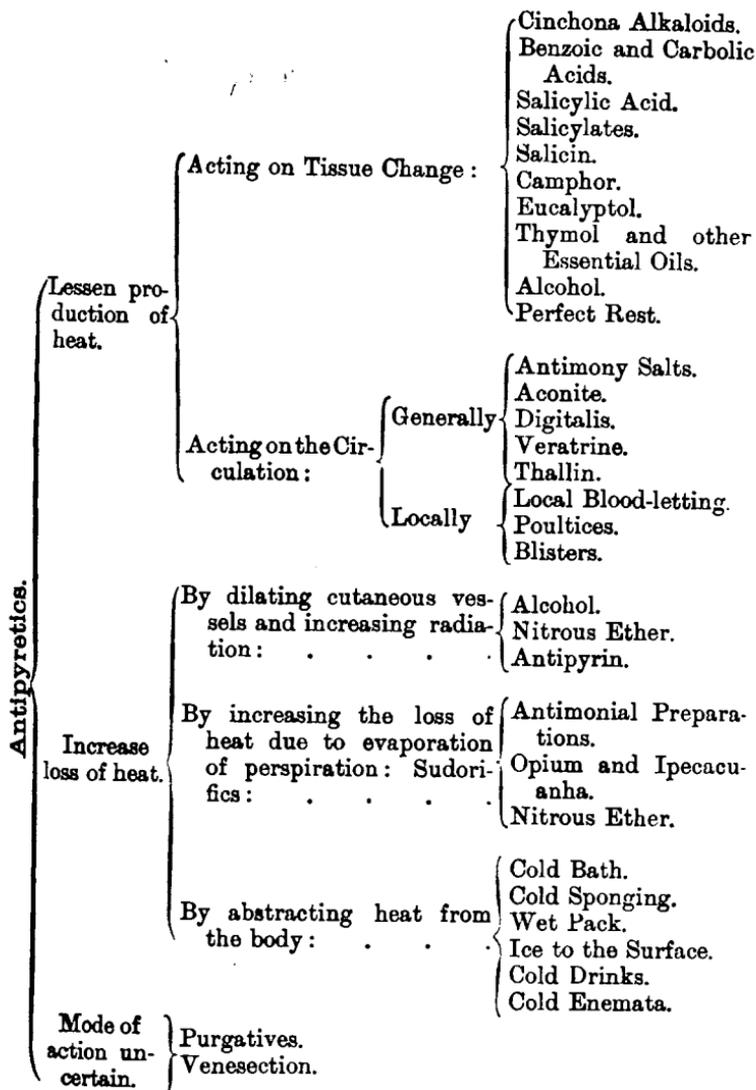
Sodium chloride, sulphate, phosphate, acetate, and bichlorate, potassium nitrate, ammonium chloride and carbonate, and probably all salts excreted by the kidneys, increase tissue change and the amount of urea excreted. Fats and fatty acids lessen decomposition of albuminoids and excretion of urea, but glycerine has no such action. Alcohol, in small or moderate doses, lessens, and in large doses increases tissue change. Benzoic and salicylic acids increase tissue change. Quinine lessens, iron appears to increase it. Mercury also causes a slight increase, but has a peculiar power of breaking up new deposits of fibrin, and hence is used to remove lymph deposits and prevent adhesions. Iodine, iodides, and probably also chlorides, apparently act on the lymphatic system, promoting absorption. In general malnutrition, without definite symptoms, mercurials, nitro-hydrochloric acid, and taraxacum

are indicated, and especially when the liver appears to be at fault. Antimony, arsenic, and phosphorous exert their actions notably on the glandular, nervous, respiratory, and cutaneous systems, and in large or continued doses affect the liver in a marked manner, producing fatty degeneration; and this also results in other tissues. Antimony is prescribed in acute disorders of the respiratory organs; arsenic, in chronic consolidations, which it probably softens by fatty degeneration. Arsenic is also employed in chronic skin diseases, such as psoriasis, lichen, and eczema. Phosphorous and arsenic are prescribed in nervous debility.

ANTIPYRETICS lower the temperature of the body in fever.

They are sometimes termed antithermals, and correspond to the old group of febrifuges. Their effects are more notable when the temperature is abnormal. **Animal heat** is chiefly **produced by oxidation**, in the muscles, both voluntary and involuntary, and in glands, especially when they are in a state of activity. It is **given off** by the skin and lungs, in small amount, by radiation; in still larger amount by contact with cold water or cold air, the latter abstracting heat with especial rapidity when it is damp or in motion. Owing to diminished activity of the cerebro-vaso-motor centre, and consequent dilatation of the surface vessels, loss of heat is greater when animals are asleep than when awake. Conversely, more heat is produced when the animal is in active motion, and blood circulates freely through the heat-producing apparatus of the muscles and glands. Small animals, having a cooling surface relatively larger than their interior heating appliances, are more rapidly cooled than large animals. A centre has been found in the corpus striatum, which appears to regulate the production of heat, and certain antipyretics appear to develop their effects by stimulating this centre.

Antipyretics are divided by Dr Lauder Brunton into two classes—those which **lessen production of heat**, and those which **increase loss of heat**; and these again he subdivides as shown in the subjoined table :—



The production of heat is lessened in various ways :—

Cinchona and its alkaloids, antipyrin, and other drugs of the aromatic hydrocarbon group, the salicyl compounds and alcohol appear to act directly on the trophic nerves and nerve-centres, both central and local, and thus retard oxidation of

protoplasm, and of red and white blood globules (p. 24). Acids long used in the treatment of fever appear to reduce the alkalinity of the nutrient fluids, and in this way retard metabolism. Antimony, aconite, digitalis, and blood-letting probably lessen the production of heat by diminishing the volume and rapidity of the blood stream. Poultices, blisters, and local blood-letting exert similar effects topically. The notable effect of purgatives in checking pyrexia is probably somewhat complex, comprising a diminished force of the circulation, counter-irritation, and increased excretion of those waste products and pathogenic germs which are fruitful causes of elevated temperature.

The loss of heat is increased, as set forth in the above table, chiefly in three ways:—

(1.) By dilating the cutaneous vessels, and augmenting radiation of heat from the body, as is effected by alcohol, volatile oils, and antipyrin. These agents, it will be noted, exert a twofold action of lessening production and increasing loss of heat.

(2.) By promoting secretion of sweat, and thus increasing cooling evaporation, as is effected by diaphoretics.

(3.) By directly removing heat, as is effected by cold baths, cold affusion, &c.

Antipyretics are used to lower abnormal temperature, whether caused by prolonged exposure to heat or by febrile disease. **Cinchona and its alkaloids** are the remedies most trusted in the treatment of the malarial fevers of animals. They mitigate the pyrexia, cut short the attack, and prevent the exacerbations which characterise such cases. **Antipyrin**, although it has little action on the temperature of healthy animals, reduces abnormal temperature quickly, and usually permanently. For veterinary patients it is the best of the new fever medicines. It has been successfully used in influenza, and is given both by the mouth and hypodermically. Salicylic acid and salicylates are specially serviceable in combating the fever and pain of acute rheumatism. Alcohol, in its several forms, exerts a twofold effect, diminishing oxidation and also dilating cutaneous vessels, and thus accelerating cooling. Bleeding, both general and local, judiciously used, lowers abnormal temperature, by relieving alike local

inflammation and symptomatic fever. Purgatives doubtless act in like manner, and in some cases, moreover, relieve gastric derangement, and remove disease products. Horses and cattle are sometimes quickly sponged with cold or tepid water, rapidly dried, and comfortably clothed. Heat is thus directly removed; the cooling functions of the skin, which are impaired in most febrile attacks, are re-established, and their action may be further stimulated by the administration of ammonia salts, ethers, and alcohol. Very essential adjuncts for ensuring the effects of antipyretics are perfect rest and quiet, comfortable quarters, and a temperature of about 60° Fahr.

BLOOD-LETTING promptly and directly affects tissue changes. It rapidly removes from the body nutrient materials, and especially blood globules. A full bleeding **diminishes the activity of all vital functions**, excepting the production of blood globules. The heart-beat is quickened, but its force is lessened; arterial tension is lowered; absorption is increased; sensibility to pain is diminished, owing to reduced activity of the peripheral centres. When blood is lost rapidly or freely, nausea, fainting, and epilepti-form convulsions ensue, and artificial anæmia is produced. In healthy subjects, however, these effects quickly disappear, and the blood is rapidly restored to its normal state.

Until within the last thirty years, blood-letting was freely used in veterinary practice, and very generally abused. It has hence fallen into disrepute, and is now seldom employed even in cases of **acute congestion** and **inflammation**, which it is especially fitted to control. It may be used either **generally** or **locally**. In robust animals suffering from acute congestion or hæmorrhage from the lungs, especially when accompanied by venous stasis, blood-letting affords prompt and frequently permanent relief. Alike in horses and cattle, it is serviceable where fever is acute, with a firm, incompressible, or full, slow, indistinct pulse, as in inflammation of the pleura, peritoneum, or brain, as well as in acute rheumatism. In lymphangitis, and in some cases of laminitis in horses it is also useful. Dogs are so readily brought under the influence of emetics and nauseants that bleeding is less needed in them than in horses and ruminants.

Blood may generally be taken in adult horses or cattle to the extent of three or four quarts. The amount drawn must be accurately measured into a graduated vessel. The circumstances of the case materially affect the amount of blood to be drawn. It should flow freely until its abstraction has made a decided impression on the volume and strength of the pulse, or until the earliest symptoms of nausea are apparent. Blood should be drawn rapidly from a tolerably large opening, as its important influence in relieving arterial tension is thus produced more rapidly and decidedly, and with less expenditure of the vital fluids. The jugular vein on either side is generally selected as the vessel on which it is most convenient and safe to operate. Bleeding from considerable arteries is not more effectual than from veins, and the flow is more troublesome to arrest. Excepting in expert professional hands, fleams are safer than the lancet, which occasionally in restive horses makes an ugly gash. When practicable, the horse should be bled with his head erect, for in this position the nauseating effects, which testify that no more blood can be spared, are most noticeable. When sufficient blood has been taken, the edges of the wound are brought accurately together, and secured by a pin, round which is wound some thread, tow, or hair.

Blood-letting, although valuable in the earlier stages of acute inflammation in vigorous animals, is **injurious** in young or weakly subjects, in the later stages of disease, in epizootic and eruptive fevers, and, indeed, wherever the pulse is small, quick, or weak. A pulse of this character indicates debility, and bleeding in such cases increases exudation and effusion instead of preventing them, while it unnecessarily weakens the patient and retards recovery. While blood is being drawn, the finger should, in all animals, be placed upon a prominent artery, and if the pulse is observed to become quicker or weaker, or begins to flutter, it is evident that the treatment is unsuitable. Such mischance should, however, never happen, for when there is any question as to the propriety of blood-letting such a reducing remedy should be avoided.

Local blood-letting is not much practised among the lower animals. Lancing the tumid gums of teething horses is seldom

necessary, especially if soft food is supplied, as it should be in such cases. In laminitis some practitioners pare down the horny sole, and open the vessels of the sensitive sole, encouraging the flow of blood by immersing the foot in hot water or in a warm poultice; but in such cases the heat and moisture are generally of more benefit than the bleeding. Cupping and leeches are not used in veterinary practice.

POISONS AND ANTIDOTES.

Antidotes are agents which **counteract the effects of poisons**. In the popular acceptation of the term, a **poison** is a drug, whether animal, vegetable, or mineral, which, in small quantity, destroys health and life; but it differs from a medicine only in the degree or intensity of its effects. Indeed, many valuable medicines, when given in large doses, become active poisons, whilst many poisons, properly administered, prove valuable medicines.

Antidotes may prevent the action of the poison, or may mitigate or arrest its effects. When a lethal dose has been swallowed, endeavours should be made, before it has time to enter the circulation, promptly to remove it by the stomach pump, stomach syphon, or by an emetic. It is advisable, however, in all cases to empty the stomach, and thus remove unabsorbed portions of the poison, before giving any fluid which favours solution and absorption, or even before administering the antidote. Some antidotes, such as charcoal and demulcents, **mechanically envelop** the particles of the poison, or ensheath and protect the mucous surfaces. Many enter into **chemical combination** with the poison, forming comparatively insoluble inert compounds. Thus, albumin forms, with corrosive sublimate and other metallic salts, insoluble albuminates. Freshly precipitated ferric oxide converts arsenious acid into the insoluble iron arseniate. When poison has been introduced into a wound, as by the bite of a rabid dog, or by the fangs of a serpent, a ligature, if possible, is placed so as to prevent or retard absorption, and the wound is forthwith thoroughly washed with antiseptics and cauterised or excised.

The action of poisons, even after absorption, may, moreover,

be controlled and counteracted by **remedies which antagonise** their lethal tendencies. Opium lessens the irritation and pain caused by irritants. Artificial respiration frequently sustains life throughout the stage of deadly narcosis induced by curare, prussic acid, or anæsthetics. But still **more definite antagonism** occurs between certain drugs. The stimulant and convulsant effects of strychnine on the spinal cord are opposed by chloral hydrate, which lessens the excitability of the cord. The fatal depression of the cardiac and respiratory centres, produced by large doses of aconite, is antagonised by alcohol, atropine, digitalin, and by strychnine. Between physostygmine and atropine the antagonism is very marked in their actions on the vagus, heart, muscular tissues, and iris, as well as on secretion.

Two explanations are given of this antagonism—(1) By chemical action, the drug first given is supposed to combine with the tissues immediately acted on, and to this combination the second drug may be added, developing another and less active compound; or, otherwise, from such compound the second drug may displace the first. (2) The two antagonistic drugs may act independently of each other on the tissues, producing opposite effects—the one exciting, the other, it may be, paralysing. This latter physiological view seems to meet with most general approval (Brunton). In the case of poisons not rapidly fatal—such as lead, mercury, savin, or yew—an important curative measure consists in hastening their removal from the body by the organs through which they are chiefly excreted.

The following table, adapted from Dr Lauder Brunton's *Pharmacology, Therapeutics, and Materia Medica*, presents some of the more common poisons and their antidotes:—

Poisonous Gases.

Sulphuretted Hydrogen.	Chlorine cautiously inhaled.
Chlorine Bromine.	} Steam inhalation.
Iodine Vapour . . .	
Ammonia Vapour Vinegar vapour.
Carbon Monoxide . . .	} Fresh air and artificial respiration; transfusion.

Nitrous Oxide . . .	}	Artificial respiration; tongue drawn forward; intermittent pressure over cardiac region if heart action failing.
Coal Gas . . .		Artificial respiration.
Charcoal Fumes . . .	}	Alternate warm and cold douches to the head and neck.
Carbonic Acid . . .		Encourage circulation by friction.
Marsh Gas . . .	}	Mustard plasters over surface.

Acids.

	}	Alkalies; sodium or potassium bicarbonate.
Sulphuric Acid . . .		Magnesia: chalk: plaster.
Hydrochloric Acid . . .	}	Soap; milk; eggs whisked.
Nitric Acid . . .		Olive or almond oils.
Phosphoric Acid . . .	}	The alkalinity of the blood impaired by acids is restored by intravenous injection of sodium bicarbonate.
Oxalic Acid and Oxalates . . .		Chalk, whiting, or wall plaster, with water.
Tartaric Acid . . .	}	
Acetic Acid . . .		
	}	Alternate cold and warm affusions.
		Artificial respiration.
Hydrocyanic Acid . . .	}	Atropine injection, repeated every half-hour.
Potassium Cyanide . . .		Mixed proto and per salts of iron: magnesia.

Alkalies.

Potassium Oxide and Carbonate . . .	}	Vinegar; lemon juice.
Sodium Oxide and Carbonate . . .		Other dilute acids.
Ammonium Solution . . .	}	Milk: oil.
Calcium Oxide . . .		

Vegetable Drugs, Alkaloids, &c.

Aconite	}	Spirits: ammonia.
		Digitalis; atropine; warmth.

Acorns; Oak Shoots	}	Oil: salines: laxative diet.
Fern		
Alcohol	}	Strong coffee, and cold douches to the head.
Anæsthetics—		
Chloroform, ether,	}	Artificial respiration.
&c.		
Antimony	}	In patients that do not vomit, wash out the stomach with tannic or gallic acids, followed by milk, white of egg, or other demulcents.
Arsenic		
Atropine—	}	Stimulants and coffee. Caffeine, subcutaneously injected. Sustain action of motor centres by interrupted electric current, and occasionally moving the animal. Artificial respiration, if needful. Physostygmine given cautiously.
Belladonna		
Hyoscyamus		
Stramonium		
Barium Salts	}	Epsom salt. Sulphuric acid diluted.
Calabar Bean—		
Physostygmine	}	Stimulants: chloral. Atropine, strychnine. Artificial respiration, if necessary.
Cantharides		
Carbolic Acid	}	Saccharated lime: stimulants.
Creosote		
Chloral	}	Keep patient moving. Strychnine and caffeine, subcutaneously.

Colchicum . . .	{	Tannic and gallic acids: demulcents. Stimulants.
Conium: Coniine—	{	Tannic acid.
Cicuta Virosa . . .	{	Strong coffee.
Enanthe . . .	{	Stimulants.
Croton Oil . . .	{	Demulcents: stimulants.
Curare . . .	{	Artificial respiration. If there be a wound, ligature, if possible, above it, and incise and suck strongly. Loosen ligature from time to time, but avoid letting too much poison into the blood at a time.
Digitalis—	{	Tannin: stimulants.
Digitalin . . .	{	Aconite, subcutaneously. Perfect quiet.
Ergot . . .	{	Tannin: stimulants.
Fungoid - infested or mouldy fodder or grain . . .	{	Substitute sound food: laxatives. Eucalyptol, menthol, other anti- septic volatile oils. Etherial stimulants: saline anti- septics.
Gelsemium . . .	{	Atropine: stimulants. Artificial respiration.
Insects' Venomous Stings . . .	{	Apply ammonia and oil.
Laburnum . . .	{	Stimulants: coffee. Alternate hot and cold douches to chest.
Lobelia . . .	{	Tannin: stimulants. Strychnine, hypodermically.
Lead Salts . . .	{	Epsom salt: dilute sulphuric acid.
See also Metallic Salts	{	Potassium iodide: occasional dose of castor oil.
Metallic Salts, as of Copper, Lead, Mer- cury . . .	{	White of egg, in large amount Subsequently wash out stomach. Give demulcents. Foment: poultice. Morphine, if needful.

		{ Empty stomach by syphon or pump.
		{ Warm coffee: ammonia.
Morphine—		{ Maintain activity of motor centres by
Opium	{	{ keeping patient moving, and by
Other Narcotics	{	{ electric shocks.
	{	{ Strychnine hypodermically sustains
	{	{ action of heart.
	{	{ Atropine in small doses subcutaneously.
	{	{ Artificial respiration, if needful.
	{	{ Stimulants.
Nitro-Benzol	{	{ Alternate hot and cold douche.
Amyl-Nitrite	{	{ Artificial respiration.
	{	{ Ergotin: atropine subcutaneously.
Nitro-Glycerine	{	{ Cold to head.
	{	{ Copper sulphate.
Phosphorous	{	{ Oil of turpentine, old and oxidised.
	{	{ Avoid fats and fatty oils.
Picrotoxine: Cocculus	{	{ Chloral: potassium bromide.
Indicus	{	{
Pilocarpine: Jaborandi.	{	{ Atropine.
	{	{ Tannic or gallic acids: coffee.
Quinine	{	{ Stimulants: artificial respiration.
	{	{ Epsom salt: demulcents: ethereal
Savin	{	{ stimulants.
	{	{ Ligature limb: excise wound, and sear
	{	{ with hot iron.
Snake-Bite	{	{ Alcoholic stimulants: ammonia.
	{	{ Artificial respiration.
Strychnine: Brucine	{	{ Chloroform: chloral.
Nux vomica	{	{ Potassium bromide: tannin.
	{	{ Warm stimulants.
Tobacco	{	{ Tannin: strychnine.
Turpentine Oil	{	{ Demulcents: Epsom salt.
Veratrine—	{	{ Stimulants: warm coffee.
White Hellebore	{	{ Perfect quiet.
	{	{ Stimulants: laxatives.
Yew	{	{ Demulcents.

DOSSES AND THEIR ADMINISTRATION.

The dose, channel of administration, and manner of using remedies demand consideration.

The dose, or quantity of the medicine used, affects the degree, and sometimes also the nature of the action produced. Thus, small doses of most potassium, sodium, and magnesium salts are alterative and diuretic, while larger quantities are purgative. Aloes, in small quantity, is tonic, and in large, purgative. Alcohol and opium are examples of medicines in which variation in dose produces difference in effect. With topical remedies, an increase of the time during which the drug is applied is generally equivalent to an increase of dose, as illustrated in the case of mustard, cantharides, and concentrated acids.

The period during which a drug remains in the body determines in like manner its activity (p. 13). Hence increased action results from rapid absorption and prolonged retention within the body, while diminished action results from tardy absorption and quick excretion. Where prompt and full effects are desired, as in the case of such a sedative as aconite, or such a stimulant as ether, carefully regulated doses are given every hour or oftener. Where continued effects are desired, as in the case of tonics or alteratives, small doses repeated three or four times daily are preferable to larger doses given at longer intervals. Stimulants, which are evanescent in their effects—such as alcohol, ether, and ammonia—are usually beneficially repeated every two or three hours, or, in critical cases, oftener. The dose of a medicine, and the desirability of its repetition, intermission, or suspension, must frequently be determined by the manner in which the patient is affected by the first dose or doses.

The doses mentioned in this work under the head of each drug, unless otherwise stated, are those suitable for adult animals of medium size. But, as already indicated (p. 19), the size, weight, and environments of the patient require consideration in fixing the dose. In the lower animals, differences of sex do not materially affect dosage; although, on account of their larger size, extra doses are required for stallions, bulls,

and rams. Doses must be adapted to the **age of the patient**. It is generally estimated that a one-year-old colt requires one-third the quantity of any medicine given to an adult horse; a two-year-old, one-half; a three-year-old, two-thirds. A somewhat similar ratio is applicable to cattle.

Medicinal agents are used to produce either local or general actions, or a combination of both.

LOCAL ACTIONS are produced by applying the agent to the surface of the skin, to the mouth or throat, the eye or ear, and also by injection into the rectum, bladder, vagina, or uterus. Such agents, besides acting locally, sometimes pass into the general circulation, and produce general effects, or by reflex action develop secondary or remote effects (p. 12).

GENERAL ACTIONS are usually produced by the introduction of the medicine into the circulation. Injection may be made directly into the veins, and occasionally into the arteries, as in the treatment of collapse and acute anæmia, as well as for purposes of experiment. When transfusion is undertaken the fluid should be watery, and of the specific gravity of blood-serum. Drugs injected into serous cavities are very rapidly absorbed. They are also quickly taken up by inoculation, and from abraded skin surfaces.

The channels by which medicines are administered are:—

- (1.) The digestive tract, generally by the mouth.
- (2.) Inhalation through the pulmonary mucous membrane.
- (3.) Intratracheal injection.
- (4.) The skin and subjacent tissues:—(a) Epidermically by inrubbing; (b) Endermically by inunction after removal of the epidermis; (c) Hypodermically, by injection into the subcutaneous cellular tissues.

1. **The mouth** is the channel by which medicines are most frequently administered, for they immediately pass into the stomach, whence they are readily and rapidly absorbed. To avoid their admixture with food, and their consequent impaired and delayed effect, they should generally be given after the patient has been fasted for several hours. Nutrient oils, iron salts, arsenic, and other irritants are, however, given along with food, or immediately after eating. When it is desired that they

shall be quickly absorbed, and thus act promptly and certainly, they should usually be given in the fluid state, and this is especially requisite in ruminants. The time, labour, and patience of attendants may sometimes be saved, and high-spirited, nervous animals preserved from injurious struggling, if they can be persuaded to take their medicines voluntarily. This may sometimes be accomplished where comparatively concentrated, tasteless, or pleasant-tasted drugs are used, by mixing them with palatable food, or disguising them in gruel, milk, or even in water. Dogs and cats will often bolt concentrated drugs rolled up in a piece of meat. Although absorption is not nearly so active from the posterior portions of the digestive tract, soluble medicines introduced into the rectum gradually enter the circulation (p. 155).

2. **The pulmonary mucous membrane** has a superficies of fifty times the extent of the skin surfaces, and actively absorbs many substances when in the gaseous form. By this channel are administered anæsthetics, when their general effects are required; watery vapour; balsams and anodynes to relieve morbid conditions of the respiratory passages; diluted sulphurous and chlorine gases to destroy bronchial filaria. But other volatile drugs might thus be introduced into the body, while others, in a finely divided state, can be inhaled along with watery vapour, or such a readily diffusible volatile body as chloroform.

3. **INTRATRACHEAL INJECTION** has lately been adopted both in this country and abroad. Tolerably bland fluids in considerable quantity can, with impunity, be introduced into the trachea, and agents too bulky to be used hypodermically can thus be absorbed into the blood more quickly and directly, and with less risk of having their activity impaired than when administered through the digestive tract. Various experiments on dogs, made at St Petersburg, indicate that the effect of curare, strychnine, and cocaine were frequently produced in ten seconds, and more rapidly than when these drugs were injected subcutaneously. Turpentine drenches by this channel exert their lethal action very effectually on the bronchial filaria which attack cattle and sheep. The injection is effected with a syringe of somewhat larger size than that used for hypodermic

purposes. Drugs have occasionally been injected directly into the lungs.

4. **On the skin** many medicinal agents are applied, most of them—such as counter-irritants, caustics, and poultices—for the production of local effects, or of reflex actions exerted on adjacent or distant parts. The skin, protected by epidermis, although it absorbs oxygen and excretes carbonic acid, and takes up water from baths or from wet clothing, especially if there is a deficiency of fluid in the body, does not absorb drugs unless they are dissolved in chloroform or other agents which have a notable power of endosmosis, or unless they are well rubbed in, so that they shall be taken up by the sebaceous or perspiratory ducts. Neither alcoholic nor watery solutions of drugs are absorbed through the unbroken skin. This is illustrated by the impunity with which arsenical dips are used even when of five times the ordinary strength, and when the sheep are kept in them for several minutes.

When the epidermis, however, is removed by a blister, the true skin readily absorbs drugs placed on it. By this **endermic method**, morphine was wont to be used for the production of its general anodyne effects, but the hypodermic method is more convenient, and is now generally preferred.

The hypodermic administration of drugs consists in their injection in solution into the subcutaneous cellular tissue, or occasionally into the substance of a muscle. They thus enter the blood-stream unaltered by contact with the contents or secretions of the digestive canal. They escape the changes which many substances undergo in the liver, and hence act more certainly and rapidly. Hypodermic injection is specially indicated—

- (1.) Where rapid energetic effects are required, as in poisoning, internal hæmorrhage, threatening collapse, paroxysms of acute pain, and convulsions.
- (2.) Where it is desired that the drug shall act promptly and directly on the diseased part, as in neuralgia, rheumatic pains, and mammitis in cows.
- (3.) Where local and general effects are desired to be conjoined, as in reflex spasms.
- (4.) Where internal administration is difficult or impossible.

The drugs thus used should be non-irritant, and soluble in water or glycerine. Many veterinarians now use morphine, atropine, ergotin, physostygmine, and other active drugs hypodermically for arresting or controlling the spasms of colic and chronic cough, the sharp twinges of rheumatism, the inflammatory pain of enteritis and pleurisy, as well as for combating the effects of poisons. Where pain is to be counteracted, the injection is made near the affected spot, or over the nerve which is believed to be conveying the disordered impression. With active agents it is unwise, without careful trial, subcutaneously to inject more than one-fourth of the dose which would be given by the mouth. The drug is thoroughly dissolved in water, or other perfectly bland fluid; two to four drachms of solution is sufficient for one injection for horses or cattle, and proportionately smaller amounts for sheep and dogs. There is less risk than in human subjects of subsequent topical irritation, but intramuscular injection of ether and of other active drugs occasionally causes motor or sensory paresis.

The hypodermic syringe has a glass barrel, on the nozzle of which a hollow needle is fitted. It is essential that the syringe be kept perfectly clean, and the needle, when put away, should have a drop of oil drawn into it, in order to prevent rusting, while a slender capillary wire is generally kept in it. Its point must be kept sharp. The operation is of the simplest description. Choice is generally made of a situation where the skin is thin, and the subcutaneous tissue loose, as behind the elbow, or at the lower part of the neck. A fold of loose skin is taken up between the finger and thumb of the left hand; the needle, detached from the syringe, is passed through the skin, and carried about an inch obliquely under, and parallel with the surface. The nozzle of the filled syringe is then screwed on to the needle, the piston slowly pushed home, and the instrument cautiously withdrawn. The puncture requires no plaster or dressing. A ready, but less prompt or certain, substitute for hypodermic injection, consists in coating a thread with a strong solution of the active principle to be introduced, and drawing this medicated seton through the skin. Convenient tabloids are now sold of the various drugs used hypodermically.

SECTION II.

VETERINARY PHARMACY.

THIS section presents a brief notice of the art of prescribing, and of such important officinal preparations and curative appliances as alkaloids, baths, boluses, drenches, tinctures, &c., arranged for convenience of reference in alphabetical order, according to their English names; while appended are the tables of the Pharmacopœia, and of metric weights and measures.

THE ART OF PRESCRIBING.

Successful prescribing obviously necessitates a competent knowledge of the chemical and physiological actions of the drugs used. Those only can be properly conjoined which are chemically, pharmaceutically, and physiologically suitable. Text-books sometimes present lists of medicines which may fittingly be used together under the title of **synergists**; while lists are given of substances **chemically incompatible** or **physiologically antagonistic**.

The prescription should be as brief and simple as possible. It should be explicit and clearly written. It may be expressed either in Latin or in English. The manner in which the medicine is to be used should be specified. Important instructions as to the regimen or diet of the patient are sometimes appended.

Prescriptions usually contain two or more of the following four representative constituents:—(a) The **basis** or active ingredient. The practice of conjoining several active drugs has wisely been abandoned. Occasionally, however, it may be advantageous to give together two drugs producing their effects in somewhat different ways. Thus, spasms of the bowels are often more effectually controlled by the conjunction of a stimulant like ether, and an anodyne like opium, than by either given alone. Pain which is not alleviated by

either morphine or atropine is sometimes abated by giving them together. (b) The **adjuvant** is introduced in order to increase, moderate, or modify the action of the basis. Frequently its chief object is to ensure solubility and ready absorption. (c) A **corrective** is occasionally required to temper the effects of the basis. Thus, a small dose of laudanum is prescribed with oil or other laxative in cases of diarrhœa; ginger is generally added to the aloetic mass for horses. (d) The **vehicle** generally consists of some comparatively inert substance, added to facilitate administration, such as the treacle, linseed flour, or liquorice powder used as excipients for boluses and pills, or the benzoated lard or vaselin used for making ointments.

The prescriber's aphorism, "*Curare cito, tute, et jocunde*," is more easily fulfilled now than formerly. With a widening choice of carefully-prepared drugs, the effects of which are becoming more fully known, the practitioner is better able to cure quickly, safely, and pleasantly. The act of prescribing has, moreover, been facilitated. The British Pharmacopœia (B.P.), the United States Pharmacopœia (U.S.P.), and various Continental Pharmacopœias present approved combinations suitable for most purposes, thus saving the practitioner the elaboration or making up of prescriptions. Instead of crude vegetable drugs, often inconveniently bulky, and containing useless and even injurious constituents, extracts and tinctures have long been used. But concentration and simplification are being carried still further. Active alkaloids and neutral proximate principles are now prepared, and possess the advantage not only of concentrated form, but usually also of more uniform quality and less liability to spoil.

To guard against impurities and adulterations, the British Pharmacopœia, under the head of each drug, gives characters and tests which enable purchasers to satisfy themselves of the quality and purity of the articles used. Many of these carefully-verified characters and tests, given in the British Pharmacopœia Edition for 1891, have been introduced into his work.

ALKALOIDS.

These **alkali-like organic bases** are found in various plants, some of which, like the opium poppy, cinchona bark, and jaborandi, contain more than one alkaloid. They probably result from the metamorphosis of albuminoid plant constituents. They are generally powerful poisons or active medicines. Sixteen are enumerated in the British Pharmacopœia. Those chiefly used are morphine, atropine, quinine, cocaine, physostygmine, pilocarpine, and ergotinine. Similar alkaloids, allied to xanthin and kreatin, are produced from the natural decomposition of proteid compounds in the bodies of living animals by the action of such unorganised ferments as pepsin, and have been termed **leucomaines**. Another series, such as neurine, cadaverine, putrescine, and mydaleine, formed by the action of bacteria in the bodies of animals, receive the title of **ptomaines** (p. 28). Free access of air favours the development of these alkaloids in decomposing animal substances. Those resulting in the more advanced stages of putrefaction are most poisonous. Brieger, by acting on beef with a microbe, from traumatic tetanus in man, has evolved an alkaloid which he calls tetanine, which causes tetanus in all animals. From putrefying brain, and from the bodies of persons dying from typhus fever, deadly alkaloids have been obtained. A few of these organic bases, such as atropine and coniine, have been prepared synthetically.

Most alkaloids contain the four organic elements; **all contain nitrogen**. But although the molecule may contain twenty or thirty carbon or hydrogen atoms, there are seldom more than two atoms of nitrogen. They are generally crystallisable solids. Three of the natural alkaloids, coniine, nicotine, and sparteine, contain, however, no oxygen, and are volatile liquids. Alkaloids are **ammonia derivatives**, but their sparing solubility in water renders it unlikely that they are ammonium bases; their not subliming without some decomposition distinguishes them from the amines; their feebly basic character and other properties more nearly **ally them with the amides** (Bloxam). They may otherwise be defined as **substituted ammonias**, capable of forming salts by direct addition of acids. Many are closely related to pyridine. Most are soluble in alcohol, ether, benzin,

and carbon disulphide, and usually in chloroform, which does not, however, dissolve morphine or solanine. Most are insoluble in water, which, however, readily dissolves brucine and codeine. Alkaloids readily unite with acids, forming salts, soluble in water; and with radicles such as ethyl and methyl, forming combinations which greatly modify their actions, as is strikingly illustrated in the difference between coniine and methyl-coniine (p. 6). Their chemical composition affords no clue to their physiological action. Those of diverse composition have sometimes similar actions; those apparently of like composition differ in their actions. Between the anodyne soporific morphine, and the emetic apomorphine, the formulæ show a difference of only two atoms of hydrogen. Plants of the same genus usually yield the same or similar alkaloids; thus, the atropaceæ yield atropine, the strychnos strychnine. Alkaloids are often associated in plants with some special acid, in combination with which, or with a diluted acid added to the plant juices, they are dissolved out, usually by water, and from such solution the alkaloid may be precipitated by ammonia.

The neutral organic principles are another group of concentrated active vegetable drugs. They contain carbon, hydrogen, and oxygen, and comport themselves sometimes as bases, sometimes as acids. Under the influence of acids and organic ferments nearly all split up, yielding glucose, and hence are called glucosides. They are represented by aloin, digitalin, santonin, and salicin, and it will be observed have the terminal "in," which distinguishes them from the alkaloids, to which the termination "ine" or "ina," or, in the older works, "ia," is given.

BATHS.

Baths are important, alike for the preservation of health and for the cure of disease amongst the domestic animals. They are used in various ways, at different temperatures, and for the treatment of various medical and some surgical cases.

Cold baths are of a lower temperature than 70° Fahr. Judiciously used, they exert tonic, bracing, or stimulating effects. They contract cutaneous vessels, promote tissue change, and increase excretion of waste products. When the cold is

too long applied, especially in young or delicate animals, chill, shivering, and even more injurious effects may follow (p. 81). Owing to its saline ingredients, and the constant movement of the waves, a sea bath is more exhilarating than fresh water at rest. Healthful reaction is encouraged by thorough drying, hand-rubbing, clothing, and, if need be, by subsequent administration of stimulants. Cold baths are sometimes used for reducing excessive temperature. The patient may be placed in water at 80° Fahr., and the temperature reduced to 60° Fahr., or even lower; or he may be placed at once in a bath of 60° to 50° Fahr.; or he may have cold water dashed over him. In such cases the patient is kept in the bath for ten or fifteen minutes, and such treatment may be repeated twice daily. By such means excessive temperature may be reduced from 1° to 4° Fahr., and with lowered temperature excessive and dangerous tissue change is moderated.

Tepid baths range from 65° to 85° Fahr. They cleanse the skin, promote perspiration, allay thirst, and are grateful to heated and overtaxed horses. They are useful not only in promoting comfort, but in removing stiffness alike in horses and dogs after hard work.

Warm baths range from 85° to 97° Fahr. They soften the epidermis, and hence relieve erythematous and chronic skin disorders. They dilate cutaneous vessels, promote perspiration, and thus antagonise internal congestion. It is forty years since Professor John Gamgee, in the *Domestic Animals in Health and Disease*, thus testified to the benefit of warm baths: "I unhesitatingly say that we have in the thermæ the most effectual means of inducing a healthy reaction that we have yet had at our disposal. It is a great addition to our therapeutic means. We needed a satisfactory means of acting on the skin of the lower animals in febrile and other diseases, and we here have it."

Hot baths range from 97° Fahr. upwards, and, if the temperature be gradually increased, may be raised to 110° Fahr. Hot baths elevate the temperature of the body, quicken the pulse and respiration, dilate the skin capillaries, and hasten excretion of waste. They soothe animals which have been subjected to severe muscular exertion, relieve cramps and colic,

benefit chronic skin disorders, and check catarrh, rheumatism, and attacks of weed.

Baths are sometimes **medicated**. Salt or mustard is added to increase skin stimulation; alkaline carbonates or potassium sulphuret are used in some chronic skin disorders; solution of arsenious acid, tobacco juice, carbolic acid, and other antiseptics are introduced when skin parasites are to be destroyed.

Turkish, vapour, steam, and Russian baths are not used for the lower animals as frequently and systematically as for man; but the stables of many trainers, large jobmasters, and veterinarians have capital washrooms provided with steam, hot and cold water-pipes, where horses after severe exertion are conveniently washed and dressed; where chronic coughs, chills, rheumatism, dyspepsia, and other ailments are hydropathically treated, and where sprains and enlarged joints can be successfully douched.

Without expensive or special appliances, many of the sanitary and curative advantages of baths can be secured by **sponging horses**, as their condition or ailment suggests, with tepid, hot, or cold water. Cleansing, tonic, or antipyretic effects may thus be readily obtained. Irritating or noxious matters are removed from the skin, circulation is equalised, and excessive temperature reduced. In acute febrile cases, whether in horses or cattle, the temperature of the water used should not at first be lower than 85° or 80° Fahr. A little acid may be advantageously added. The sponging should not occupy more than three or four minutes. The animal should be wiped dry and immediately clothed. Within three or four hours the operation, if necessary, may be repeated, especially if the temperature reduced by the first sponging again rises. After the first or second sponging, water at 65° or 60° Fahr. may be used. Concurrently with such treatment, antiseptic salines or stimulants may be prescribed. In chorea, especially in tolerably vigorous and short-haired dogs, sponging with cold water is serviceable. Enveloping the patient in a sheet wetted with either tepid or cold water, and covering with two or three blankets, constituting what is entitled the "wet pack," is not generally so serviceable in veterinary practice as either sponging or the bath (p. 133).

BALLS—BOLUSES—PILULÆ.

Balls correspond in veterinary practice with the **pills** used in human medicine. Extracts are conveniently moulded into cylindrical balls. Drugs in powder or concentrated solution are made into mass or bolus with such **excipients** as linseed meal and water, oil, lard, soap, mucilage, liquorice, and powdered gentian, treacle, syrup, glycerine, vaselin, and conserve of roses, the choice being determined by the nature of the active ingredients. The eight excipients first mentioned are chiefly used when the bolus or mass is intended for immediate use ; when it is to be kept for any considerable time some of the others are more suitable. To keep a mass in its desirable moist, soft-solid state, it is often advisable to add to it a small quantity of such a deliquescent alkaline salt as potassium acetate, which serves especially well for most diuretic masses. When the active principles are resinous, a little alcohol or oil of turpentine is a useful addition, as in making aloetic masses.

In preparing a ball mass, the various ingredients are sometimes mixed in a mortar or on a slab ; but when the materials are waxy or resinous, the aid of heat is necessary. A good ball mass must be soft, and yet possessed of proper consistence and cohesion, must retain these properties although kept for a considerable time, and must further be prepared so that each dose shall make a proper sized ball, which for the horse usually weighs one to two ounces. The ball mass should be preserved in jars covered with moistened bladder and stout paper, and be made into doses only as required ; for when balls are long kept they are apt to become hard, and in this state act tardily and uncertainly, sometimes passing through the alimentary canal unchanged. To prevent spoiling, as well as for cleanliness and facility of administration, balls are given either rolled up in soft paper, or are coated with kreatin, with a solution of one part of gelatin and twenty of water, or with an ethereal solution of tulu.

For horses the bolus is a common and handy method of administration ; for dogs it is also often used. It is given to horses either with the balling-iron or with the fingers ; and the

latter method is preferable, except in animals with small, narrow mouths, or in which the mouth cannot be sufficiently opened. The operation, with a little practice and dexterity, is easily performed. The ball is held by one end between the thumb (which supports it below) and the fingers of the right hand, which is drawn together and rounded as much as possible. The patient's tongue is gently drawn out a little way by the left hand, and the ball passed rapidly along the roof of the mouth, and dropped on the back of the tongue, which is at once let loose, the mouth closed, and the head kept slightly elevated for a couple of minutes. Dogs generally bolt their pills if they are deftly rolled in a piece of meat.

DECOCTIONS.

Decoctions are solutions prepared by **boiling the drug in water**. To ensure perfect solution, the substance is bruised or cut into small pieces, occasionally undergoes preliminary digestion, and is boiled in a glass or earthenware vessel for a period not exceeding twenty minutes. Any insoluble residue is subsequently separated by filtering through bibulous or un-sized paper, straining through muslin or calico, or allowing time to settle, and pouring off the supernatant fluid. Decoctions, when intended to be kept beyond a week or two, should have a little spirit added, or about 1 part to 200 of benzoic acid, and are bottled and well corked while hot. Without these precautions they are apt to ferment, or otherwise spoil. The B. P. gives directions for making decoctions of aloes, cinchona, poppies, oak bark, and nine others less used by veterinarians.

DRAUGHTS—DRENCHES—DRINKS.

Drenches are generally **extemporaneous fluid preparations** used in a single dose. Bulky substances which cannot be administered in bolus are necessarily given in draught. They are prescribed for horses and dogs, especially when a speedy effect is desired, as in colic, and are almost the only form in which physic is given to cattle or sheep. In these ruminants,

medicines in the solid state get mixed with the immense bulk of food always found in the rumen, remain unabsorbed often for a long time, and thus act tardily and imperfectly. Medicines in liquid form, however, come more immediately into intimate contact with absorbing mucous surfaces, and pass on more speedily towards the second and fourth stomachs. Saline febrifuge and tonic draughts, made fairly palatable, are often readily taken by patients in gruel or water, without the trouble of forcible administration.

In preparing drenches, care must be taken that the several ingredients are not incompatible, decomposing, or injuriously reacting on each other; and further, that their quantity is not so great as unnecessarily to increase the trouble of administration. For dogs, from two to six ounces, according to the size of the animal, is an average amount; for horses, one or two pints; for sheep, from six to eight ounces; but for cattle it is not so necessary to limit the proportion of fluid. Before being given, drenches ought to be thoroughly mixed and well shaken, in order to prevent ammonia, turpentine, or other light constituents floating to the surface, or heavy, partially dissolved substances falling to the bottom.

In giving drenches, the head should be slightly raised, which in horses is conveniently done with the aid of a twitch, the noose of which is placed over the animal's upper jaw within the incisor teeth, and the stick held by an assistant, standing on the left side of the patient. In cattle, the head should be steadied by an assistant, who holds either the horns or ears. In dogs, the jaws may be kept sufficiently apart by an assistant placing a loop of stout tape or string, or a towel folded repeatedly, over each jaw, and gently separating them, when the medicine is readily poured over. Small dogs are most conveniently dosed when placed on their hind-quarters on a table or bench; but larger dogs should be backed into a corner, and their head held between the operator's knees. Cats get their physic without doing damage with their claws if rolled in a stout rug or dropped into a capacious top-boot, the head being left out, and the jaws held apart with a couple of pieces of tape. In all animals the nostrils must be left unobstructed, and the tongue loose, or only gently held down, so as to pre-

vent its interfering with the medicine passing from the bottle. Drenches should be carefully and slowly given; and if coughing occurs, the operation should be stopped, and the animal set free for a few minutes

Glass bottles, generally used for the administration of drenches, have the disadvantage of being fragile, and, when they break, waste the medicine, and may besides injure the mouth of the patient, or the hands of the operator. Veterinarians, and even agriculturists, should therefore have stout **tin bottles** of two sizes, capable of holding a pint and a quart, made either round or flat—the latter more convenient for the pocket—and closed by a cap screwed on the nozzle. The old-fashioned horn requires practice to use it without spilling its contents, and is now generally superseded by the metallic bottle.

ENEMAS—ENEMATA—OLYSTERS—SUPPOSITORIES —INJECTIONS.

Enemas are liquid injections into the rectum, and are employed to effect several useful purposes. They empty the lower bowel when it may be undesirable to excite other parts of the intestine. They accelerate, increase, and maintain the action of purgatives. They destroy and remove worms infesting the posterior part of the canal. They may exert either soothing or stimulating effects; and, reflexly, such effects may be propagated to adjacent and even to remote organs. They besides prove convenient vehicles for introducing into the body food and medicines, which in sore throat, tetanus, apoplexy, or other cases, cannot readily be swallowed, and which are absorbed, although not nearly so rapidly as from the duodenum.

For maintaining the regular action of the bowels, whether in health or disease, no remedies are so safe and effectual, and when properly used they sometimes supersede the necessity for purgatives. In constipation and torpidity, after hardened, impacted, obstructing fæcal masses are broken down and removed, according to the species of patient, by the hand, finger, or small spatula, laxative enemata are advantageously injected, intermitting the operation whenever straining occurs, raising the hind parts, and by external pressure from behind

increasing the retaining capacity of the sphincter. A gallon and a half to five gallons of tepid water may thus be slowly introduced into the rectum of a draught horse; half a pint to a pint into the rectum of a dog 40 lbs. weight. When the posterior gut is thus distended, not only is mechanical facility given for the outward movement of the contents of the canal, but by reflex action peristalsis is encouraged far beyond actual contact of the injected fluid. The effects of the tepid water are increased by the addition of soap, bland oil, salines, oil of turpentine, or solution of aloes. These copious injections, alternated with tobacco smoke, enemata, and the administration of full doses of opium, Indian hemp, or atropine, relieve intestinal spasm, and prove the chief treatment for cases of invagination and strangulation of the intestines, whether in horses or dogs.

Obstinate torpidity of the bowels in horses, depending on impaction of dry food or faeces, or from earthy deposits in the colon, may frequently be relieved or removed by the free use of enemata introduced into the large intestines by a special apparatus. Professor Fred Smith, of the Army Veterinary School, Aldershot, has devised and successfully used such an apparatus, which he described at the Peterborough meeting of the National Veterinary Association in 1887, as consisting of six feet of elastic tubing, of the same calibre as that of the Reid enema tubing, on to which it is screwed. It is provided with a rounded nozzle, with side perforations. The tubing can be passed into the single, perhaps into the double, colon of the horse. Any difficulty in introducing it is overcome, not by force, but by injection of a gallon of water, which, dilating the bowel in advance, facilitates further passage of the tube. Mr Smith in such cases throws up from five to fifteen gallons generally of cold water; has in some cases injected at a time as much as twenty-seven gallons; and repeats the enema at intervals of three or four hours. Unlike enemata discharged into the rectum, these large amounts of fluid are in great part retained, with the effect of softening and mechanically bringing away obstructions.

Tolerably copious clysters of tepid water or other bland fluid exert local soothing effects, not only on the intestines, but they also reflexly allay irritability, spasm, and pain of the

urino-genital organs, and frequently relieve suppression of urine. Their efficacy is sometimes increased by addition of opium and other sedatives, which are used in about the same doses as are given by the mouth. By reflex action the kidneys, bladder, and uterus are also sometimes beneficially acted upon by stimulant enemata. For destroying and dislodging the oxyuris curvula, clysters of turpentine and lime water, and of solution of aloes, quassia, or ferric chloride, are effectual. In house dogs, troubled with constipation and hæmorrhoids, the cautious daily injection of two or three ounces of cold water proves serviceable.

When intended to be retained or absorbed, enemas should be limited in amount; one to two pints suffice for horses, three to four ounces for dogs weighing 20 lbs. To allay irritation and spasm in troublesome diarrhœa and dysentery, vegetable astringents, opium, and lead acetate are given, usually with well-boiled tepid starch gruel. In such cases the injection may be repeated every hour or two, so long as straining or diarrhœa continue. Nutrient clysters, useful in tetanus, sore throat, and debilitating complaints, when patients will not or cannot eat, usually consist of linseed tea, with milk and eggs, or of strong beef tea introduced at a temperature of 100° Fahr., and repeated not oftener than four or five times in the twenty-four hours. In cases of influenza in horses and distemper in dogs, a little wine or whisky is sometimes added to the nutrient enema.

The apparatus for giving enemata are—the old-fashioned bladder tied on a piece of lead pipe; Reid's patent clyster syringe, improved by Mr Arnold, which is also available as a stomach pump; the far-reaching Reid's apparatus, with six feet of extra tubing, above described; Mr Gamgee's block-tin tube and funnel, which fill the rectum by gravitation, and obviate the necessity of pumping; and the common barrel syringe, of which the best are made of copper, tinned over, with a nozzle which screws out at pleasure, and can be carried in the interior of the instrument. In the horse the rectum is generally cleared by the hand before any of these articles are used; and in all animals the part of the apparatus which enters the gut should be smeared with lard or oil, and introduced slowly and carefully.

Suppositories of raw or cooked meat are readily absorbed from the rectum, especially if they are previously moistened with diluted hydrochloric acid and pepsin. Drugs in the form of suppositories, usually made up with cocoa-butter and a little wax, are occasionally introduced into the rectum, vagina, and uterus. A cylinder of soap introduced within the anus, and held for a minute or two, conveniently encourages the action of the bowels, especially in dogs and cats, and in young foals and calves.

Injections are made into the nostrils, urethra, bladder, and uterus, as also into the trachea, for the destruction of bronchial filaria. Hypodermic injections have already been noticed (p. 144) Medicated spray thrown from a caoutchouc ball and tube, or from a steam spray-producer, is frequently used for irrigating irritable, relaxed, or diphtheritic throats, especially in horses (p. 80).

EXTRACTS—FLUID EXTRACTS—FRESH OR GREEN EXTRACTS—ABSTRACTS—SUCCI.

Extracts consist of the **soluble, active principles** of plants **reduced to a semi-solid paste** by evaporation of the natural expressed juices, or of decoctions, infusions, or tinctures. Selection is made of the solvent—whether water, rectified or proof spirit, or occasionally ether—which most readily removes the active principles. Where two active principles, soluble in different media, are to be dissolved out, the drug is acted upon by the two solvents in succession, and the solutions mixed and evaporated. It is important that evaporation be effected at low temperatures; those above 150° Fahr. are apt to injure or decompose many active principles. Well-made extracts keep for a considerable time without change, especially in a cool, dry place, and if occasionally moistened with rectified spirit; but when twelve months old they should be regarded with suspicion. Of the thirty-four B.P. extracts, veterinarians chiefly use those of belladonna, hemlock, and Indian hemp.

The liquid B.P. extracts number fifteen. The corresponding U.S.P. **fluid extracts** number seventy-nine. They are prepared from infusions, decoctions, or weak tinctures, in the

same manner as the semi-solid extracts. Being less concentrated they are not so strong, and require the addition of spirit to ensure their keeping. Those chiefly used in veterinary practice are liquid extract of cinchona, ergot, male shield fern, and opium.

Green or fresh extracts are prepared from fresh plants, the leaves and tender stems being generally preferred. They are bruised, the juice expressed, and gently heated to about 120° to 130° Fahr. The green colouring matter is separated by filtration, the strained juice is heated to 200° Fahr. to coagulate albumin, again filtered, and the filtrate evaporated in a water bath to the consistence of a thin syrup. The green colouring matter previously separated is then added, and evaporation continued with stirring at a temperature not exceeding 140° Fahr., until a suitable consistence is attained.

Abstracts are **concentrated extracts**, about twice the strength of the corresponding fluid extract, and occur in dry powders mixed with milk-sugar. Eleven of these figure in the U.S.P., including those of aconite, belladonna, hemlock, and digitalis.

The succi or expressed juices of belladonna, hemlock, henbane, and taraxacum, by instruction of the B.P., are preserved by digestion for seven days, with one-third of their bulk of rectified spirit, and subsequent filtering.

FOMENTATIONS.

Fomentations are **topical baths**, usually consist of water alone, but vinegar, saline, and other substances are sometimes added. Unless otherwise specified, they are applied hot. The temperature at which they are used must be determined by the purpose to be served, by the nature and extent of the malady, and the part of the body to which they are applied. For the eye, they should not exceed 100° Fahr.; for contusions, abscesses, strains, and weed, they should be as hot as the hand can bear. Up to 110° Fahr. they generally soften and soothe. At higher temperatures they irritate. To produce active counter-irritation, as in bronchitis, pleurisy, or enteritis, they are used at temperatures ranging from 120° Fahr. upwards. For such

cases, pieces of flannel or horse-cloth are saturated with boiling water, are partially dried by a wringer, or by being rolled and pressed between dry coarse towels, and are laid over a considerable extent of surface contiguous to the parts affected. The hot, wet woollen article should be covered with oilskin or a piece of mackintosh to retard evaporation and cooling. The pained part to be soothed, or the surface to be stimulated, is sometimes covered with several folds of woollen stuffs, amongst which water of the fitting temperature is poured at short intervals. Jets of steam mixed with air, to prevent their scalding, and used either plain or medicated, may be substituted for the ordinary stuping with water. Fomentations are generally made with a sponge or soft piece of rag, tow, or lint. When there are foul discharges, sponges should be interdicted, as they are apt to retain and convey putrefactive germs, while the piece of lint or tow is thrown away as soon as done with.

Fomentations are **used** mechanically to cleanse wounds and soften hard skin or encrusted discharges. They relax and soothe irritated, congested, inflamed parts to which they are applied, and thus lessen tension and pain (p. 53). When freely employed for some considerable time, they moreover dilate the capillaries of collateral areas of circulation, withdrawing blood from adjacent inflamed parts, and thus acting as counter-irritants (p. 43).

Their chief disadvantages, as ordinarily used, are their being withdrawn before their heat and moisture have time to do much good, and their causing rapid subsequent cooling. To obtain their full benefits, they should be continued during several hours; fresh supplies of water, of the requisite temperature, being had in abundance. After the operation is finished, the parts should be dried and well clothed, in order to prevent the rapid diminution of temperature which otherwise ensues from evaporation. Further, to prevent chilling, the fomented surfaces are sometimes stimulated by a gentle warming with mustard paste.

Heat applied to the spine, usually in the form of the hot-water bag, at a temperature of 120° Fahr., as shown by Dr Chapman, stimulates the cord and sympathetic ganglia, contracts the involuntary muscular fibres of arterioles, and thus

lessens the volume and rapidity of blood passing through them. The spinal hot-bag is hence used to arrest hæmorrhage.

The ice-bag applied to the spine, on the other hand, is a sedative to the cord and nerve-centres brought under its paralyzing influences, and hence lowers muscular tone, sensibility, and secretion. Applied in the cervical region, it increases afflux of blood to the head; applied over the anterior dorsal region, blood is driven to the chest and anterior extremities; applied over the posterior dorsal and lumbar regions, blood is moved in larger amount through the abdominal and pelvic organs, and the posterior extremities. Acting upon the spinal and sympathetic centres, the ice-bag controls remote morbid processes; cramps and spasms, even of tetanus, are stated to be abated; pains of neuralgia and rheumatism are sometimes arrested; while inordinate discharges, and even hæmorrhages from the lungs, bowels, or kidneys, are sometimes checked (*Ringer's Therapeutics*).

GLYCERINES.

Glycerines are solutions of soothing astringent or antiseptic substances in glycerine. They are applied locally to the skin and mucous surfaces. Those of carbolic, gallic, and tannic acids contain one ounce by weight of the acid, mixed and gently heated with four fluid ounces of glycerine. Glycerine of borax contains, besides the one of acid and four of the solvent, two of distilled water. Glycerine of starch is made with one ounce by weight of starch, five fluid ounces of glycerine, and three of water. Glycerines of lead subacetate and of tragacanth are also occasionally used.

INFUSIONS.

Infusions are solutions prepared by **digesting vegetable substances in hot water**. Nearly all the twenty-eight officinal infusions are made by pouring boiling water on the powdered or cut drug, usually in the proportion of one part to twenty of water. The process is generally conducted in stone-ware jars or jugs, provided with a cup having perforated sides

and bottom, fitting into the top of the jug, extending about half-way down, and containing the solid matters to be infused. Digestion is effected on a stove, is continued for periods ranging from fifteen minutes to two hours; boiling is avoided. The infusion, when cool, is generally strained, but for veterinary purposes and for immediate use decanting is often sufficient. Unless carefully bottled and corked while hot, infusions soon spoil, especially in warm weather. Their keeping is sometimes improved by concentration, by evaporation, or by addition of alcohol, or about a quarter grain of benzoic acid to the ounce. *Examples*—infusion of catechu, gentian, ergot, and valerian.

LIQUORS—SOLUTIONS—LOTIONS.

The B.P. enumerates fifty-one **liquors** or solutions, nearly all containing inorganic bodies or alkaloids, dissolved in water alone, or with other solvents. They vary greatly in strength and dose. Those containing arsenic, atropine, morphine, and strychnine have $4\frac{1}{2}$ grains of the poison to the fluid ounce, or 1 part to 100. The liquors chiefly used by veterinarians are liquor ammoniæ, liquor ammonii acetatis, or Mindererus spirit, liquor arsenicalis, liquor ferri perchloridi, liquor potassæ, and liquor calcis. Solutions of extra strength for hypodermic injection are now included in the Pharmacopœias.

Lotions are watery solutions intended for external use. Those for the eye are usually called **collyria**.

MIXTURES—MUCILAGES—EMULSIONS.

Mixtures or **misturæ** are preparations usually containing insoluble drugs suspended in mucilage or other viscid substances. They are exemplified by camphor, chalk, and catechu mixtures. Insoluble heavy powders, mixed with dissolved gum or starch, are sometimes also termed **mucilages**.

Emulsions are opalescent mixtures of oil or resin, suspended in aqueous solutions of gum, soap, alkali, or white of egg.

OILS, FIXED, VOLATILE, AND MINERAL.

Fixed oils and fats occur in many plants, usually in the seeds or fleshy pulp, frequently associated with mucilage, and are also present in animal bodies. Besides almond, olive, castor, croton, cocoa-nut, and cod liver oils, enumerated in the Pharmacopœias, lard, linseed, palm, and cotton-seed oils are also used in veterinary practice. The fixed oils are obtained by expression. They consist of two or more fatty acids—oleic, margaric, palmitic, and stearic—in combination with the sweet basic principle glycerine. They contain 76-79 parts of carbon, with 11-13 of hydrogen, and 10-12 of oxygen. Their consistence varies according to the proportion of the fluid olein. When fresh, they are generally almost colourless, and are inodorous and tasteless. When exposed to the air, the traces of albuminoids which they contain oxidise, a species of fermentation ensues, as in saponification, resulting in the breaking up of the neutral fatty matters, with the production of disagreeable rancidity, which may, however, be removed by boiling the faulty oil with water, and subsequently washing it with a weak soda solution. Oils and water are mutually but very slightly soluble, but oils and fats are readily dissolved by carbon disulphide, benzine, oil of turpentine, ether, and chloroform. They are miscible, and hence sometimes conveniently administered, in milk. Castor and croton oils are soluble in cold alcohol. They vary in their combustibility and their melting and freezing points. Their specific gravity ranges from 900-970. The bland oils—such as olive, linseed, palm, and cod liver—in small quantities are **nutrients**, but administered in larger amount they are **purgatives**. Croton oil is irritant, whether applied to the mucous surfaces or to the skin.

The volatile or essential oils are mostly of vegetable origin, being found generally in the flowers, leaves, fruit, or seeds of plants, but they occur in all parts of the coniferæ. Most are found ready formed, but some, as the hydrocyanated, almond, and mustard oils, are produced by a species of fermentation. The B.P. details twenty-five volatile oils of vegetable origin, and the several volatile animal odorous principles—ambergris, from the sperm whale, civet, musk, and castor are occasionally

used. The chemical constitution of the volatile oils differs from that of the fixed oils; most are pure hydrocarbons, with the molecular formula of oil of turpentine ($C_{10}H_{16}$), and are termed terpenes. With this terpene is generally associated an oxidised product, analogous to the colophony or resin ($C_{20}H_{30}O_2$) of turpentine. Some, such as oil of garlic, contain sulphur ($C_6H_{10}S$). They produce no permanent grease stain. Unlike the fat oils, they are not unctuous, but make the skin rough or brittle. They are mostly colourless, but have a powerful odour, and distinctive—often aromatic—taste. They are insoluble, or only slightly soluble, in water, but are readily soluble in alcohol, ether, fatty and mineral oils. They are mostly lighter than water. Most boil between $302\text{--}382^\circ$ Fahr., but the boiling point of camphors is about 372° Fahr. All are acted upon by oxygen, and distil unchanged. They are prepared in several ways—(1), by expression; (2), distillation; (3), extraction with solvents at ordinary temperatures, with or without pressure; (4), maceration or infusion; (5), absorption, with the use of hot air. The volatile oils are **antiseptics** and **stimulants**, and are used as carminatives, antispasmodics, and parasiticides, and for flavouring.

The camphors are the oxides of volatile hydrocarbons. Common camphor has the formula $C_{10}H_{16}O$. In physiological action they are allied to the volatile oils.

Oleo-resins, such as crude turpentine and oleo-resina cubebæ, are mixtures of volatile oil and colophony or resin (p. 169).

Balsams are vegetable exudations consisting of resins with benzoic or cinnamic acids, dissolved in volatile oils.

Mineral, paraffin, or petroleum oils are a series of paraffin hydrocarbons, obtained from the distillation of shale, coal, and other such geological deposits, and having the formula C_nH_{2n+2} . (See Petroleum). The several members differ in their boiling point, and are separable by distillation. Methane, or marsh gas (CH_4), and several of the simpler members are gaseous, and used for heating and illumination. Others, such as pentane (C_5H_{12}), and hexane (C_6H_{14}), are known as petroleum spirit, are solvents for fats, resins, and indiarubber, and are used for making varnishes. Heptane (C_7H_{16}), known as benzoline, paraffin oil, or mineral sperm oil, is used for burning.

Nonane and dodecane are employed as lubricants. Hexadecane ($C_{16}H_{34}$) is the chief constituent of vaselin and other soft paraffins. It is used as a bland protective, and for the making of ointments, which are not liable to rancidity. The solid, hard, or wax paraffins, melting at 110-145° Fahr., are substituted for wax in the making of ointments.

OINTMENTS—OLEATES—LINIMENTS—CERATES— PASTES.

Ointments or **unguenta** are **mixtures of drugs with fatty matters**, are of the consistence of butter, and are used externally. The excipients generally employed are lard and oils; greater consistence and adhesion are conferred by addition of wax and resin; rancidity is checked by admixture of benzoin, or by substituting mineral for animal or vegetable oils. By using lanolin or oleic acid as the basis, absorption through the skin is said to be facilitated. When lard or oil is the excipient, the ointment may generally be prepared in a suitable mortar; but when wax or resin is used, it must be melted over a slow fire, the other constituents added, and the mass stirred until it has acquired proper consistence. Ointments, of which forty-three are enumerated in the B.P., should be kept in well-closed pots or jars, which (except when in daily use) should be covered with moistened bladder and strong paper. They are generally dispensed either in wooden chip boxes or in earthenware pots, both of which the practitioner should have of several sizes. In dispensing these and other officinal preparations, spatulæ of steel, bone, wood, and horn are essential articles of the laboratory furniture.

Oleates are solutions of active principles in oleic acid. The B.P. now includes oleatum hydrargyri and oleatum zinci. These oleates are sometimes preferred to the corresponding ointments, on account of their being more readily absorbed. The smart friction employed in the in-rubbing of this class of remedies is itself of considerable therapeutic value. It causes temporary contraction, followed by more permanent dilatation of cutaneous capillaries, and hence promotes increased circulation through superficial blood and lymph vessels, with conse-

quent quickened removal of waste products. Smartly applied friction is a counter-irritant (p. 44).

Liniments or **embrocations** are solutions of active principles in oil or spirit; some, besides, contain camphor; several have soap added, to increase their lubricant properties; all are intended for external use. The B.P. enumerates sixteen liniments.

Cerates are stiff ointments containing wax.

Pastes are topical applications, of which the basis consists wholly or partially of fine silica, magnesium carbonate, or other silicious earths. Zinc oxide and other ointments are sometimes united with 10 per cent. of such silicious matters. The term "paste" is occasionally also applied to mixtures of farina or flour with such drugs as borax, alum, or zinc oxide. The silicious pastes do not impair skin secretion as fatty bodies do, and, moreover, leave a protective powdery coating on the skin. They are hence indicated in some cases of moist eczema and other irritable conditions of the skin.

PLASTERS—EMPLASTRA.

Plasters are **adhesive substances**, usually containing lead oxide, conjoined with resin, wax, soap, fats, tar, or pitch; are conveniently kept fused in rolls; and are prepared for use by being melted and **spread on calico, linen, or leather**. The equable pressure of a well-applied plaster gives support and protection; retards evaporation, and hence raises topical temperature; increases glandular activity; and sometimes also hastens removal of inflammatory products. Plasters are rendered more stimulating by addition of mustard or cantharides; more soothing or anodyne by addition of opium or belladonna.

Ordinary plasters are less useful in veterinary than in human practice; for in the lower animals they are apt to be displaced from the greater power of the panniculus carnosus, and from the patient's rubbing or biting at them. Where they are to remain on for some days or weeks, the melted ingredients are applied directly to the skin, covered first with a little teased tow or lint, and then with a linen or leather bandage.

Plasters of this kind are popularly known as **charges**, and were formerly much used in all kinds of lameness. Besides the benefits already enumerated, they are serviceable from their stimulating; from their preventing, when large and thick, undue motion of injured parts; and from their ensuring the patient several weeks' release from work.

POULTICES—CATAPLASMS.

Poultices are local baths or semi-solid packs, used for the topical application of heat and moisture. They closely resemble fomentations. They constitute an important form of emollients (p. 52). They are made of such farinaceous substances as linseed meal, bran, or oatmeal, stirred into boiling water until the fitting consistence is reached; or of carrots or turnips, either steamed or boiled. Bread and starch make bland porous poultices, adapted for abscesses; spent hops are indicated where the poultice should be light. Unless nicely prepared, soft, fresh, and changed every two or three hours, they merit Liston's condemnation that they are associated "with putrefaction and nastiness." In order to secure to the fullest the softening of the skin, as well as the soothing of peripheral nerve-endings, poultices are generally laid directly on wounds, sores, or abscesses, or with only a very thin substance intervening. When used, however, either directly or reflexly, to relieve congestion, inflammation, or pain, they are placed in a well-warmed flannel bag, or in folds of flannel, which, conducting heat slowly, justifies their being applied at a higher temperature than could otherwise be borne, and, moreover, preserves heat longer. Poultices arrest superficial and circumscribed inflammation in the early stages; and in more advanced stages, when white corpuscles have escaped through the vessels, or pus has begun to form, they favour its formation, and promote maturation of the abscess. They are, however, unsuitable for wounds, which, if kept dry or treated antiseptically, will heal by first intention or adhesion, and for chronic inflammation, where the parts have become relaxed and deficient in tone. In such cases cold applications are indicated (p. 43).

Heat, without moisture, may be applied by the agency of hot bricks, salt, or sand, of hot-water bags, of well-warmed rugs or flannels, or of the smoothing-iron. A piece of flannel, thoroughly wrung out of boiling water, applied dry and hot, its several folds covered with thin mackintosh, and kept in place by a bandage, in virtue of the heat and equable pressure, relieves strains, and diminishes fulness of the legs of horses rattled on hard roads.

Poultices, to be properly and securely applied, require some ingenuity and mechanical tact. To prevent unpleasant sticking, the skin is sometimes covered with a piece of muslin, or moistened with vaselin, oil, or solution of glycerine. Before application of the poultice, the irritable inflamed surface is sometimes dressed with equal parts of belladonna extract, glycerine and water, or other anodyne. To keep the poultice as long as possible at a uniform temperature, unless its weight is injurious, it should be of considerable bulk, and usually several inches thick; hot water is poured over the mass every hour or two, or, better still, fresh poultices are supplied as the old ones become dry, lower in temperature, or foul. Such changes should be quickly effected, for exposure chills the moist, warm surface. When the poulticing is done with, the surface should be enveloped in flannel, or in a woollen rug covered with oil-skin. In cases of chest and bowel inflammation, dogs, like children, are advantageously placed in jacket poultices. Poultices are rendered more soothing by addition of opiates or other anodynes; more stimulating by sprinkling with mustard or turpentine; more antiseptic by admixture with yeast, chlorinated soda, carbolic acid, or charcoal.

Too long persisted with, they are apt unduly to soften and sodden the skin, to cause crops of small abscesses, and destroy reparative power. Unwieldy to apply, and troublesome to regulate as to temperature, they are often superseded by fomentations, by antiseptic dressings, by water dressings of moistened and medicated lint or tow, from which evaporation is retarded by a covering of oiled silk or guttapercha cloth, or by spongiopiline—a felted wool and sponge, coated on one surface with guttapercha, and when soaked with hot water proving a cleanly, handy substitute for a small poultice.

POWDERS—PULVERES.

Many medicines may be reduced to a rough powder in a hand-mill such as that used for grinding coffee or pepper; or in an **iron mortar** (which should be fixed into a block of wood), with a large, heavy, iron pestle, which ought to be suspended from one end of a flexible rod running along the ceiling, and fixed into the opposite wall. Preparatory to further reduction, many roots and barks are pounded or cut. To effect minuter subdivision, small quantities of the coarse powders are reduced in **hand mortars**, which are conveniently kept of wood, marble, or Wedgwood ware, the latter being cheap, easily cleaned, and little affected by acids. When a fine state of division is required, the powder is sometimes put through wire-gauze or horse-hair **sieves**, the meshes of which are made of suitable closeness. For light, pungent, or irritant powders, compound sieves, closed in with a lid above and below, are used.

To facilitate reduction of tough vegetable drugs such as opium, they are sometimes mixed with a hard salt, such as potassium sulphate. To avoid tedious trituration, powders, like calomel and flowers of sulphur, are conveniently obtained by sublimation; others, like magnesium carbonate or mercury red oxide, by precipitation; other insoluble substances, like prepared chalk, by stirring in water, allowing the coarser particles to settle, and pouring off the solution from which the finely-divided powder is gradually deposited and dried. Nauseous, deliquescent, efflorescent, and volatile substances, and those given in large doses, cannot be conveniently administered in powder. Active drugs are prescribed with such inert substances as starch, gum, liquorice, or sugar of milk. Powders, when not too bulky, are occasionally dropped upon the patient's tongue. When free of disagreeable flavour, they are sometimes scattered upon or mixed with the food.

RESINS.

Resins (resinæ) are **amorphous solids** consisting of acids formed from the oxidation of terpenes ($C_{10}H_{16}$). They are

insoluble in water, soluble in spirit, and melt when heated. They dissolve in alkalies, forming soap. They are frequently found in plants conjoined with volatile oil, constituting an **oleo-resin**, such as that of copaiba or of jalap. Occasionally they are associated with gum, as in the **gum-resins**, asafoetida ammoniacum, and galbanum. The resins proper are only sparingly soluble in the animal secretions, but they irritate by contact, and hence, when swallowed, are cathartic and diuretic. The oleo-resins are more active; they stimulate mucous surfaces, from which they are absorbed or excreted.

SYRUPS—CONFECTIONS—ELECTUARIES.

Syrups are **saccharine solutions**, usually containing flavouring or medicinal substances. Their specific gravity ranges from 1.300 and 1.400. Their consistence is important. If too thin and weak, they become mouldy, and are apt to ferment; if too thick and strong, the sugar crystallises out. But the B.P. ensures uniformity and good keeping by definite instructions as to the proportion of refined sugar and other constituents in the seventeen syrups. Americans, fond of sweets even with their physic, have introduced thirty-three syrups into the U.S.P. Simple syrup is prepared by dissolving, by the aid of heat, five pounds of refined sugar in two pints of water. The syrups chiefly used in veterinary practice are those of buckthorn, poppies, ginger, and iron iodide, in which the sugar prevents oxidation. **Electuaries** are made of sugar or mucilage. **Confections and conserves** are soft pastes, largely composed of sugar or honey, and, like syrups, chiefly used as vehicles for administering soluble or disagreeably tasted drugs.

TINCTURES—SPIRITS—ESSENCES—WINES.

Tinctures are **spirituous solutions** of active principles. Spirit is used of such strength as most readily dissolves the active principles. For solution of most alkaloids and oils, rectified spirit is preferable. Aromatic spirits of ammonia is conveniently used in the preparation of the tinctures of guaiac, valerian, and opium. Sometimes the solvent is pyroxylic

spirit, and occasionally it is ether. More than half of the seventy-four tinctures of the B.P. are made with one part of the drug to eight of spirit. They are prepared without heat by simple solution, by maceration, or by displacement, or sometimes by a combination of these processes. The materials, first reduced by cutting or bruising, are placed with the spirit in a suitable vessel, and usually remain from two to seven days; the solution is poured off, the residue pressed, and the tincture, when filtered, is ready for use. Sometimes the materials, in a state of moderately fine division, are packed in a percolator or cylindrical vessel of glass, earthenware, or metal; the spirit passes gradually through them, displaces and dissolves out their soluble parts, filters through the linen or calico, which is usually stretched across the lower part of the cylinder, and passes off by the stop-cock, which should be attached to the apparatus. Some tinctures are made by macerating the materials in water for a couple of days, obtaining the remaining active principles by percolation with spirit, and mixing the two solutions. More thorough and rapid extraction of active principles is obtained by Burton's process. The drug and solvent are packed in the percolator, on the neck of which an elastic cap is fixed; with an exhausting syringe, a partial vacuum is created; and air being subsequently admitted, the spirit penetrates the drug, and more effectually extracts its active principles.

Tinctures are clear, of a yellow, red, or brown colour, and generally keep well. The revisers of the B.P. have endeavoured to reduce dubiety and risk of accident by enjoining the preparation of many tinctures of such uniform strength that one drachm is the average dose for an adult human patient, while six to eight drachms are prescribed for a horse. A number, however, are more concentrated—namely, those of belladonna, cannabis indica, digitalis, opium, and iron perchloride; while the tincture of aconite is still stronger.

Medicated spirits, of which the B.P. contains eighteen, are solutions of volatile oils or ethers in alcohol, and are represented by spiritus ætheris, camphoræ, and chloroformi.

Essences are concentrated tinctures, the essence of anise and of mentha piperita, each containing one part of volatile oil to four of rectified spirit.

Medicated wines, such as vinum antimoniale and ipecacanhæ, made with sherry or orange wine, are merely weak tinctures. **Elixirs** are tinctures mixed with aromatics and syrup.

VAPOURS—INHALATIONS.

Vapours are volatilised applications used for soothing, stimulating, deodorising, or disinfecting the air-passages, or for destroying parasites lodged therein. The inhalation most frequently used is moist, warm air, produced from a steam kettle, or, in the treatment of horses, from a hot mash, placed in a capacious nose-bag, or in a large bucket brought under the nostrils, the animal's head and the bucket being covered with a piece of sacking. Such inhalations are serviceable in catarrh and bronchial congestion, and may be rendered more soothing by mixing with the moist, warm air a little chloroform, laudanum, or conium. Antiseptic properties are conferred by impregnating the air with chlorine or sulphurous solutions, or by the use of creosote, iodine, or iodoform. As in the administration of chloroform for production of anæsthesia, volatile drugs may be conveniently inhaled from a sponge placed in one nostril. Irritability of the larynx and violent coughing are sometimes relieved by the cautious vaporising of hydrocyanic acid and conium, or by spraying the throat with cocaine. Chlorine, or sulphurous acid inhalations, twice or thrice repeated at intervals of three or four days, are usually effectual in destroying bronchial filaria in calves and lambs.

WEIGHTS AND MEASURES, IMPERIAL AND METRIC.

Two systems of weights—the avoirdupois and the apothecaries'—were formerly employed by medical men, veterinarians, and chemists. The avoirdupois or imperial weight was used by wholesale druggists, and also by retailers in buying their drugs, and usually in selling out quantities amounting to or exceeding an ounce. In dealing with smaller quantities, and in making up prescriptions, apothecaries' weight was employed. To avoid the ambiguity occurring from the use of these two

systems, the framers of the B.P. in 1864 abolished the apothecaries' weight, adopted the avoirdupois ounce as the standard, divided it into 437·5 grains, and ignored entirely drachms and scruples. But so great is the inconvenience arising from the want of some denomination between the grain and the ounce, that medical and veterinary authorities, although dispensing with the scruple, still use the drachm (dr. ℥j.), which is one-eighth of the avoirdupois ounce, or contains 54·6875 grains.

PHARMACOPŒIA MEASURE OF WEIGHT.

1 grain, gr.j.	
1 ounce, oz.j. ℥j.....	= 437·5 grains.
1 pound, lb.j.....	= 16 ounces = 7000 grains.

As some veterinarians may still use the abolished apothecaries' weight, its denominations with their appropriate signs are appended, and it may be recollected that the grain is one-eleventh more than that of the B.P.

APOTHECARIES' MEASURE OF WEIGHT.

1 grain, gr.j.	
1 scruple, ℥j.....	= 20 grains.
1 drachm, ℥j.....	= 3 scruples = 60 grs.
1 ounce, ℥j.....	= 8 drachms = 480 „
1 pound, lb.j.....	= 12 ounces = 5760 „

The measures of the B.P. are those in former use. The fluid ounce of distilled water, although weighing 437·5 grains, is still divided into 480 minims.

MEASURE OF CAPACITY.

1 minim, min. ℥j.	
1 fluid drachm, f℥j.....	= 60 minims.
1 fluid ounce, f℥j.....	= 8 fluid drachms.
1 pint, O j.....	= 20 fluid ounces.
1 quart, Qt.j.....	= 2 pints.
1 gallon, C.j.....	= 4 quarts.

It is often useful to recollect the weight of different measures. Of water, one minim (m.j.) weighs nine-tenths of a grain; a fluid ounce at 60° Fahr. weighs exactly an ounce avoirdupois; hence a pint is equal to a pound and a quarter, and a gallon to ten pounds avoirdupois.

Practitioners require proper balances of different sizes, legibly marked weights of different denominations, and graduated measures, which, for the sake of cleanliness, should be made of glass or earthenware rather than of metal. Much time is saved both to himself and his employers by having the bottles in which his medicines are dispensed graduated to ounces; and such bottles may now be purchased at very moderate prices. To prevent mistakes, medicines for external and internal use should be sent out in differently shaped and differently coloured bottles, properly labelled; while all potent preparations should further be labelled "Poison."

When standard measures cannot be obtained, the practitioner has often occasion to use some of the ordinary domestic utensils, with the capacity of which he ought therefore to be familiar. Common tumblers contain from eight to ten fluid ounces; teacups, five to seven fluid ounces; breakfast cups, about eight to ten fluid ounces; wine-glasses, two to two and a half fluid ounces; tablespoons, half a fluid ounce; dessertspoons, two fluid drachms; and teaspoons, one fluid drachm of sixty minims. Such measurements, however, are merely approximative. The pint and quart bottles, subdivisions of the old wine measure now disused, contain respectively about 13 and 27 fluid ounces, and *not*, as their names might indicate, 20 and 40 fluid ounces. A Scotch pint contains 60 fluid ounces. Medicines are sometimes measured by the drop, which varies, however, exceedingly with the density and viscosity of the fluid, and the form and size of the vessel from which it falls.

The **metric system** of weights and measures is now legalised in this country, is everywhere extensively used in scientific observations, and, from the simplicity of its decimal gradations, is certain to become general for all purposes. The metric tables of weight, capacity, and length, with their relations to the corresponding B.P. and English tables, are appended:—

MEASURES OF WEIGHT.

1 milligramme	=	0·001 gramme	=	0·015432 grains.
1 centigramme	=	0·01	„	= 0·15432 „
1 decigramme	=	0·1	„	= 1·5432 „
1 gramme	=	1·0	„	= 15·432 „
1 decagramme	=	10·0	„	= 0·022046 lbs.
1 hectogramme	=	100·0	„	= 0·22046 „
1 kilogramme	=	1000·0	„	= 2·2046 „

The gramme, taken as the unit of weight, is a cubic centimètre of water at 4° C. or 39·2° Fahr.

MEASURES OF CAPACITY.

1 millitre	=	1 gramme of water	=	0·0610 cubic in.
1 centilitre	=	10 „	„	= 0·610 „
1 decilitre	=	100 „	„	= 6·10 „
1 litre	=	1000 „	„	= 61·0 „

A litre is a cubic decimètre, equal to one kilogramme, or 1·76 pint.

MEASURES OF LENGTH.

1 millimètre	=	0·001 mètre	=	0·03937 English in.
1 centimètre	=	0·01	„	= 0·3937 „
1 decimètre	=	0·1	„	= 3·937 „
1 mètre	=	1·0	„	= 39·37 „
1 decamètre	=	10·0	„	= 32·80 English ft.
1 hectomètre	=	100·0	„	= 328·08 „

A mètre is equal to the ten-millionth part of a quarter of the meridian of the earth. It is equal to 3·28 English feet.

The Fahrenheit **thermometer**, being the measure of temperature still retained by the B.P., and in many works on human materia medica, is the measure again adopted in this book. The Centigrade scale, however is now extensively used. It is often requisite to ascertain the corresponding numbers on each scale, and for this purpose the following rule is useful. To convert any number of Centigrade into Fahrenheit degrees, multiply by 9, divide by 5, and add 32. For the converse process, subtract 32, multiply by 5, and divide by 9.

VETERINARY MEDICINES.

ACIDS—ACIDA.

THE mineral acids, with acetic, tartaric, and oxalic acids, resemble each other in their actions and uses, and may be conveniently grouped together. Boric, sulphurous, carbolic, salicylic, tannic, and hydrocyanic acids differ chemically and physiologically, and will be separately dealt with in their alphabetical order.

Sulphuric	Acid.	Acetic Acid.
Hydrochloric	„	Tartaric „
Nitric	„	Lactic „
Nitro-hydrochloric	„	Oxalic „
Phosphoric	„	
Chromic	„	
Hydrobromic	„	
Carbonic	„	

Acids are hydrogen salts which in presence of an alkali exchange for it their hydrogen, or a portion of it. They redden various blue and violet colouring matters, and most have a sour taste. In virtue of their **affinity for basic substances and for water**, acids, especially when concentrated, form new compounds with the animal tissues. Their primary effects are (1) to unite with and neutralise the free alkali which is present in most normal tissues; (2) the stronger often displace weaker acids; (3) they precipitate albumin, while all the mineral acids, except nitric, again dissolve albumin. When introduced into the blood, they, moreover, decompose hæmoglobin, forming a substance which parts with oxygen much less readily. They coagulate myosin, and hence cause muscular rigidity. The stronger acids, especially when concentrated, in fulfilling these affinities, are caustics and escharotics (p. 45). Weaker and more diluted acids act as rubefacients, cause temporary con-

gestion, and, if freely or continuously applied, inflame the dermis, producing vesication (p. 44). They destroy enzymes, and check proliferation of organised ferments.

Acids, when swallowed, are **corrosive, irritant poisons**. As with other irritants, they are more active and fatal in horses and dogs than in cattle or sheep, in which their toxic effects are diminished by admixture with the bulky food usually present in the first stomachs of these ruminants. "In cases of acute poisoning, where death has not occurred too quickly, much albumin, hæmatin, and indican have appeared in the urine, and fatty degeneration in the liver, muscles, and kidney has been found" (Dr Lauder Brunton). Their appropriate **antidotes** are alkaline bicarbonates, or calcium, and magnesium carbonates, given with such diluents and demulcents as milk, oil, and linseed gruel, and followed by opium and fluid nutrients (p. 137).

Acids in the mouth **increase the saliva** from the parotid and submaxillary glands, have no effect on the sympathetic saliva, and effectually moisten the fauces and allay thirst (p. 87). As they are in part neutralised by the alkaline saliva, the resulting salts exert some astringent and antiseptic effects. If not neutralised before they reach the intestines, they increase their alkaline secretions, and also that of the alkaline bile. Dr Sidney Ringer (*Handbook of Therapeutics*) believes that **acids increase alkaline secretions**, while, conversely, alkalis increase acid secretions. He, moreover, states that acids hinder acid secretions. Whether they do so merely by neutralising the alkalis which stimulate acid secretion, or by some further action, is not ascertained.

Acids **assist digestion** apparently in several ways.

(1.) **They furnish** the gastric juice with its **acid constituent**, which, unlike the pepsin, is not capable of reproduction, and without which the digestive power of the gastric solvent is impaired. Hydrochloric acid, being the chief natural gastric acid, is generally prescribed when the acidity of the gastric fluid is believed to be deficient, as it sometimes is in young animals living chiefly on milk, in febrile, enfeebled, or old subjects, or in those suffering from gastric catarrh. To effect these purposes, acids are given along with or shortly after food.

Where there is want of appetite and irregular action of the bowels, acids are given conjoined with bitters.

(2.) Acids **check gastric secretion** where it is excessive, as it appears to be in cases of indigestion, where the fluids in the mouth are sour, not only after, but before, feeding, and where animals instinctively lick the walls, or eat alkaline earthy matters. In such cases the alkaline treatment frequently adopted affords temporary relief; but a laxative, followed by acids, generally removes the conditions on which the dyspepsia depends. To such patients acids are given before feeding.

(3.) Acids acting **antiseptically** check fermentation, and thus prevent formation of gases and irritating organic acids. In this way they are serviceable not only in indigestion, but in certain cases of diarrhœa.

Before reaching the circulation, acids must **pass through the liver**, where they appear to set free biliary acids (Ringer), stimulate expulsion of bile from the liver and gall-bladder, alter processes of tissue change, and check formation of urea (Brunton). As hepatic tonics and stimulants, nitric and nitrohydrochloric acids are preferred (p. 186).

When **they enter the general blood current**, their acidity must be considerably neutralised. They, nevertheless, still act specially as acids, for their alterative and tonic effects are not the same as those of the salts they form when fully neutralised. They are **excreted** from the body in part through the intestinal glandular apparatus, but chiefly by the kidneys, in combination with ammonia and other bases. Full or repeated doses diminish, however, the alkalinity, or increase the normal acidity of the urine. The vegetable acids, being readily oxidised into carbonates, exert a primary acid, but a secondary alkaline, effect, notably on the urine.

On account of their diminishing secretion of gastric juice, acids should not be prescribed for more than a week or ten days at a time. They must be given freely diluted, and are often conjoined with bitters, iron salts, and alcoholic stimulants.

The several acids, although possessing properties in common, have **distinguishing characteristics**. Hydrochloric being volatile, and possessing, besides, a strong affinity for water, whether in the gaseous or fluid state, is most destructive to

vegetation, browning and shrivelling the plant tissues. Hydrochloric, sulphuric, and phosphoric acids are the most powerfully corrosive. Nitric acid does not so readily redissolve the precipitated albumin, and hence is scarcely so penetrating as other mineral acids. Sulphuric acid, when applied to the skin or swallowed, causes blackening or browning of the parts with which it comes into contact; nitric acid leaves a yellow stain; hydrochloric, a white film of precipitated albumin. The special uses of the three important mineral acids are thus indicated by Dr Bence Jones—"Hydrochloric," he says, "promotes digestion; nitric, secretion; sulphuric, astringency." Nitric and nitrohydrochloric acids are chiefly useful as hepatic tonics and stimulants. Tartaric and citric acids, and vinegar, are much less powerful than the mineral acids.

Sulphurous, boric, benzoic, and salicylic acids, used for their antiseptic rather than for their special acid properties, with their salts, will be dealt with later. Carbolic acid is also an antiseptic, and an alcohol rather than an acid. Arsenious acid, is not a true acid, but an anhydride. Tannic and gallic acids, although they have acid reactions, are glucosides. The striking actions of hydrocyanic acid distinguish it from all other acids. These acids will accordingly receive separate notice under their English names.

SULPHURIC ACID.

ACIDUM SULPHURICUM. Hydrogen sulphate. Oil of vitriol.

An acid produced by the combustion of sulphur and the oxidation and hydration of the resulting sulphurous acid by means of nitrous and aqueous vapours. It contains about 98 per cent. of real acid. (H_2SO_4 or $\text{SO}_2(\text{OH})_2$). (B.P.)

MANUFACTURE.—Into large leaden chambers, the floors of which are covered with water, gaseous sulphurous anhydride (SO_2) is introduced from the burning of sulphur or the roasting of iron pyrites. Nitric acid (HNO_3), obtained by the action of sulphuric acid on potassium or sodium nitrate, is discharged with jets of steam into the chambers, and supplies the oxygen which converts the sulphurous into sulphuric acid

(H_2SO_4). The nitric acid is thus changed into nitric peroxide (NO_2), which, in the presence of air, regains oxygen, and, without itself undergoing much diminution, continues the carrier of oxygen from the air to the sulphurous acid. The diluted sulphuric acid formed in the chambers is concentrated in leaden vessels to the specific gravity 1.72, when it constitutes the brown acid of commerce. For pharmaceutical or chemical purposes it is further concentrated in platinum or glass vessels.

PROPERTIES.—The strong acid of commerce contains about 98 per cent. of real acid (H_2SO_4), has the specific gravity 1.843, is oily-looking, colourless, odourless, with an intensely acid, acrid taste. It freezes about 30° Fahr., boils at 640° Fahr., absorbs moisture from the air, and hence, if kept in unstoppered bottles, speedily becomes diluted. It has great affinity for water, mixes with it in all proportions, with evolution of much heat. Thus, combining with water and albumin, it decomposes and chars organic substances and soft animal tissues. When heated with charcoal, sulphur, or metals, it rapidly parts with oxygen, and is converted into sulphurous acid.

The acidum sulphuricum dilutum, or medicinal acid, contains 13.65 per cent. of real acid. **The acidum sulphuricum aromaticum**, containing eighteen fluid parts of rectified spirit, and flavoured with cinnamon and ginger, has 12.5 per cent. of real acid.

The test for sulphuric acid is its forming, in diluted solution, with soluble barium salts an abundant white precipitate (BaSO_4), insoluble in nitric or hydrochloric acids. Sulphuric acid is a **dibasic acid** (H_2SO_4), and forms a triple series of salts. Its two hydrogen atoms may be displaced (1) by two atoms of the same metal, constituting a normal sulphate, as potassium sulphate (K_2SO_4); (2) by one of two different metals where a double sulphate like potassium aluminium sulphate is formed ($\text{KAl}(\text{SO}_4)_2$ (12 H_2O); or (3) one atom of hydrogen remains and one is replaced by a metal constituting an acid sulphate like potassium acid sulphate (KHSO_4).

Its **impurities** seldom interfere with its medicinal uses.

ACTIONS AND USES.—Sulphuric acid is a corrosive, irritant

poison ; is used medicinally as a refrigerant, antiseptic, tonic, and astringent ; and externally as a caustic, stimulant, and astringent.

TOXIC EFFECTS.—Its local actions depend upon its affinity for water and bases, and its coagulating albumin. Swallowed in concentrated form, it almost immediately produces retching, with emesis in animals that vomit. The vomited matters are acid, stain and corrode, are often dark, viscid, and bloody, and contain shreds of mucous membrane. The lips, mouth, and fauces are red, inflamed, and swollen. From irritation and swelling of the throat breathing is frequently difficult, and when a strong acid has been swallowed in human patients, or in rabbits experimented upon, death from suffocation has resulted in an hour, or even less time (*Taylor On Poisons*). There is great abdominal pain, rapidly increasing prostration, and death usually in twelve to twenty-four hours. The mouth, fauces, gullet, and stomach exhibit brown and black stains, and patches of corrosion, and there is sometimes perforation of the stomach. When the acid has been diluted, and death does not occur for several hours, the digestive mucous membrane is softened, swollen, and inflamed, but not so blackened or charred as when the acid has been concentrated, and death more rapid. Injection into the veins proves fatal by coagulation of blood and thrombosis (*Orfila*).

Sulphuric and other acids are sometimes ignorantly given by grooms and carters, with the idea of improving the condition of their charges. Acute poisoning occasionally occurs from overdoses, chronic irritation of the bowels not infrequently results ; and horses which for a season have thus been senselessly doctored, usually continue for months and even for years thriftless, and difficult to keep in condition.

The antidotes are alkaline bicarbonates, chalk, or magnesium carbonate, given diluted in milk or water, in small quantity at short intervals. Demulcents are subsequently administered. Where the breathing is difficult, tracheotomy is performed.

MEDICINAL USES.—Sulphuric acid is prescribed as a tonic and astringent. It is given in chronic diarrhœa and dysentery usually with laudanum in starch gruel or mucilage. In influenza in horses, with a tendency to œdema or purpura,

thirty drops of the medicinal acid are sometimes given in gruel or ale several times a day, with an ounce each of ether and powdered cinchona bark. In purpura the late Professor Robertson prescribed ℥ xx. to ℥ xxx., with grs. xxx. iron sulphate, in cold water thrice daily. In relaxed and ulcerated sore-throat, a diluted solution, slowly given, exerts the twofold influence of a local astringent and general tonic. It was wont to be prescribed in contagious pleuro-pneumonia amongst cattle, but was not more successful than iron sulphate or other tonics. It checks bleeding from the lungs and stomach, arrests excessive perspiration, and, correcting gastric derangement, abates the itching of chronic nettle-rash and lichen. It is an antidote for poisoning by lead, carbolic acid, and alkalies.

Externally it is used for **cauterising** irregular, sinuous, and poisoned wounds, and as a **styptic** and **astringent**. Three parts strong acid, thoroughly mixed with one of asbestos, and rubbed to fine powder, are used in France for removing cancerous and other swellings; a half-an-inch layer placed over a tumour the size of an egg is stated to remove it in twelve hours. For destruction of cancer Professor Syme made sulphuric acid into a thin pulp with sawdust, protecting the neighbouring tissues by a wall of guttapercha. It is used in like manner to destroy warts, which, from their shape or situation, cannot readily be removed by knife or ligature. It hastens disintegration of necrosed bone. Mixed with linseed oil, it is sometimes repeatedly applied to contract and remove umbilical hernia; but ligatures, clamps, or needles are more effectual. It is occasionally added to blistering ointments, but, unless in small amount, is apt to cause blebbling. A few drops, given along with Epsom salt and other saline purgatives, diminish their disagreeable taste and rather increase their activity.

Doses, &c.—Of the medicinal acids horses take fʒj. to fʒij.; cattle, fʒij. to fʒiv.; sheep, fʒss. to fʒj.; pigs, ℥ v. to ℥ xx.; dogs, ℥ ij. to ℥ vi., repeated several times a day, given freely diluted, and often conjoined with aromatics and bitters. As an external astringent, ten to twenty drops of medicinal acid are mixed with an ounce of water.

HYDROCHLORIC ACID.

ACIDUM HYDROCHLORICUM. Muriatic Acid. Spirit of Salt. Hydrochloric Acid Gas (HCl) dissolved in water, and forming about 32 per cent. by weight of the solution (B.P.)

When one volume each of hydrogen and chlorine are mixed, and exposed to sunlight or an electric spark, combination occurs with explosive violence, and there result two volumes of the colourless, pungent, acrid, irritating hydrochloric acid gas. The acid of commerce and medicine is mostly got as a bi-product in the manufacture of sodium carbonate from common salt. The Pharmacopœias order the distilling together of sodium chloride sulphuric acid, and water; acid sodium sulphate remains in the retort; hydrochloric acid gas distils over, is purified by passing it through a wash bottle containing a limited amount of water, and thence is conducted into a retort about two-thirds filled with distilled water, which dissolves 32 per cent. of the gaseous acid. This preparation is colourless, intensely sour and acrid, emits white, pungent fumes of the gas, and has the specific gravity 1.16. A still stronger acid may be made, containing 43 per cent. by weight or 480 volumes of gaseous acid, and reaching the specific gravity 1.21. The B.P. **acidum hydrochloricum dilutum** is made by mixing eight fluid ounces of the stronger acid with water until the mixture at 60° Fahr. measures 26½ fluid ounces. It has the specific gravity 1.052, and contains 10.58 per cent. of gaseous acid. **The test** for hydrochloric acid is its producing, with silver nitrate, a curdy white precipitate (AgCl), insoluble in nitric acid, but soluble in excess of ammonia. Its chief **impurities** are sulphuric and sulphurous acids, nitrous compounds, chlorine, iron, and occasional traces of arsenic.

ACTIONS AND USES.—Concentrated doses are corrosive and irritant; medicinal doses are astringent, antiseptic, tonic, and antidotes for poisoning by alkalis; it is excreted mainly in the urine, increasing its quantity and diminishing its alkalinity. Topically it is used as a caustic, stimulant, astringent, and antiseptic.

TOXIC EFFECTS.—Like the other mineral acids, concentrated

solutions have a strong affinity for the water bases and albuminoids of the tissues. They leave upon them a white film. When swallowed they cause gastro-enteritis. Independently of irritant or corrosive effects, they appear to destroy life by neutralising the alkali of the blood. Rabbits and other herbivora are stated to suffer in this way more readily than dogs or other carnivora. Seven or eight grammes per kilogramme of body-weight may be given to rabbits in twenty-four hours without serious results, but nine grammes prove fatal in a few hours, causing frequent laboured breathing, quick pulse, imperfect power of moving, and death, depending upon fatal diminution of the alkali in the blood, determining first stimulation, and soon paresis of the respiratory centre. That these toxic effects directly depend upon neutralising of the alkali in the blood appears to be demonstrated by Mr F. Walter's experiments, in which animals nearly dying from acid poisoning promptly revived when sodium bicarbonate was injected into the veins. The alkaline antidote proves effectual even when three times the ascertained fatal dose of acid has been administered (Phillip's *Materia Medica*, 1882).

MEDICINAL USES.—Hydrochloric acid, made into an electuary with glycerine, treacle, or honey, or diluted with water, while slowly swallowed, exerts stimulant, astringent, or antiseptic effects on **irritable, relaxed, or ulcerated throats**. Stimulating the mucous membrane of the mouth, it reflexly evokes **secretion of saliva**, moistening the parched mouth and abating thirst. Like other acids, it specially stimulates the mucous, intestinal, and other alkaline secretions. These effects are increased by combining the acid with gentian or other bitters. Hydrochloric acid is the **special acid** of the **gastric juice**; in herbivora it amounts to .15, in dogs to .3 per cent. When the natural acid constituent of the fluid is deficient, digestion is performed tardily and imperfectly, the food ferments and acid acids are evolved. For obviating or removing such conditions, hydrochloric acid is specially suitable; it **aids digestion**, especially of albuminoids, controls acid fermentation common in young animals, particularly when feeding on milk, and hence often checks diarrhœa. In young calves or

foals, digesting their food indifferently, and scouring, a few drops of hydrochloric acid are used with the milk; and acids are usually preferable to alkalies, being given either immediately before or about an hour after feeding. Acids conjoined with bitters are also useful for convalescents from exhausting disease, for show beasts that have been systematically over-gorged, and for young and weakly, as well as for old, enfeebled subjects. The acid treatment is equally appropriate in the totally different gastric condition of undue acidity depending upon excessive secretion; but in such cases the acid should be administered half an hour before feeding. Given alone or with ferric chloride, it promotes a healthier state of the bowels in animals affected by intestinal worms, and sometimes expels ascarides. Like other mineral acids, it exerts some unexplained alterative action as it passes through the liver, and during excretion acidifies the urine.

Externally it is used to destroy warts, and, as a **caustic** and **antiseptic** for wounds, for foot-rot in sheep, and occasionally as a styptic. A tepid solution, diluted until only faintly acid to the tongue, is sometimes used, instead of vinegar and water, for rapidly sponging the skin of febrile patients.

Doses, &c.—Of diluted or medicinal acid, horses take fʒss. to fʒij.; cattle, fʒij. to fʒiv.; sheep and pigs, ℥ xv. to ℥ xx.; dogs, ℥ ij. to ℥ x., usually prescribed with forty or fifty times its bulk of water; often given along with bitters and iron salts.

NITRIC ACID.

ACIDUM NITRICUM. Aquafortis (HNO_3).

The strong acid of commerce and medicine is prepared in iron retorts from seven parts of potassium or sodium nitrate, four of sulphuric acid, and water. It **contains** 70 per cent. of real nitric acid (HNO_3), has the specific gravity 1.42, but is inconveniently unstable and caustic, and gives off nitrous fumes. The B.P. recognises a **diluted acid** with the specific gravity 1.101, and containing 17.44 per cent. of anhydrous acid.

PROPERTIES.—Nitric acid, in tolerably concentrated solution, is colourless; emits pungent, corrosive, suffocating fumes; has an intensely sour taste; oxidises, corrodes, and dissolves many

organic substances; has great affinity for water; in imperfectly stoppered bottles it quickly increases in quantity and diminishes in strength; diluted with water it evolves much heat.

Its tests are (a) the production of an orange-red colour with a solution or crystal of morphine or brucine; (b) copper, mercury, and some other metals deoxidise strong solutions, with evolution of ruddy nitric peroxide fumes (NO_2); (c) it gives a yellow stain of picric acid to wool and to the skin—a decoloration deepened by alkalies, and removed from the skin only by its desquamation; (d) it bleaches a warm solution of indigo sulphate; and (e) a solution of ferrous sulphate dropped on nitric acid in a test-tube produces an olive-brown coloured ring where the two liquids meet. With bases, nitric acid forms an extensive series of soluble salts, the **nitrates**, which deflagrate when heated, and give the olive-brown or dark purple colour when a few crystals of ferrous sulphate are dropped into a cold solution in a test-tube, gently shaken, and eight or ten drops of strong sulphuric acid are added.

IMPURITIES.—The tests of purity are the specific gravity, which indicates the proportion of water; freedom from colour, proving absence of ruddy nitric peroxide. Any trace of sulphuric acid is precipitated from a diluted solution by barium chloride; while hydrochloric acid is precipitated by silver nitrate.

ACTIONS AND USES.—Nitric acid is **irritant** and **corrosive**, and especially destructive when in concentrated solution and containing the volatile nitrous acid. It leaves yellow or brown stains on the skin and throat, but in the stomach this decoloration is usually obscured by inflammation or extravasation of blood. Besides acting like the other mineral acids, it exerts oxidising effects, notably when used locally, and probably also when given internally. It is specially used as a **hepatic stimulant and tonic**, frequently indicated in horses convalescing from influenza, jaundice, and other debilitating disorders, and, alternated with arsenic, in eczema and chronic skin diseases.

Externally the medicinal acid is applied for extirpating warts, fungous and malignant growths which cannot be removed by the knife; for dissolving the hardened scurf, and promoting a healthier condition of skin in mallenders and

chronic eczema; and as a caustic in poisoned wounds, caries, foul, and foot-rot. As an escharotic it is generally applied on a splinter of soft wood; surrounding tissues are protected by moistening with oil, and undue action arrested by subsequent washing with an alkaline solution. Freely diluted in hot water, it abates the itching of nettle-rash. Dissolved in two to three hundred parts of water, it is used for sponging the skin, and for relieving the tenderness and tension of piles in dogs. Nitric acid preserves putrescible substances, and prevents evolution of hydrogen sulphide and other noisome gases more effectually than either hydrochloric or sulphuric acids; but it is ineligible as a disinfectant, owing to its oxidising organic and metallic substances, and producing irritant effects if its fumes are incautiously breathed.

Doses, &c.—Of the diluted medicinal acid, horses or cattle take ℥i. to ℥ij.; sheep and pigs, ℥x. to ℥xx.; dogs, ℥ij. to ℥x. It must be largely diluted with water or other bland fluids, and is often conjoined with bitters. For external application, a drachm of strong acid to the pint of water suffices for all except escharotic purposes. An **ointment** is occasionally used, made by melting together in a glass vessel a pound of olive oil, four ounces of axunge, and when the mixture is nearly concrete, adding six drachms of nitric acid, and stirring briskly with a glass rod till the whole solidifies. A **paste** made with sulphur and lard is also in use for extirpating warts, destroying acari, and stimulating the scurfy skin.

NITRO-HYDROCHLORIC ACID.

ACIDUM NITRO-HYDROCHLORICUM. Nitro-Muriatic Acid. Aqua regia.

When one measure of nitric acid and three of hydrochloric are mixed, red acid fumes are evolved, and there results a golden-yellow corrosive liquid, a compound of nitric oxide and chlorine, to which it owes its suffocating odour, and its property of dissolving gold and platinum. The **diluted medicinal nitro-hydrochloric acid** of the B.P. is prepared by adding to twenty-five fluid ounces of distilled water in a glass-stoppered bottle three fluid ounces of nitric acid and four of hydrochloric,

and allowing the mixture to stand for fourteen days before it is used. It contains free chlorine, and has the specific gravity 1·07.

ACTIONS, USES, AND DOSES.—The strong acid is very corrosive and irritant, but it is not used as a caustic. Medicinal doses exert special tonic and stimulant actions on the skin, liver, and intestinal glands, and are used in hepatic torpidity, chronic hepatitis, catarrhal jaundice, rickets, and occasionally in equine influenza. It is prescribed in the same doses as nitric acid, and with the same precautions as to dilution and avoidance of too frequent or prolonged use.

PHOSPHORIC ACID (H_3PO_4).

Acidum phosphoricum concentratum is prepared by heating phosphorous with diluted nitric acid until nitrous fumes cease to form, and diluting it with water until it has the specific gravity 1·5, when it contains H_3PO_4 , with 33 per cent. of water. It is a colourless, sour, syrupy liquid, with an acid reaction. In diluted solution it gives, with ammonia silver nitrate, a canary-coloured precipitate, soluble in ammonia and dilute nitric acid. **The acidum phosphoricum dilutum** is prepared by mixing three parts concentrated phosphoric acid with twenty of water. It contains 13·8 per cent. of H_3PO_4 . It is a colourless liquid of specific gravity 1·08.

Compared with the other mineral acids, it is not so corrosive, but **is used** for many of the same purposes, is believed to be less apt to derange digestion when given for any considerable period, has some reputation for checking tuberculosis and the growth of bony tumours, and is used in human patients in diabetes.

CHROMIC ACID (CrO_3).

Acidum chromicum is prepared from potassium bichromate, occurs in crimson, deliquescent, needle-shaped crystals, and is very soluble in water. The liquor acidi chromici is made with one part of acid and three of water. It readily parts with oxygen, oxidises organic matters, coagulates albumin,

destroys low organisms, and decomposes ammonia and sulphuretted hydrogen, and though not prescribed internally, it is used as a caustic, antiseptic, deodoriser, and disinfectant.

HYDROBROMIC ACID (HBr.)

Diluted hydrobromic acid, containing 10 per cent. of gaseous hydrobromic acid (HBr.) and 90 of water, is employed in human medicine as a nerve sedative for most of the purposes for which potassium bromide is prescribed, and has been recommended as an anodyne for nervous diseases of dogs in doses of ℥xx. to ℥l. (*Veterinarian*, June 1888).

CARBONIC ACID.

ACIDUM CARBONICUM. Carbon Dioxide. Carbon Anhydride.
Choke Damp. After Damp. (CO₂).

When air is inhaled, by either man or the domestic animals, containing more than $\frac{1}{200}$ parts by volume of carbonic acid, discomfort and languor are produced. An atmosphere containing $\frac{1}{12}$ promptly prevents removal of the carbonic acid from the blood, **interferes with oxidation** of the tissues, and hence impairs their functions; $\frac{1}{5}$ shortly causes unconsciousness and anæsthesia; $\frac{1}{3}$ does so more rapidly, renders the blood markedly venous, but if respiration of the mixture is continued only for a few minutes, recovery gradually occurs. Equal parts of carbonic acid and air quickly produce death by asphyxia, exhibiting the three stages characteristic of such poisoning, namely—(1) dyspnœa, (2) convulsions, and (3) paralysis. Examination after death discovers general venous congestion, the blood dark coloured, the right side of the heart much distended with blood, the brain congested, and sometimes exhibiting exudation and extravasation. In treating such cases, endeavour is made to oxygenate the stagnating venous blood by bringing the animal into a pure atmosphere, stimulating respiratory effort by dashing cold water over the head and neck, employing artificial respiration, and, if the action of the heart is failing, relieving its engorgement by drawing blood from the jugular vein. Carbonic acid in solution applied to

the skin or stomach produces stimulation. Effervescent drinks increase gastric and intestinal secretion, hasten metabolism, and are excreted from the kidneys more rapidly than corresponding quantities of non-aërated water.

ACETIC ACID.

The British Pharmacopœia recognises the following varieties of acetic acid :—

Glacial acetic acid	contains 98·8 per cent. anhydrous acid :	1·058 spec. grav.
Acetic acid	„ 33 „ „	1·044 „
Diluted acetic acid	„ 4·27 „ „	1·006 „
Vinegars	„ 5·41 „ „	1·017-19 „

Glacial acetic acid is prepared by heating sodium acetate with sulphuric acid. When rectified it contains one per cent. of water, and corresponds to 84 per cent. of acetic anhydride—a colourless, volatile, pungent liquid ($\text{HC}_2\text{H}_3\text{O}_2$ or $\text{CH}_3\text{CO}_2\text{H}$). The glacial acid is mobile, oily, and colourless, with a pungent acetous odour and taste, and a corrosive action upon organised tissues. It boils at 243° Fahr., distils unchanged, is combustible, miscible in all proportions with water and alcohol, crystallises at 34° Fahr. into radiating pearly plates; hence its title of glacial acetic acid.

Acetic acid (*acidum aceticum*, B.P.) is about one-third the strength of the glacial acid, is colourless, strongly acid, with a pungent odour. It is usually prepared from the **destructive distillation of wood** or sawdust. The condensed products separate into two layers, the lower consisting of wood tar; the upper, an aqueous solution of 2 to 4 per cent. of pyroligneous or acetic acid, associated with methyl alcohol, acetone, and other allied bodies. Sodium carbonate is added; the volatile hydrocarbons are distilled off; the remaining liquid is evaporated; sodium acetate crystallises, and, when distilled with sulphuric acid, acetic acid is produced. An imperfectly purified acid, still containing some residual tarry matters, is sold as **pyroligneous acid**. A mixture of one volume of this commercial acid with seven of water constitutes the B.P. **diluted pyroligneous acid**, which corresponds in strength with vinegar.

Acetic acid, even when considerably diluted, reddens litmus,

dissolves volatile oils, resins, camphor, and most alkaloids, and unites with bases to form the crystallisable and soluble **acetates**, which are distinguished by the acetous odour they emit when heated with sulphuric acid; the pleasant odour of acetic ether they evolve when heated with alcohol and sulphuric acid; and the red-brown colour they produce in neutral solution when treated with ferric chloride—a colour which changes on boiling to a brown precipitate of basic acetate of iron.

Vinegar (*acetum*) is diluted acetic acid, sometimes containing traces of colouring matter, mucilage, alcohol, ethers, sulphuric acid, and calcium sulphate. Besides being got from the destructive distillation of wood, as described above, it is also obtained from the oxidation of impure alcohols, by exposing them to the air at a temperature of about 80° Fahr., and in contact with a ferment. In this way vinegars are manufactured in this country from malt, grain, cider, or solutions of sugar or spirit; in France, by exposing the poorer wines in half-filled casks; and in Germany, by what is termed the quick vinegar process, from weak spirits mixed with about 1-1000th part of yeast, or beetroot juice, and allowed slowly to trickle at a temperature of from 75° to 80° Fahr. over a large surface of wood shavings previously soaked in vinegar. There is shortly formed on the surface of the shavings a gelatinous mould—the *mycoderma aceti*—which favours attraction of oxygen from the air, supplies it to the alcohol, and hastens its conversion into acetic acid.

ACTIONS AND USES.—Acetic acid is corrosive, irritant, and vesicant. It is not used internally. Diluted, usually in the form of vinegar, it is employed externally as a stimulant and refrigerant, and pharmaceutically as a solvent.

TOXIC EFFECTS.—An ounce of acetic acid destroyed a medium-sized dog in an hour, with symptoms of uneasiness, abdominal pain, vomiting, and collapse; a quarter of an ounce was fatal in five to nine hours; four or five ounces of vinegar in ten to fifteen hours (*Christison On Poisons*). Horses take six to twelve ounces of vinegar, and cattle three or four pounds, without apparent injury (*Hertwig*). A goat weighing 44 lbs. got five ounces, and died in twenty-six hours, the lesions consisting of hyperæmia and œdema of the lungs, and in-

flammation of the mucous lining of the digestive tract, the kidneys, and liver (Fröhner). Once in high repute as an antidote for many poisons, vinegar is now employed only in the case of the alkalis and alkaline carbonates.

EXTERNAL USES.—Rubbed into the skin, acetic acid speedily causes redness, and eruption of large blisters resembling those produced by boiling water; but as a vesicant, mustard or cantharides is preferable. As an astringent or caustic it is rarely used. Dissolving albumin, fibrin, and gelatin, it removes warts as well as corns in the human subject, softens scurf, destroys cryptogamic parasites and acari, and hence is sometimes found in prescriptions used in cases of mallenders, ring-worm, scab, and mange. Along with either hot or cold water, vinegar is used for contusions and strains, and for sponging the skin and checking excessive perspiration in febrile disorders. For fumigating stables or cow-houses, it is not nearly so effectual as carbolic acid, sulphurous acid, or chlorine. It dissolves the active principles of various medicines, and enters into the composition of **aceta**, or vinegars of cantharides and squill. **Oxymel** is made by heating together forty ounces of sugar or honey, and five each of acetic acid and distilled water. The antiseptic properties of vinegar recommend it for preserving various vegetables.

TARTARIC ACID ($H_2C_4H_4O_6$).

Acidum tartaricum is prepared from potassium acid tartrate, or argol, the incrustation found in the interior of wine casks ($KHC_4H_4O_6$), by boiling it with water, gradually adding chalk, and then calcium chloride, washing the calcium tartrate, decomposing it with sulphuric acid, decanting the acid solution from the calcium sulphate, and evaporating and crystallising. The crystals are colourless, oblique rhombic prisms, with an acid taste, soluble in less than their own weight of water, and less than three times their weight of rectified spirit. Either watery or spirituous solution not too diluted, when stirred with potassium acetate, yields a white crystalline precipitate.

Tartaric acid is devoid of irritant and poisonous properties. Christison gave drachm doses to cats without causing them apparent inconvenience. Like other organic acids, it is burnt

within the body, and the resulting carbonates exert their usual alkaline effects. It closely resembles **citric acid**, and, like it, is used as a cooling antipyretic.

LACTIC ACID, $\text{HC}_3\text{H}_5\text{O}_3$.

Acidum lacticum is prepared by the fermentation of glucose with putrid cheese in presence of chalk, and when purified is a syrupy liquid, which the B.P. states contains 75 per cent. of absolute lactic acid, and 25 per cent. of water.

It is present in the gastric juice, while sacrolactic acid, which is isomeric with it, is found in the juice of flesh and in the bile. It has a special power of dissolving false membranes, and in human patients has accordingly been used as spray or vapour in the treatment of croup and diphtheria. Diluted and sweetened, it is occasionally substituted for hydrochloric acid in dyspepsia.

OXALIC ACID, $\text{H}_2\text{C}_2\text{O}_4, 2\text{H}_2\text{O}$.

Acidum oxalicum occurs in rhubarb, sorrel, and other plants, is prepared on the small scale by oxidising sugar with nitric acid, and for commercial purposes by the oxidation of sawdust with potash. It forms monoclinic prisms resembling those of Epsom salt, for which it is sometimes mistaken; is soluble in nine parts of water, and in alcohol, and is entirely dissipated by heat.

It is an irritant, corrosive, and cardiac paralytant, and poisonous doses cause fatal collapse. Two drachms killed rabbits in fifteen minutes; half a drachm in thirty minutes. It is introduced into the B.P. as a chemical test.

ACONITE.

ACONITE.—Monkshood. Wolfsbane. Blue Rocket. Aconitum.

The root, fresh leaves, and flowering tops of *Aconitum Napellus*. *Nat. Ord.*—Ranunculaceæ.

ACONITINA.—Aconitine. An alkaloid obtained from Aconite Root. (B.P.)

Botanists have numbered twenty-two species and upwards of a hundred varieties of aconite, which are common throughout

the cooler mountainous countries of both hemispheres. Some species are eaten as vegetables, some are bitter tonics; but others, as the *Aconitum ferox*, *Sinense*, and *Napellus*, are sedative poisons. The last of these, the common officinal species, is a doubtful native of Britain, but often grown for its flowers in gardens and shrubberies. Its several varieties are herbaceous, with perennial tapering, carrot-shaped brown roots, with lateral rootlets, from which, after the first year's growth, are formed one or more oval tubers, at first nourished by the decaying parent root; several annual erect glabrous stems two to five feet high; numerous alternate dark-green leaves, with long channelled stalks very deeply cut palmately into five or three segments, which are again deeply and irregularly divided into oblong acute narrow lobes; long-stalked, helmet-shaped blue or purple flowers, which form loose terminal racemes, and appear in June or July; and dry, black, angular seeds, which ripen about the end of August.

The B.P. directs that **the fresh leaves and flowering tops**, which are used for the preparation of the extract, shall be gathered when one-third of the flowers are expanded. **The dried roots**, from which are prepared the tincture, liniment, and active alkaloid, are imported from Germany or cultivated in Britain. They are two to three inches long, and from half an inch to nearly an inch thick at the crown, which is knotty; are brown externally, but pinky white within; conical, rapidly tapering, prominently marked, with the bases of the rootlets, and of an earthy odour—characters which distinguish them from the larger, longer, more uniformly cylindrical, white, pungent, bitter root of horse-raddish, for which aconite roots have sometimes been fatally mistaken. According to Professor Schroff of Vienna, the root is six times as active as the other parts, and should be taken up after the plant has flowered in autumn, or before the new stem rises in spring, cut into small pieces, and dried at a low temperature. The leaves are less active than the root, but more so than the flowers, fruit, or stem. Any part of an active aconite, when slowly chewed, produces a peculiar acidity, tingling, and numbness of the lips and tongue.

An active alkaloid—aconitina ($C_{33}H_{43}NO_{12}$)—is extracted

by a tedious process from the powdered root by rectified spirit. It is colourless, usually amorphous, but crystallisable with some difficulty in right rhombic prisms, markedly alkaline, soluble in 150 parts of cold water, 50 of hot water, and more readily in alcohol, ether, and chloroform. The crystalline is purer than the amorphous; the English is generally more active than the Continental; Morson's is more uniform than that of most other makers.

The B.P. aconitina is a mixture of two alkaloids—pure aconitina and pseudo-aconitina. These have been examined by Professor Fraser, who finds that their proportions vary in specimens obtained from different sources, the former being in larger amount in the *Napellus*, the latter in the *ferox* and Indian aconites. Pure aconitina specially paralyses the motor ganglia in the heart; pseudo-aconitina more markedly paralyses the respiratory centres in the medulla, and hence is more dangerous. Another alkaloid—aconella—has been isolated by Messrs T. & H. Smith & Company of Edinburgh. The alkaloids in the plant are united with aconitic acid ($C_6H_6O_6$), which is present in all parts of the aconites in larkspur and in equisetum.

ACTIONS AND USES.—Aconite acts as a sedative, specially on the peripheral endings of sensory nerves, on the heart, and on respiration. It kills by respiratory arrest. Its physiological actions as a cardiac and respiratory sedative render it a febrifuge; it is also diaphoretic and diuretic. It is prescribed in acute febrile conditions, and in the earlier stages of acute local inflammation. It is used topically to relieve pain.

GENERAL ACTIONS.—**Locally applied**, in virtue of its action on the peripheral endings of sensory nerves, aconite produces first tingling and irritation, and subsequently numbness and paresis, and, becoming **quickly absorbed**, these effects are produced more or less notably throughout the body. The motor nerve-endings, although not so prominently affected as the sensory, are also irritated, as is illustrated by the fibrillary twitchings of the muscles. Aconite tincture is rapidly absorbed from the stomach within four minutes, and quickly passes into the tissues, as is shown by the blood of a poisoned dog, five minutes after the drug has been swallowed, being transferable

into the veins of another dog without producing the physiological action of the poison.

Full medicinal doses administered by the mouth induce **salivation**, champing of the jaws, movements of swallowing, and nausea, and cause in dogs and cats **vomiting**, and in horses, ruminants, and rabbits retching and eructation of frothy mucus. The **topical irritant action** is exerted not only on the stomach, but sometimes on the bowels, which are affected by spasms and diarrhœa, while the secretions of the skin and kidneys are also increased.

Within fifteen to twenty minutes the strength and frequency of the **heart-beats are reduced**, and blood-pressure is lowered. These effects on the circulation appear to depend upon paresis of the motor ganglia in the heart, as well as of the vagus roots in the medulla, and of the vaso-motor centres. From the impaired circulation, the skin secretion is increased, temperature is lowered, and general muscular weakness ensues. Kaufmann records that subcutaneous injection of aconitina in moderate doses in dogs lowered the temperature from 38·5° Cent. to 36·7° Cent.; while intravenous injection in horses reduced the temperature from 37·4° Cent. to 37·1° Cent. (*Traité de Thérapeutique et de Matière Médicale Vétérinaire*). Partly from the reduced circulatory force, and partly from the drug directly depressing the respiratory centre, **breathing is slow** and deepened, and exhibits a distinct expiratory effort. When large or repeated doses have been given, cardiac action becomes irregular, and often quickened, but tension remains low; the breathing becomes still slower, shallower, and more laboured; after each two or three respirations there is a distinct pause in expiration. Convulsions, mainly due to asphyxia, sometimes precede death, which generally results from **stoppage of respiration**. Neither brain nor special senses are affected. The pupils, which in the earlier stages of poisoning are sometimes dilated and sometimes contracted, during the later stages remain dilated. Aconite is **removed** from the body chiefly **in the urine**, augmenting both its solid and fluid parts.

Toxic Effects.—Aconite exerts tolerably uniform effects upon all animals, especially when injected hypodermically. **Horses** are poisoned within two or three hours by 120 to 150

minims of B.P. tincture given by the mouth, or by 40 minims of Fleming's tincture. **Cattle**, however, sometimes swallow these doses without fatal effects. **Dogs** weighing 40 lbs. are killed usually within half an hour by 50 to 60 minims of Fleming's tincture; cats by 10 minims. But half these doses are liable to produce violent and dangerous effects. Full medicinal doses sometimes leave untoward effects; pulse, blood-pressure, and breathing may continue reduced for ten or twelve hours, while appetite is occasionally impaired, and nausea remains for still longer periods.

The following **experiments on horses** were made at the Edinburgh Veterinary College many years ago by my lamented friend, Mr Barlow, and myself:—

A black mare, 15½ hands high, previously used for slow work, and in good health, got, at 12.40 P.M., one fluid drachm of Fleming's tincture of aconite. At 1 she was nauseated, had eructations of frothy mucus, with attempts to vomit, which increased till 1.30, when she went down. The pulse, which was 35 before the administration of the poison, was now 60, and very weak; she continued down till 7 P.M., when she was destroyed in consequence of being unable to stand.

An aged chestnut cab horse, 16 hands high, and useless from a bad quittor, was tied up by the head for ten minutes, to ensure perfect quietude. The pulse was then found to be 56, and the respirations 12. The animal had a good appetite and regular evacuations. At 10 o'clock he got 90 minims of Fleming's tincture of aconite in a linseed meal ball, the head being still kept tied up for fifteen minutes. In half an hour he fed greedily on potatoes and beans, but no change was observable. At 1 P.M. he got 50 minims of the same tincture in four ounces of water. At 1.15 he appeared to be making continual efforts to swallow something; his mouth was closed; and, after such attempts at swallowing, air and fluid were regurgitated up the gullet, causing a rattling noise, as of air-bubbles mixed with water. At 1.20 the pulse was 50; symptoms of actual nausea appeared; the muscles on the side of the neck and throat were contracted, the muzzle brought near to the breast, the lips retracted, and the mouth slightly opened. Fits of retching came on every two minutes, and increased in violence during the next ten or fifteen minutes. 1.30.—During each paroxysm of retching the mouth was opened, the lips widely retracted, and four or five ounces of frothy mucus discharged on the ground. The pulse had fallen to 40, and become weak. On account of the retching, the respirations could not be counted. Copious perspiration broke out over the body; the mucous membrane of the mouth, nose, and eyes were pallid, and there were fibrillary twitchings of the muscles, especially about the head and neck. 2 P.M.—Pulse 38, and weak; the respirations not easily counted, but probably about 9; in other respects no change. The animal passed feces and urine freely; and, shortly after getting a pint of cold water, lay down somewhat relieved, with the retching scarcely so frequent. At 2.30 the pulse was weaker than ever; the breathing irregular, interrupted, and sighing; and the animal unable to rise. The labial and nasal muscles were contracted, causing retraction of

the lips, and disclosing the gums blanched, and the teeth covered with frothy mucus. Two bottles of strong ale were given, with half an ounce of spirit of ammonia. At 3 P.M. the pulse was 35, and still weaker than before; respiration was somewhat accelerated, probably owing to the animal being down; perspiration continued to stream from every part; and the retching, though somewhat subsided, still came on about every ten minutes. The animal remained down without much change until about 6, when the nausea was somewhat diminished, but the pulse so weak as to be scarcely perceptible. He was raised with difficulty, and stood blowing much for fifteen minutes. At 7 there was little change; the pulse remained imperceptible, the respirations about 20, and there was no appetite for food or drink. He was left with the expectation of finding him dead next morning, but at 7 A.M. he was up and eating. His pulse was 65, his respirations 10, and his appearance very haggard and reduced. He continued in much the same state for a week, never regained his former look or appetite, for two days was unable to rise or stand, and became much wasted. He was destroyed by six drachms of prussic acid; but, on post-mortem examination, every part except the lungs seemed healthy. These organs, more especially the right one, were extensively studded with patches of extravasated blood about the size of walnuts, which, in those parts connected with the pulmonary tissue, were more or less softened, and emitted an odour characteristic of heated decomposed blood. The rusty fluid produced from the softening had in various places passed into the bronchi, imparting to their frothy mucus a brown colour.

The following experiments on **cats and dogs** were made at the Edinburgh Royal (Dick's) Veterinary College many years ago:—

A cat of average size got 7 minims of Fleming's tincture of aconite. In two minutes severe retching came on, with a copious flow of saliva, probably arising from paralysis of the fauces; and in five minutes painful vomiting and involuntary muscular contractions of a most active kind, with perverted action of the voluntary muscles, causing the animal to leap up the wall and turn somersaults backwards. In this, as in most other cases, the pupil, at first somewhat contracted, ultimately became dilated. The pulse was reduced in volume and strength, shortly becoming very weak; the breathing was gasping. The vomiting and inordinate muscular action continued until within two or three minutes of death, which took place twenty minutes after the administration of the poison. No morbid or peculiar post-mortem appearances were observable.

A medium-sized Scotch terrier got 30 minims of Fleming's tincture. In five minutes painful and active vomiting came on, which must have effectually emptied the stomach. The retching and vomiting continued, however, for half an hour, when the animal was so exhausted and paralysed in its hind extremities as to be unable to walk except by supporting itself on its fore limbs and dragging the hind after it. It gradually recovered, however, in about two hours. In some other cases a drachm of Fleming's tincture has destroyed dogs with as much rapidity as an equal quantity of medicinal prussic acid.

After death the lungs are found to be shrunk, and contain little blood; the trachea and bronchi contain excess of frothy mucus, accumulating owing to paralysis of the respiratory

muscles and glottis; the cavities of the right heart are greatly distended with blood; the left side is nearly empty; there is ecchymoses of the lungs, pleura, and endocardium; but nothing abnormal is noticed about the digestive organs.

ANTIDOTES.—If the patient is seen immediately after swallowing the poison, endeavour should be made to empty the stomach by an emetic or the stomach pump. Alcoholic and ammoniacal stimulants are given. Ether or atropine should be used hypodermically to antagonise the sedative effects of aconite on the heart and breathing. Warmth and infriktion into the chest-walls of some stimulating liniment also assist in maintaining cardiac and respiratory action.

MEDICINAL USES.—Aconite is more used by British than by German practitioners. Fröhner states that there are other safer febrifuges. Professor Cagny indicates its more general use in France, and characterises it as the grand vaso-motor sedative, slowing the circulation in acute fever. M. Kaufmann designates it a very precious febrifuge in the early stages of all internal inflammatory maladies, especially of the air-passages. Medicinal doses, as already stated, within ten or fifteen minutes **lower the pulse-beats** in force, and sometimes one-fifth in number, reduce abnormal **temperature**, and also appear to **lessen perception of pain**. The arteries being dilated, the capacity of the vascular system is increased, and, as Dr Fothergill aptly puts it, “the patient bleeds into his own vessels,” sometimes with consequent relief of limited inflammation. In virtue of these physiological actions, carefully regulated doses relieve pyrexia and **acute local inflammation** in robust patients, as in the earlier stages of pleurisy, enteritis, peritonitis, mammitis, lymphangitis, laminitis, and acute rheumatism. Acute sore-throat in horses, accompanied by high fever, is sometimes controlled by a moderate dose, followed at intervals of an hour by half-doses, repeated until five or six are given. In the more common epizootic sore-throat, accompanied, as it generally is, by typhoid symptoms, aconite is useless, and indeed injurious. Although serviceable in acute sore-throat, laryngitis, and pleurisy, it is too reducing a remedy to be used in most cases of bronchitis or pneumonia. Professor Williams recommends it in horses in pleurisy and also in pneumonia, where pyrexia is

considerable, but does not find it so serviceable in these complaints amongst dogs (*Principles and Practice of Veterinary Medicine*).

Conjoined with a purgative, aconite is sometimes prescribed in spasmodic colic. **In enteritis** in horses, Mr Hill of Wolverhampton has stated that, within five minutes after aconite tincture is swallowed, he has repeatedly found the pulse fall from 100 to 70 beats per minute, and this notable effect is usually succeeded by gradual abatement of fever and pain (*Veterinarian* for July 1871). Professor Robertson was wont to prescribe in enteritis ℥v. Fleming's tincture, and ℥ss. each of camphor and powdered opium, administered in a pint of gruel (*Equine Medicine*). Mr Richard Rutherford, Edinburgh, informs me that he finds aconite specially useful in **laminitis**. The patient, he urges, should be hobbled and thrown, especially when all four feet are affected. A full dose, followed by four or five half-doses, given at intervals of one to two hours, abates violent cardiac action, fever, and pain. In **acute rheumatism** it usually relieves both febrile symptoms and local pain. Mr Connachie, Selkirk, in the treatment of acute rheumatism, after a dose of physic conjoined with opium, recommends thrice daily, for either horses or cattle, ℥x. Fleming's tincture and a drachm of nitre. Repeated small doses are beneficial in the outset of **puerperal peritonitis** in cattle; and some flockmasters use aconite tincture with success during the lambing season, giving it with gruel to ewes which have a hard time, begin to blow, or show febrile symptoms. Conjoined with perfect quiet and a dose of physic, a few small doses of aconite have been used in the earlier stages of tetanus by Mr Thomas Dollar, London; by Mr Hill, Wolverhampton; and Mr Macgillivray, Banff (*Veterinarian* for 1871). In small, frequently repeated doses, either alone or with hemlock, it usually controls and steadies tumultuous, excessive, or irregular action of the hypertrophied heart, especially in plethoric patients. Although administered for other purposes, it frequently expels intestinal worms.

Paralysing sensory nerves, aconite is **used externally** as a local anodyne in neuralgic and rheumatic affections, and in swollen and painful joints. As with other anodynes, it is more

effective in combating irritative than inflammatory pain. It frequently relieves the itching of grease and other eczematous eruptions in horses and 'dogs. More rapid absorption and greater anodyne effect are secured by adding a little chloroform to the aconite tincture or liniment. The external use of aconite, it must be remembered, demands, however, as much care as its internal use.

Doses, &c.—The plant is not used in the crude state. The **extract**, unless very carefully made from an alcoholic solution, is apt to be of defective or irregular strength. The **B.P. tincture**, prepared from the root by digestion and subsequent percolation, and convenient alike for internal and external use, is occasionally of uncertain and insufficient strength, and, to prevent disappointment, should be obtained only from trustworthy sources. For horses, the dose varies from ℥xx. to ℥xxx.; for cattle, fʒss. to fʒi.; for sheep and pigs, ℥v. to ℥x.; for dogs, ℥i. to ℥v. **Fleming's tincture**, still much used in veterinary practice, is about four times as strong as the B.P. tincture, and, on account of its concentration, requires to be used very carefully. The dose for horses is from ℥iv. to ℥x.; for cattle, from ℥v. to ℥xii.; for sheep, ℥ij. or ℥iij.; and for dogs, from ℥ss. to ℥j. Whichever tincture is used should be given in several ounces of cold water. The effects of full doses sometimes continue for twelve or fifteen hours. Small and repeated doses are preferable to larger doses at longer intervals. The first may be a full dose, and may be followed by five or six half-doses, repeated, as the case appears to require, at intervals of from half an hour to two hours. The antipyretic effects which should thus be produced are usually kept up by salines and other treatment. Used hypodermically, less than half the above quantities suffice. Professor Walley finds that the activity of aconite is increased by giving it in combination with alkaline carbonates (*Veterinarian's Pocket Conspectus*).

Aconitina is one of the most potent of sedative poisons. Dr Headland (*The Action of Medicines*) records that $\frac{1}{300}$ th of a grain in solution in water suffices to destroy a mouse; $\frac{1}{100}$ th of a grain kills a small bird after a few minutes, and $\frac{1}{50}$ th almost instantaneously; $\frac{1}{20}$ th to $\frac{1}{10}$ th kills cats, the latter

quantity in twenty minutes or half an hour. Half a grain, given to a shepherd's dog weighing 30 lbs., began to operate in three or four minutes, and proved fatal in sixty-five minutes. The lethal dose for an adult man is $\frac{1}{50}$ th grain. Messrs Mavor and Burness subcutaneously injected over the scapula of a horse $\frac{1}{20}$ th grain, and noted in a few minutes champing of the teeth, salivation, fits of retching, and reduced number and force of the heart's action (*The Action of Medicines*).

Professors Frederick Smith and Charles Rutherford, of the Army Veterinary School, Aldershot, have kindly placed at my disposal the unpublished notes of four experiments made on healthy horses with B.P. aconitina. One grain of the alkaloid was dissolved in one ounce of water, and 10 minims, containing $\frac{1}{8}$ th grain, were injected hypodermically into the anterior region of the chest of two geldings. Within ten minutes there were produced biting and licking at the site of puncture, persistent shaking of the head, yawning, pawing; increase of pulse in one subject to the number of ten beats, in the other of two beats; no change of temperature occurred. The effects disappeared in one and a half hours.

Two horses had injections of 15 minims of the above solution with 15 minims of water, the dose containing $\frac{1}{32}$ nd grain of B.P. aconitina. The same effects resulted; but pawing and movements of the head were more marked; both subjects coughed and sneezed; while one occasionally belched, ground its teeth, and showed indications of pain; the pulse, previously 38 and soft, rose to 52 beats, and was firmer; there was no change of temperature, and no increased secretion from skin, bowels, or kidneys, and in about two hours the symptoms passed off.

These and other experiments indicate that for hypodermic use $\frac{1}{30}$ th to $\frac{1}{25}$ th grain of B.P. aconitina is a sufficient dose for the horse. As with other preparations, administered either hypodermically or otherwise, the effects may be increased and maintained by repeating the dose in about half the amount, three or four times, at intervals of half an hour or an hour. Safer and more effectual results would be obtained if the pseudo-aconitina present in the commercial aconitina, the tincture, and other preparations of the drug, and objectionable

on account of its depressing action on the breathing, could be got rid of or materially reduced.

ALCOHOL.

The more important mono-hydric alcohols used in medicine and pharmacy are:—

Methyl-	alcohol,	CH_3 .	HO,	from	distillation	of	wood.
Ethyl-	„	C_2H_5 .	HO,	„	fermentation	of	grape sugar.
Propyl-	„	C_3H_7 .	HO,	„	„	„	grapes.
Butyl-	„	C_4H_9 .	HO,	„	„	„	beet.
Amyl-	„	C_5H_{11} .	HO,	„	„	„	potatoes.

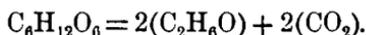
These alcohols are hydrates of the radicles of the methane or marsh gas series (CH_4). In their production the radicle has one of its atoms of hydrogen (H) displaced by an atom of the radicle hydroxyl (HO). Thus, methane (CH_4), losing one atom of H, and assuming one of HO, becomes CH_3HO , or methyl-alcohol, popularly known as wood spirit. Ethane (C_2H_6), losing one atom of H, and taking up one of HO, becomes $\text{C}_2\text{H}_5\text{HO}$, ethyl-alcohol, or spirits of wine. Each of these alcohols, when oxidised by removal of H_2 , in the form of a molecule of water (H_2O), yields an aldehyd; while by substitution of HO for H, the aldehydes are converted into acids. Thus, ethyl-alcohol ($\text{CH}_3\text{CH}_2\text{HO}$) is converted into aldehyd (CH_3COH), and thence into acetic acid (CH_3COOH). In each of the alcohols, moreover, the H in the HO can be replaced by an alcohol radicle, when an ether is formed; thus, ethyl-alcohol ($\text{C}_2\text{H}_5\text{HO}$) yields common ether ($\text{C}_2\text{H}_5\text{O.C}_2\text{H}_5$).

METHYL-ALCOHOL.—In the destructive distillation of wood, the distilled products separate into two layers, the lower consisting of wood-tar, the upper of impure methyl-alcohol, pyro-ligneous acid, acetone, methyl-acetate, and other bodies. On subsequent redistillation of the upper layer with chalk, the acetic acid is retained in the still as calcium acetate (p. 190). The distillate is the yellow empyreumatic **wood naphtha**, now largely used for making varnishes. Methyl-alcohol is also prepared in large quantities from beet-sugar refuse. Repeated distillation and treatment with quicklime remove acetone,

higher ketones, and malodorous pyroligneous substances, leaving methyl-alcohol, which, when pure, closely resembles ethyl-alcohol.

It has many of the properties, and is applied to many of the purposes of ethyl-alcohol. It is very inflammable, burning with a pale flame, has a specific gravity of .799, boils at 140° Fahr., and has an empyreumatic odour, depending upon the presence of oily matters. From ethyl-alcohol it is distinguished by heating with sulphuric acid and potassium bichromate, when it yields formic acid; while ethyl-alcohol, similarly treated, yields acetic acid. Silver ammonia nitrate, when warmed with formic acid, is reduced to the metallic state, but it is not affected by acetic acid.

ETHYL-ALCOHOL is found in small amount in some unripe fruits, in coal-tar, and other products of the distillation of wood, while traces have been distilled from the bodies of rabbits and other animals which have never tasted alcohol, but in which it is probably formed by the breaking up of hepatic sugar (Phillip's *Materia Medica and Therapeutics*). It can also be got synthetically. It is chiefly obtained, however, from the fermentation of glucose or grape sugar ($C_6H_{12}O_6$). Starch ($C_6H_{10}O_6$), contained in barley, maize, rice, and other grains, or in potatoes, is the cheapest source of sugar, and hence of alcohol. When heated with very dilute sulphuric acid, or mixed with infusion of malt, starch takes up a molecule of water (H_2O). By a similar appropriation of water, cane-sugar, which is not directly fermentable, is converted into grape-sugar ($C_{12}H_{22}O_{11} + H_2O = 2[C_6H_{12}O_6]$). The saccharine solution is treated with **yeast**—the *torula cerevisiæ*, which finds fitting nutriment in the albuminoid materials present in ordinary sugars, rapidly multiplies, and decomposes about 95 per cent. of the glucose into alcohol and carbonic acid:—



There are, besides, produced traces of glycerine and succinic acid. The action of the yeast is stopped when the alcohol reaches 20 per cent., and fermentation does not occur below 32° or above 95° Fahr.

The weak, impure spirit thus obtained, when concentrated

and purified by repeated distillation, attains the specific gravity $\cdot 825$, which, according to British Excise standard, constitutes alcohol or pure spirit. Seven to ten per cent. of water are still, however, retained, which, though inseparable by distillation, may be removed by digestion with such water-absorbing bodies as potassium carbonate and quicklime, and subsequent cautious distillation. **Absolute** alcohol thus obtained is a mobile, colourless fluid, with a spirituous odour, an intensely fiery taste, and the specific gravity $\cdot 795$. It is entirely volatile, burns without smoke, boils at $78\cdot 3^{\circ}$ Cent., and freezes at $130\cdot 5^{\circ}$ Cent. It has great affinity for water, takes it from any substances with which it is in contact, and thus exerts its notable power of preserving both vegetable and animal matters.

The tests for ethyl-alcohol are two—(1) Add to the suspected liquid hydrochloric acid, and sufficient potassium bichromate to colour it orange yellow, and boil. If alcohol is present the fragrant odour of aldehyd will be perceived and the liquid will become green from production of chromic chloride (Cr_2Cl_6). (2) The liquid is gently warmed, a little solid iodine is added and weak potash solution, until bleaching occurs on stirring; iodoform in yellow crystals is precipitated, identified by its saffron-like odour.

RECTIFIED SPIRIT (*spiritus rectificatus*), or spirit of wine, are the terms applied to the alcohol obtained from distillation of fermented saccharine fluids. It contains 16 per cent. by weight, or 11 per cent. by measure, of water, and has the specific gravity $\cdot 838$. To absolute alcohol it bears general resemblance, but has less pungency and volatility, and a higher boiling point. It dissolves iodine, bromine, oils, gum-resins, most alkaloids, most deliquescent salts, excepting potassium carbonate, but not efflorescent salts, nor salts sparingly soluble in water. It is used for making all the spirits, and a large number of the tinctures and extracts of the *Pharmacopœia*.

PROOF SPIRIT, the *spiritus tenuior* of the B.P., is directed to be made by mixing five pints of rectified spirit with three pints of water. Thus prepared, it is freer from impurity than the weak, imperfectly rectified spirit of the shops; it contains 49 per cent. by weight, or 57 per cent. by volume, of absolute

alcohol, has the specific gravity of $\cdot 920$, and is used for the preparation of many tinctures. The specific gravities of spirits and other such fluids are generally determined with a hydrometer or with marked beads.

Methylated spirit is a mixture of 90 parts of rectified spirit with 10 parts of the pungent, disagreeably flavoured wood spirit or impure methylic alcohol. This mixture is unfit for drinking, and is sold free of duty for pharmaceutic and other manufacturing purposes.

The following alcoholic fluids, employed dietetically and medicinally for man, are occasionally also prescribed for the lower animals:—**Wine**, the fermented juice of the grape, contains from 8 to 17 parts by volume of Excise alcohol ($\cdot 825$), and owes its peculiar bouquet to traces of fragrant ethers. **Brandy**, prepared by distillation of the weaker wines, contains about 53 per cent. of Excise alcohol. **Rum**, a fluid of about the same strength, is made by distillation of a fermented solution of molasses. **Whisky**, of similar strength, is obtained by distilling a thoroughly fermented solution of malt, or of malt and raw grain; while **Hollands**, **Geneva**, and **Gin**, a little weaker than these, are prepared from fermented malt, with a small quantity of juniper berries. **Ales** and **Porter** are made by infusing malt in water at about 180° Fahr., allowing it to stand for a few hours until the starch is in great part converted into dextrin and sugar, boiling the solution with the requisite hops, and adding yeast to cause fermentation, which, however, must be carefully prevented from going too far. The dark colour of porter depends on a part of the malt being roasted. Porter and ales contain between 4 and 8 per cent. of Excise alcohol.

PROPYL-ALCOHOL, or ethyl-carbinol, is obtained from the later portions of the distillate in the rectification of crude spirits of wine.

BUTYL-ALCOHOL is got from the fermentation of beet-sugar refuse, and also from the distillation of crude spirits.

AMYL-ALCOHOL or fusel oil is present in all crude ethyl-alcohols, is specially obtained from the distillation of potatoes, and is distinguished by its offensive flavour. It is sparingly soluble in water, but readily dissolved in other alcohols, ether,

and essential oils. When oxidised, it yields valerianic acid. It is used for the manufacture of amyl-nitrite.

ACTIONS AND USES.—The monobasic alcohols, according to dose and concentration, are local irritants, refrigerants, mild astringents, and antiseptics. They are diffusible, and readily absorbed, and their in-contact effects are produced on a wide range of organs. Large doses paralyse the nerve-centres, and kill by respiratory arrest. Full doses, especially when given repeatedly, impair the oxidising power of the blood, and hence diminish metabolism. Medicinal doses are diffusible stimulants, and are prescribed as carminatives, antispasmodics, and cardiac excitants. Ethyl-alcohol is a readily assimilable food, and hence a restorative and tonic; it is antiseptic, antithermal, and antipyretic. Causing a fuller stream of blood to circulate through the glands, it increases their secretions, notably that of the kidneys, by which the unassimilated portions of the drug are chiefly excreted. Both ethyl and methyl alcohols are used as preservatives of vegetable substances, and pharmaceutically as solvents.

GENERAL ACTIONS.—Ethyl and methyl alcohol in tolerably concentrated solution withdraw water from albuminoid solutions, and precipitate them. Applied to the mucous surfaces, or to the skin, they act in a similar manner, precipitating a thin white pellicle of albumin, and thus exerting irritant and slight **astringent** effects. Owing to their evaporation when applied to the skin they cause a **sensation of cold**; but if evaporation be prevented by a covering of oiled silk, they pass through the skin, inducing a sensation of warmth. When swallowed, a similar warming effect is produced in the mouth and stomach.

Ethyl-alcohol is the variety almost invariably given internally. If not too concentrated, it is **readily absorbed** through any of the ordinary channels of administration. Orfila poisoned dogs by causing them to breathe air charged with it. Being highly diffusible, it quickly enters the blood. It appears to form with the hæmoglobin a compound of diminished capacity to take up and give off oxygen. Full or large doses, accordingly, **interfere with oxidation** of blood and tissue. Its effects vary considerably with the dose and its concentra-

tion. It quickens circulation, increasing the strength as well as the frequency of the pulse. The functions of **nerve-centres generally are stimulated**, causing sometimes a slight temporary rise of external temperature, seldom exceeding, either in man or animals, half a degree. Quickly, however, there follow dilatation of cutaneous vessels, and consequent lowering of temperature.

Observations on various classes of animals demonstrate that alcohol in full doses **lowers animal temperature**. This mainly results from (1) lessened oxidation; (2) increased circulation, and consequent increased evolution of heat; and (3) vaso-motor paresis. As with most of the other effects of alcohol, the lowered temperature is not, however, of long duration. Magnan has shown that puppies lose 3° to 7° Fahr. when alcohol was added to their food. "The experiments of Binz and Bouvier on septicæmic fever in animals gave singular results. In rabbits, for instance, after injecting septic fluid, and inducing a febrile reaction ranging from 102° to 105° Fahr., about three drachms of alcohol diluted with water were introduced into the stomach by means of a sound; fifteen minutes afterwards the temperature was 104.1° , in forty-five minutes 102.4° , in ninety minutes 100.9° , in two hours and a half 100.6° Fahr. The following day the pyrexia returned, and increased till the death of the animal. Very large doses lower the temperature as much as 8.5° Cent., and if narcosis was induced before fever began, quite prevented its development" (Phillip's *Materia Medica*). Dr B. W. Richardson's experiments also show that doses sufficient to cause unconsciousness dangerously reduce temperature of birds to the amount of 5° , of dogs 3° , of rabbits 10° , and of man himself 2° to 3° Fahr. (Cantor Lecture, 1874).

Digestion and nutrition, although injured by large, are improved by small doses. Small or even moderate quantities diminish the discharge of carbonic acid from the lungs, check metabolism, and increase secretion of urine. Mere traces are removed by the lungs, skin, and kidneys, but by far the **larger proportion undergoes combustion** in the body, and, like other hydrocarbons, and especially when used with suitable food, alcohol proves a **source of heat and vital**

energy. Schulinus' experiments on these points are conclusive, and have been repeatedly verified. Animals receiving measured quantities of alcohol, so soon as full effects were produced, were killed by bleeding and insoufflating air into the vessels. Fractional distillation of the blood and viscera were made separately, and repeated investigations have demonstrated—(1) that alcohol in small or moderate quantity does not localise itself in any particular organs, such as the brain or liver, but diffuses itself equally in the system; (2) that only the blood contains proportionately more than other tissues; (3) of the alcohol taken, the greater part is decomposed within the organism, and the amount eliminated by the lungs, skin, and kidneys is insignificant (Phillips). Professor Binz' experiments show that not quite three per cent. of moderate doses is excreted unchanged.

The dietetic value of alcohol has been the subject of much controversy. Its consumption in great part within the body explains how men and animals kept on somewhat deficient diet, on which weight would be lost, nevertheless maintain their weight, when receiving, in addition, daily small doses of alcohol. But for ordinary nutrition it is a food which, although quickly assimilated, is rapidly used up, and, unless carefully employed, has the disadvantage of impairing oxidation and excretion. For permanent repair of waste, and maintenance of strength during severe continued exertion, it cannot compare with suitable food. This was strikingly illustrated in the Ashantee War, when soldiers, on exhausting marches, who received rations of rum, although temporarily recruited, soon flagged again; while those receiving beef-tea were equally refreshed in the first instance, and did not experience the secondary depression which overtook those who preferred the spirits.

Different classes of animals are somewhat differently affected by alcohol. Man, whose intellectual centres are about eight times larger than his motor centres, has his intelligence quickly acted on by doses which are insufficient to impair his motor functions. Amounts corresponding to 0·4 to the 1000 of the total weight of the body disturb human intelligence; while 2·40 per 1000 of weight are needed to

impair motor functions. In dogs the cerebral are about five times the weight of the motor centres. Alcohol has no notable effect until 1·5 to the 1000 of body weight is taken, and the prominent results then occurring are disturbance, not of intelligence, but of motor function. Horses and cattle receiving full doses exhibit like excitement and perversion of motor function; they prance, strike with the feet, are unsteady in their gait, and drag the hind limbs. Muscular twitching and convulsions occasionally occur.

Toxic Actions.—Large doses paralyse the nerve-centres in the inverse order of their development, the cerebral being first affected, the cardiac and respiratory last. Their effects are generally divided into four stages—(1) stimulant, (2) narcotic, (3) anæsthetic, and (4) paralytic. With ethyl-alcohol these stages are usually distinctly marked. With methyl-alcohol the excitement is more intense, the subsequent stages follow more rapidly; but if the doses are not lethal the effects pass off more quickly. With cœnanthic and caprylic, which are non-fermented alcohols, the stages are less regular, and are marked by convulsions. Ethyl or methyl alcohols are not so deadly as most of the others. Their toxic dose is 8 grammes to the kilogramme of the live weight of an animal. The toxic dose of propyl-alcohol is 3·9 grammes; of butyl, 2·0 grammes; of amyl, 1·7 grammes (Brunton). The toxic dose of all crude spirits is less than that of the same spirit after rectification, and such impure spirits produce greater excitement and heavier stupor.

Large concentrated doses produce rapid narcosis with a minimum of preliminary excitement. Hertwig gave an old but sound horse eight ounces of ethyl-alcohol of specific gravity ·825. He became much excited and uneasy, pranced, staggered, and after two minutes fell, struck out vehemently with his feet, rolled his eyes—the pupils at first were contracted, but afterwards were dilated. He rapidly became insensible, and died in about ten minutes. The heart continued to beat for several minutes after death. Four to six ounces produced similar motor excitability, but did not prove fatal (*Arzneimittellehre*).

Dogs about 20 lbs. weight, swallowing quickly four or five

ounces of whisky, if it is retained, speedily and without any appreciable excitement become comatose, and die within a few minutes. Dr Percy injected strong alcohol into the empty stomachs of dogs, which almost immediately fell over insensible; respiratory and cardiac movements ceased within two minutes; the blood was found charged with alcohol. Similar sudden fatal paralysis occurs in men swallowing quickly full draughts of spirits (*Christison On Poisons*). Dogs receiving one to two ounces of rectified spirit, when the œsophagus is ligatured, become uneasy, endeavour to vomit, are unable to control their movements, become comatose, and die in periods ranging from a quarter to half an hour. One to two drachms induced in dogs reeling and stupor, which continued for about half an hour. Dr George Harley found that half an ounce of alcohol, with an equal quantity of water, injected into the portal vein of dogs, so seriously interfered with the glycogenic functions of the liver that the urine within three hours became diabetic.

Cattle and sheep, and indeed all ruminants, are less susceptible to the actions of alcohol than dogs or horses. Hertwig mentions that when brandy is given to sheep and goats, they soon become fond of it, taking six or eight ounces at a time, and gradually becoming less easily affected by it.

Chronic poisoning by alcohol, with impaired nervous power and fatty degeneration, common in human patients, is unknown in the lower animals; but Professor John Gangee describes (*Domestic Animals in Health and Disease*) a form of encephalitis in cattle, resulting from alcoholism, due to the practice, "prevalent in some parts of Scotland, of giving 'burnt ale' to cows in the neighbourhood of distilleries. The ale is given by steeping straw in it, and the animals will also drink it freely. They often sleep soundly after such a beverage, and intoxication is not infrequent. The symptoms are as follows:—The head is turned singularly to the side, and is slightly elevated. The pupils are widely dilated, and the eyes have a remarkably wild appearance. On approaching the animals they wink rapidly and tremble. There is marked heat of head, horns, and ears. When pressed with the finger in the axilla, they fall instantly, and when pulled by the head they incline to

turn over. The pulse is about seventy or eighty per minute. After death all the organs are found healthy except the nervous centres, and both the brain and its membranes are found congested. This congestion often extends into the spinal canal, and the pia mater over both brain and cord is the seat of red spots; the redness is either ramified, or is obviously due to blood extravasation. Clots of blood have been found in the lateral ventricles, and around the spinal marrow in the cervical region. There is evidently softening of the brain substance, as a direct result of this condition." At distilleries, where the live stock are freely supplied with the dreg or wash and other refuse containing spirit, pigs, as well as cattle, are frequently intoxicated, exhibit symptoms similar to those described, and are sometimes fatally affected.

The antidotes are tea and coffee, cold douches, and other means of warding off the deadly stupor. Strychnine and alcohol are mutually antagonistic, and alcohol, used hypodermically, restores rabbits apparently dead from the alkaloid.

MEDICINAL USES.—Few remedies are more frequently and extensively used than the several forms of ethyl-alcohol. **They stimulate** gastric secretion, and improve appetite in atonic indigestion; they act as carminatives in flatulence; control the spasms of intestinal colic; and check persistent diarrhoea, especially when they are conjoined with sodium benzoate or vegetable astringents. They equalise irregular circulation in chills, and antagonise cardiac feebleness, especially of a temporary character, such as results from debilitating disease, poisoning by sedatives, snake-bite, or shock. Many cases of milk fever in cows, when stupor is approaching, or even during the earlier excitable stages, are benefited by five or six ounces of whisky, given at intervals of one to two hours. Where such draughts cannot be swallowed, they are sometimes introduced into the rumen by a stomach syphon or pump; but where coma has set in the stimulation needful to maintain heart and respiratory action is best effected by subcutaneous injection of ether.

In **epizootic catarrh** and **sore-throat** amongst hard-worked horses, when the pulse is quick and weak, the breathing hurried and embarrassed, and the temperature above 102° Fahr.,

no treatment is more successful than a couple of ounces of spirits, diluted with gruel or water, repeated every two or three hours; a saline draught administered thrice daily; the body well clothed, and mustard, if need be, applied to the throat. Many cases of bronchitis and pneumonia, after a few days' illness, and especially during the period when inflammatory products are being absorbed, are benefited by moderate, frequently repeated doses of spirits. The restorative sustaining power of alcohol in the second stage of such disorders is well illustrated by a case of double pneumonia communicated to me by Mr Israel Print of Clapham. The horse, seen after forty-eight hours' illness, was in a state of serious distress and prostration; his pulse 100, and scarcely perceptible; his respirations 52; his temperature 106° Fahr. He was ordered a wine-glass of whisky every two hours, and took 27 ounces in twenty-four hours. His pulse had then fallen to 84, his respirations to 46, his temperature to 104° Fahr. The frequent doses of spirit were persevered with for another day, with continued abatement of fever and distress, and the animal made a good recovery.

The **antiseptic, antithermal, and antipyretic** actions of alcohol are notably exhibited in septicæmia and pyæmia, howsoever produced. This is well illustrated by an experiment of Professor Binz, who produced septic fever by injection of pus in two young healthy dogs of equal weight, one of which, treated with three doses of two drachms of alcohol introduced into the stomach, shortly recovered, while the other, which remained without treatment, died on the second day. His experiments with rabbits, above quoted, also testify to the notable antipyretic effects of alcohol. Not only does it lower exalted temperature, but in such cases it also helps to maintain the failing cardiac action, and tides over critical nervous depression. It is hence serviceable in horses fevered and enfeebled with protracted strangles abscesses, and reduced by purpura; in all animals suffering from puerperal metritis; and in dogs exhausted from distemper; as well as in most other forms of blood poisoning. During **convalescence from reducing disorders**, as well as in chronic cases connected with malassimilation, alcohol is serviceable in all classes of patients as a gastric

and general stimulant, and a readily assimilable food. Anæmic subjects are frequently treated with sound ale or spirits and water, conjoined with iron salts. Tubercular patients are often benefited by alcoholic drinks and oleaginous food.

The more important medicinal **effects follow within ten or fifteen minutes after administration.** There is hence little difficulty in determining whether the remedy proves beneficial or the dose is suitable. As already indicated, the weak pulse should become stronger and firmer, the quick pulse slower, breathing should be more natural, the skin more moist, and temperature lower—in a word, there should be remission of the more prominent morbid symptoms. If such favourable conditions are not produced, the alcohol is probably not the suitable remedy, or is not being used in suitable dose. When **unsuitable**, or given too frequently or too largely, whether in health or disease, alcohol hinders oxidation, retards excretion, impairs digestion, and causes dryness of skin and mucous surfaces.

Alcohol **resembles** in its actions and uses the volatile oils, ethers, and ammonia, and is frequently prescribed with one or more of these allied remedies.

EXTERNAL USES.—Rubbed into the skin, alcohol, in a state of concentration, acts as a **rubefacient**. Coagulating albumin, it is occasionally applied to **arrest bleeding**. Beat up with white of egg, it is used in veterinary as well as in human practice to harden the epidermis and prevent excoriation of parts exposed to pressure. Weak solutions, conjoined with a half to one per cent. of carbolic or salicylic acid, exert **anodyne** effects, relieving itching in erythematous and other skin diseases. Nettle-rash is often treated with dilute spirituous solutions, to which one per cent. of petroleum benzene is usefully added. For surgical purposes it is employed as a **refrigerant** and **antiseptic**. Dr Jonathan Hutchinson keeps amputations, compound fractures, and other wounds moist with six parts absolute alcohol, half a part liquor plumbi, and sixteen parts distilled water. As a stimulant and refrigerant for bruises, wounds, and strains, it is popularly used throughout Scotland in the familiar form of whisky and water. A cooling lotion is made with an ounce each of rectified spirit,

vinegar, and ammonium chloride, dissolved in a quart of water. As a refrigerant, ice, however, is generally more convenient and effectual. A convenient, well-keeping solvent for the active principles of many drugs, alcohol is largely used for making tinctures and extracts.

Doses, &c.—Of rectified spirit horses take about $f\bar{z}i$; cattle, $f\bar{z}j$. to $f\bar{z}ij$.; sheep, $f\bar{z}ss$.; pigs, $f\bar{z}ij$.; and dogs, about $f\bar{z}j$., diluted with six or eight parts of water or other bland fluid. Whisky, gin, and brandy, as already indicated, are about half the strength of rectified spirit; sherry and port, sometimes prescribed for foals, calves, and dogs, are about one-third the strength of whisky; while good ale is about half the strength of these wines. The suitable doses and the frequency of their repetition are mainly determined by the condition of the patient, and the purpose they are intended to serve. They act promptly, but their effects are transient, and require to be maintained by frequent doses, repeated, in critical cases, at intervals of one or two hours. They are less apt to excite or disagree if administered along with food. Properly diluted, they are voluntarily drunk by most patients. Mixed with linseed gruel, there is little risk of their misappropriation.

To **determine or intensify** one or other of the effects of alcohol, it is often conjoined with other medicines—with ether or ammonia, when more prompt and powerful stimulation is desired; with opium or chloral hydrate, when anodyne effects are required, or spasms are to be combated; with digitalis, when the full effects of a cardiac tonic and stimulant are sought; with ammonium acetate, when diaphoresis is to be encouraged; with red cinchona or coto barks, creosote, or sodium benzoate, when antiseptic and astringent effects are to be produced on the intestine.

ALOE S.

ALOE.—Inspissated juice from the transversely-cut bases of the leaves of various species of Aloe. *Nat. Ord.*—Liliacæ.

ALOIN, $C_{18}H_{18}O_7$.—A crystalline substance extracted from aloes by solvents and purified by recrystallisation. (B.P.)

The several species of **Aloe**, which yield the various commercial aloes, are succulent liliaceous perennials, having short

woody stems; strong, thick, fleshy, amplexicaul light-green leaves, with sharp serrated edges, and a stout spine projecting at the apex; while on a slightly branched scape are carried a raceme of yellow, scarlet, or white tubular pendulous flowers. Underneath the leathery cuticle, and exterior to the loose mucilaginous pulp, lie elongated thin walled cells, which contain the yellow, bitter, purgative juice. Somewhat different processes are pursued in extracting and concentrating this juice. The better qualities exude spontaneously from the base of the cut leaves. The results are inferior when the leaves are exposed to pressure, which mixes the mucilaginous sap of the mass of the leaf with the cathartic juice, or when a high temperature is used in concentrating the juice.

The Pharmacopœias recognise Barbadoes and Socotrine aloes, while a Cape variety is sometimes used.

BARBADOES ALOES.—Aloe *Barbadensis*, sometimes called Curaçoa aloes, is the variety chiefly used in veterinary practice, and the product of the *Aloe vulgaris*. It is exported from Barbadoes and most of the West Indian islands. A dwarf variety is cultivated; the leaves, measuring one to two feet in length, are chopped off close to the stem; are placed for twelve to twenty hours in tubs with their cut ends down; from the longitudinal vessels the juice trickles, is collected in casks, and heated for four or five hours, sediment and impurities being carefully kept back. When sufficiently concentrated, the juice is poured into gourd shells, and the opening closed by a portion of shell let in, and secured in its place by a piece of coarse cloth nailed over it. The gourds, when filled, usually weigh from 10 to 40 lbs.; and fully 2000 of these, with a quantity of the drug in boxes, are annually exported from Barbadoes alone. The total export exceeds 1000 cwts., most of which comes to Great Britain. The price ranges, according to quality, from £4 to £9 per cwt. Barbadoes aloes has a liver-brown colour; a brown, opaque, earthy fracture; a disagreeable, bitter, persistent taste, and a strong and disagreeable odour, especially when breathed upon—an odour generally likened to that of the human axilla. It is tough, hard, and difficult to pulverise; small fragments are translucent, and of an orange-brown hue; its powder is dull olive-yellow, and

darker than that of other varieties. It is almost entirely soluble in proof spirit.

SOCOTRINE (also known as East Indian, Bombay, or Zanzibar aloes) is chiefly imported from Bombay and other Indian ports. It is stated to be yielded by the leaves of *Aloe Perryi*, and is probably also got from other species. It occurs in red-brown pieces of variable size; darkens on exposure; breaks usually with a smooth resinous fracture; thin fragments are translucent and orange-red or orange-brown; the odour, though strong, is somewhat agreeable; the taste very bitter.

CAPE ALOES (brought from Cape Town and Natal) is chiefly got from the *Aloe ferox*, *Africana*, or *Spicata*, or from hybrids obtained by crossing these and other varieties. The better qualities have a dark-brown or olive-green resinous appearance, a compact structure, a vitreous, conchoidal, dark-green fracture, and a strong and rather disagreeable sour odour. They are very brittle, and easily reduced to a gamboge-yellow powder. The better qualities of Cape, although sold at less than half the price of Barbadoes aloes, are little, if at all inferior to them or to Socotrine. Mr Joseph Gamgee's experiments showed that, compared with Barbadoes, they cause equally copious but less watery discharges, while their action was not quite so long kept up (*Veterinarian*, April 1856).

CABALLINE OR HORSE ALOES usually consists of the residue left from the purification of more valuable sorts. It is black, vesicular, and bituminous, lacks the compact structure of the better kinds, usually contains such impurities as straw, bark, stones, and sand, and should be discarded from veterinary practice.

PROPERTIES.—The several varieties have a specific gravity of 1.364, are resinoid, rather brittle, their external surface is duller and darker than a freshly-made fracture. The temperature at which the juice is concentrated accounts for such marked differences in opacity, as the dull opaque Barbadoes and the translucent East Indian. All have an intensely bitter and persistent taste, and a strong and more or less disagreeable odour, much increased when the specimen is breathed on or heated. When held in the hand for some minutes, aloes softens and becomes adhesive. At a low red-heat it is partially fused,

froths up, chars, and burns. Temperatures exceeding 150° Fahr. alter its composition and impair its purgative property. Moistened with rectified spirit, a thin stratum, examined under the microscope, exhibits numerous crystals. It is almost entirely soluble in boiling water, which deposits, however, as it cools, 60 to 80 per cent. of a brown resin. Good specimens are almost entirely soluble in proof spirit. The watery solution, when cold, reddens litmus, is deepened in colour by alkalis, blackened by ferric chloride, and yields a yellow-grey precipitate with lead acetate.

COMPOSITION.—The Messrs T. & H. Smith of Edinburgh, who have thoroughly investigated the composition of aloes, have isolated from 25 to 30 per cent. of an active yellow, crystalline, neutral bitter principle—**aloin**, which is noticed more in detail at the end of this article; and about the same proportion of an equally active, soluble, uncrystallisable aloin, into which the crystallisable form is convertible by heat, much in the same way as uncrystallisable treacle is formed during the careless manufacture of crystallisable cane-sugar. A pale-yellow, mobile, mint-flavoured **volatile oil**, of which an ounce only is obtained from 400 lbs. of aloes, imparts its characteristic odour. Besides mineral matters and albumin, aloes further contains about 30 per cent. of a transparent **brown resin**, deposited from watery decoctions as they cool, almost entirely soluble in rectified spirit, occurring in large amount in inferior samples, in which it is formed at the expense of the aloin, usually by exposure of the juice to high temperatures during inspissation. This resin possesses little purgative activity.

ACTIONS AND USES.—Aloes is purgative; small doses, insufficient sensibly to increase the action of the bowels, are bitter tonics; applied externally, it is stimulant and desiccant.

GENERAL ACTIONS.—Given by the mouth, it is dissolved in the gastric fluid, and emulsionised and saponified by the bile and pancreatic juices. Mr Joseph Gamgee, sen., made seven drachms of Cape aloes into a ball with sixty minims of glycerine, rolled it in tissue paper, and gave it to a horse, which, thirty-three minutes later, was killed by dividing the carotid artery. An hour after the ball was found entirely dissolved; the distinct odour of aloes in the stomach and

duodenum had not, however, extended to the large intestines. Aloes **enters the circulation**, communicates its bitterness and purgative properties to the milk and other secretions, and is **excreted** chiefly by the intestinal glandular apparatus, and also in less amount by the kidneys, when it causes diuresis. It is prone to cause hyperæmia of the kidneys, uterus, and pelvic organs. While in contact with the intestine it produces both **peristalsis and increased secretion**. It acts notably on the **large intestines**, which explains in part its rather slow effects. It causes copious but not such fluid discharges as full doses of salines, gamboge, or croton. It is not so irritant as croton, colocynth, elaterium, or podophyllin. Even after repeated doses it is less liable than most other cathartics to lead to constipation. It **increases the secretion of bile**. Professor Rutherford introduced aloes into the duodenum of a fasting dog, and found that, although only slight purgation ensued, all the bile constituents were increased. It is said to produce evacuations which possess a peculiar disagreeable odour (Hertwig).

Six drachms of Barbadoes aloes, dissolved in twenty-four ounces of water, and injected into the jugular vein of a horse, caused nausea, frequent straining, and efforts to dung, colic—which, however, was only of short duration—and, after twelve hours, purgation. When injected into the veins, it sometimes acts on the kidneys rather than the bowels. Moiroud injected four drachms, dissolved in diluted alcohol, into the veins of a horse, and next day eight drachms, dissolved in a similar manner; but instead of catharsis, observed only diuresis.

The several varieties differ somewhat in the degree of their action. Barbadoes, although the most expensive, is generally preferred by veterinarians. It is the most active and uniform in its effects, nor does it seem to be more drastic than the Socotrine, while it is certainly less liable than the Cape to produce diuresis. Every sort is most effective when freshly powdered, and hence, except for immediate use, should be kept in pieces, preserved from moisture in oiled silk or in tin canisters. A temperature approaching 150° Fahr. applied, whether in the extraction of the juice, or in making it up for use, impairs activity by converting the active aloin into inert resin.

In the horse, a cathartic dose generally causes in a few hours dryness and increased warmth of the mouth; an advance of one or even two degrees in temperature occasionally occurs; the pulse is somewhat quickened; nausea, colic, and copious secretion of urine may result. Such diuresis occurs sometimes with good Barbadoes aloes, especially when the bowels are constipated, and more commonly with inferior specimens of Cape and other kinds, in which the aloin has been converted into resin. Combination with jalap, calomel, or other purgatives, usually counteracts this diuretic tendency. Combination with ginger or other aromatics, or with hyoscyamus or belladonna, wards off nausea and tenesmus. The purgative effect is usually accelerated and increased by giving the drug in solution, or conjoined with oil or calomel.

The time required for the operation of aloes differs considerably in different horses, being modified by various circumstances, especially by the previous feeding. Four to six drachms generally **operate in sixteen to twenty-four hours**. The degree and continuance of the action are also liable to variation; in some horses purging is over in two or three hours; in others it extends over twenty-four hours. Where aloes fails to move the bowels, it is seldom wise to prescribe another dose until forty-eight hours have elapsed. A second too closely following dose is liable to cause nausea or superpurgation. Meanwhile, if further physic is believed to be absolutely necessary, oil and a little calomel are preferable to more aloes, and enemata should be diligently used. In order to prevent superpurgation, which even ordinary doses of aloes and other cathartics occasionally produce in horses, it is important, until the physic has set, that the amount of cold water drunk be carefully regulated, and that the animal, although getting a little walking exercise, shall not be put to work. Neglect of such precautions is liable to produce not only superpurgation but enteritis and laminitis.

Ruminants are neither promptly nor powerfully purged by aloes. When given to cattle, even in the fluid state and in doses of several ounces, it fails to produce copious evacuations, such as are obtained in the horse. Hertwig mentions that, in an experiment made at the Veterinary School of Lyons, a cow

got six ounces of aloes, partly in solution, partly in electuary ; but although uneasiness and loss of appetite were observed, the bowels remained unmoved. Gilbert also gave six ounces, with an infusion of four ounces of senna leaves, without effect. Sheep and goats take doses varying from two drachms to an ounce without being speedily or certainly purged. This tardy and uncertain effect mainly depends on aloes acting particularly on the large intestines, which are not so developed in ruminants as in horses ; and on its notable increase of peristalsis, which is difficult to excite in ruminants.

For the dog, aloes, when given alone, is neither so speedy nor so safe a cathartic as calomel and jalap, or castor oil. It has also the disadvantage of occasionally producing irritation of the rectum ; but this may, in great part, be overcome by combining it with other purgatives. The dose required to purge a dog is large as compared with that administered either to human patients or to horses. The doses of most medicines for men and dogs are very similar ; but man is purged by an eighth or tenth of the aloes requisite to physic the dog. Aloes is a good purge for **swine**, but usually takes about twelve or fifteen hours to operate.

MEDICINAL USES.—Aloes is the **purgative in general use for horses**. In dyspepsia, where the appetite is capricious, the bowels irregular, the coat staring, or where there is itching and fulness of the limbs, a dose of aloes is prescribed, generally followed by salines, acids, or bitters. In torpidity of the bowels it is conjoined with nux vomica, which stimulates peristalsis. In flatulent colic it is prescribed either in bolus or rubbed down with hot water, and in either case there should besides be given volatile oils, ethers, ammoniacal or other antiseptics and stimulants. In spasmodic colic, it is also used with stimulants and anodynes. Professor Dick was wont to recommend four or five drachms of aloes dissolved in a quart of hot water, and given with an ounce each of oil of turpentine and laudanum. Some bad colic cases are relieved by conjoining with the aloes twenty to thirty minims of B.P. tincture of aconite. In obstinate torpidity, physostygmine, conveniently given hypodermically, promptly produces copious evacuations. When the bowels are overloaded with indigestible food, aloes is

frequently given, but linseed oil and calomel are generally preferable. Whatever physic is used, enemata should, however, be thrown into the colon with an extra long tube, in quantities of six or eight gallons (p. 156). Alike in obstruction, obstinate torpidity, and serious cases of colic, these copious enemata introduced into the large intestine are very important adjuncts. The bitterness and power of increasing peristalsis render aloes useful as an **anthelmintic**. In such cases it is administered with oil of turpentine, ether, santonin, sometimes with iron or copper sulphates. Although aloes is effectual in sweeping out excess of bile lodged in the intestines, it is unsuitable in jaundice or torpidity of the liver, in which the bile requisite for its prompt solution and emulsifying is deficient. In such cases, salines, oils, and calomel are preferable, or the aloes may be prescribed with ox bile, which greatly assists its action.

Aloes **purges both the bowels and the blood**. It promotes excretion of waste products, and hence usefully relieves febrile symptoms, rheumatic attacks, skin irritation, swollen limbs, and inflamed joints. It is effectual alike in preventing and curing lymphangitis; while it also hastens the removal of cedematous swellings, when not depending upon debility or serious disease of internal organs. Removing excreta, and withdrawing, by a species of derivation or counter-irritation, blood from congested or inflamed parts, it relieves irritation and inflammation of the brain and spinal cord, full doses being usually requisite; while it is also serviceable in the onset of paralysis, especially in subjects in gross or high condition, or suffering from gastro-intestinal derangement. Repeated doses lessen the formation of superfluous blood and fat, are given both professionally and empirically to promote condition—an object usually, however, more safely and effectually secured by judicious feeding and well-regulated exercise.

Among cattle and sheep, in constipation and indigestion, as well as in febrile and inflammatory complaints, aloes is occasionally given; but, as already stated, it is less reliable than for horses. If used for ruminants, it should be combined with salines, gamboge, or croton, and given in the fluid form. For **dogs** it is sometimes prescribed in the same class of cases in which it is given to horses; but calomel and jalap, or some

of the oils have the advantage of acting more speedily and surely.

Aloes should be **avoided** in irritation or inflammation of the alimentary canal, and in piles or hæmorrhage from the rectum. In bronchitis and other inflammatory affections of the mucous membranes or skin, in inflammation of the kidneys, and in influenza and typhoid complaints generally, if used at all, it must be with great caution; for in such cases the intestinal mucous membrane is unusually irritable, and superpurgation and inflammation are readily induced. During pregnancy, both in the mare and bitch, the violent operation of aloes must be carefully avoided. Some practitioners give it both to foals and calves, but for these young animals linseed or castor oil, or a mixture of the two, is more suitable.

As a tonic aloes is occasionally prescribed in enfeebled and relaxed conditions of the alimentary canal, and where there is suspicion of intestinal worms. It is sometimes applied externally, as a gentle stimulant and desiccant, and is an ingredient of the once famous friar's balsam. (*See Benzoin.*)

Doses, &c.—Horses receive ℥ij. to ℥viiij., the dose depending upon the rapidity and amount of catharsis required. For foals several months old, the dose may be readily ascertained by allowing grs. v. for every week of the patient's age. Cattle take ℥i. to ℥ij.; sheep, ℥ss. to ℥i.; dogs, grs. xxx. to ℥iss.; and swine, ℥j. to ℥iv.

As a bitter tonic, the dose of aloes for any of the domesticated animals is about an eighth or tenth of that given as a purgative. Tonic doses may be administered daily, or every second day, in combination with other bitters and aromatics. A convenient laxative tonic for the horse is made with two drachms each of aloes, gentian, and ginger, rubbed into a ball with treacle. Another of less laxative effect is prepared with a drachm each of aloes and iron sulphate, and half an ounce of ginger, made up with treacle and linseed meal. Either of these may be repeated daily, or every second day.

Aloes is generally administered in the form either of **ball** or **watery solution**. A ball for immediate use is made with freshly-powdered aloes, mixed with about one-eighth of powdered ginger, and made up with soft soap, lard, glycerine, or

vaselin. The **physic mass** of the Royal (Dick's) Veterinary College consists of equal weights of Barbadoes aloes and treacle, with two ounces of ginger to every pound of aloes. The addition of ginger, or some such aromatic, hastens catharsis, and diminishes nausea and griping. The ingredients are mixed over a slow fire, and constantly stirred until properly melted, great care being taken to prevent the temperature rising above 120° Fahr. The mass should be kept in air-tight jars with closely-fitting covers, the balls being made up as required. Another good and less bulky mass is prepared by adding to melted aloes about one-fourth of its weight of rectified spirit or oil of turpentine, which is retained by the resinous matter, and keeps the mass long soft and moist. Aloetic balls made with lard, oils, or soap are only suitable for immediate use, and, if kept for several weeks, become dry and hard. Drying may, however, be retarded by adding a little glycerine and an ounce of potassium carbonate or acetate to every pound of the combination. Twenty grains each of powdered aloes, jalap, ginger, and soap, made into a pill, with glycerine or vaselin, is a good purge for a large dog, and will make two doses for a smaller.

Watery infusions are prepared by rubbing down the aloes in hot water, avoiding a temperature exceeding 120° Fahr., and answer well for immediate use. **Tinctures** are made by macerating the drug, in coarse powder, in proof spirit for seven days, and may be of such strength as suits the practitioner's convenience. **Extracts** made with the view of removing a portion of the resin have nothing to recommend them. Aloes is slowly dissolved when introduced into the rectum, and hence exerts little laxative effect; but one or two drachms are occasionally ordered as an enema for the horse, dissolved, with soap and a drachm of potassium carbonate, in two quarts of warm water.

ALOIN.—In 1850, Messrs T. & H. Smith, Edinburgh, discovered, first in Barbadoes aloes, and subsequently in the other varieties, the active crystalline principle **aloin**. An analogous crystalline substance has been separated from Natal aloes, and named **nataloin**, while from Socotrine aloes **socaloin** has been obtained. These three aloins are generally believed to be

isomeric, although some authorities regard them as a homologous series. Histed distinguishes them by the following tests : A drop of nitric acid produces with barbaloin a brilliant crimson, which rapidly fades ; with nataloin a brilliant crimson, which is permanent unless heat be applied ; with socaloin little effect follows. A drop of sulphuric acid, similarly applied, and a rod dipped in nitric acid passed over the mixture, has no effect on barbaloin or socaloin, but develops with nataloin a fine blue.

Aloin is thus prepared by Messrs Smith :—Barbadoes aloes is powdered with sand to prevent agglutination, macerated in successive quantities of cold water, and the solutions thus obtained mixed and concentrated *in vacuo* to the consistence of a syrup. This, after being kept in a cool place for two or three days, becomes filled with minute brownish-yellow granular crystals of impure aloin, which is purified by drying between folds of bibulous paper, and by repeated solution in hot water, filtration, and crystallisation. Ultimately it is dissolved in hot rectified spirit, from which the pure aloin crystallises in radiating masses of slender, four-sided monoclinic prisms of a pale yellow colour, breaking when in mass with a dull short fracture (*Monthly Journal of Medical Science*, February 1851).

Pure barbaloin is odourless ; its taste, at first slightly sweet, soon becomes intensely and permanently bitter, and distinctly aloetic. It is entirely combustible, burning with a yellow flame and much smoke. It yields, by destructive distillation, an aromatic volatile oil, and a resinous residue. It is neutral to test paper, is soluble in rectified spirit, but less so in cold water, an ounce of which dissolves about a grain of aloin. The solvent power both of water and alcohol is greatly increased by heat. Barbaloin is also dissolved by acetic acid and alkalis, forming with the latter orange-yellow solutions, which deepen in colour by oxidation. It is insoluble in ether, oil of turpentine, and chloroform. Watery solutions rapidly darken by exposure to air and light ; and, when heated above 150° Fahr., the aloin is oxidised, decomposed, and converted into a resinous substance of little activity.

ACTIONS AND USES.—For twenty-five years aloin has been used with growing favour in medical practice, and with some practitioners it has entirely superseded aloes. The dose for an adult is from one to two grains, or about one-third of the quantity of Barbadoes aloes usually prescribed.

Messrs T. & H. Smith having liberally supplied me with aloin, I administered drachm doses made up with flour and glycerine to six three-parts-bred carriage horses, four and five years old, 15 to 16 hands high, in good health and condition, and prepared with one bran mash given four hours previously. No effect was observable on the pulse, temperature, appetite, or secretion of urine ; the bowels were relaxed to a slight

extent in two of the animals, when they were exercised twenty-four hours after receiving their ball; whilst in two of the subjects of experiment fulness and itching about the joints disappeared, although no sensible effect was observed on the bowels. Drachm doses of aloin, conjoined with half an ounce each of gentian and ginger, proved serviceable in **abating febrile symptoms**, and removing heat and fulness of the limbs in hard-worked or grossly fed horses. Two drachms of aloin given to strong five and six year old hunters, well prepared by mashes for upwards of twenty-four hours, caused, in thirteen or fourteen hours, abundant fluid evacuations. Nothing notable was observed as to the pulse or temperature; there was less dulness and loss of appetite than usually accompany the full action of the ordinary aloetic ball; there was no nausea or griping; the purging usually continued six or eight hours. In these horses, which were in the country, it will be noted that two drachms of aloin operated several hours earlier, without impairment of appetite or spirits, and with the certainty and effect usually following six drachms of Barbadoes aloes.

Mr Thomas A. Dollar, of New Bond Street, London, frequently prescribes aloin, and furnishes the following observations regarding its efficacy:—London horses, he remarks, are generally more susceptible to the action of physic than country patients. Five carriage horses, $15\frac{1}{2}$ to 16 hands high, prepared by mashes during two days, received two drachm doses of aloin, made up with ginger and treacle, and were purged with **less dulness, nausea, and griping** than attend the administration of full doses of aloes. In several cases the purging came on within twelve hours; full and fluid evacuations occurred; but there was less prostration and interference with appetite than usually attend the action of physic, and the horses were ready to return to work a day sooner. Three heavy cart horses received two and a half drachms of aloin, made up with ginger and treacle, and in eighteen hours were as fully physicked as if they had got six drachms of good Barbadoes aloes. As in the better-bred animals, dulness, nausea, loss of appetite, tenesmus, and diuresis were looked for in vain. From these and other observations Mr Dollar concludes that, comparing aloin with the crude drug, a little less than half

the quantity acts in horses with more certainty and equal effect.

Professors Fred. Smith and Charles Rutherford of the A.V.D. recently made several experiments on healthy horses with aloin. Five grains were **hypodermically injected** into the breast of one subject, and 8 grains into the right jugular of another. Neither case exhibited any evidences of gastrointestinal disturbance. In a third case 12 grains were injected hypodermically; in three hours the animal lay down, apparently pained, and the bowels were moved. During the next four hours there was dulness, uneasiness, scraping, circling round the box, the bowels were repeatedly moved, but the droppings were hard and dark, and the effects gradually wore off. A fourth case had 24 grains injected hypodermically. In an hour and a half rumbling was noticed in the intestines, and hard pellets were passed. To these symptoms were shortly added dulness, scraping, circling round the box, pain, exhaustion, and further passing of hard droppings. These effects continued for nine hours from the exhibition of the drug, but gradually passed away without the bowels being notably relaxed.

A strong shorthorn cow had two drachms dissolved in hot water, and given by the mouth, with an ounce of ginger; the bowels were only mildly relaxed; but three drachms operated tolerably freely in twenty hours. Two drachms, with half a pound Epsom salt, acted as rapidly and effectually as $1\frac{1}{4}$ pounds Epsom salt. **English terriers** 20 lbs. weight are little affected by doses of 20 grains given in bolus; even drachm doses had scarcely any effect on pointers and setters; but when two or three grains of calomel or half a drachm of jalap are added, full effects occur in six or eight hours.

Old and knowing horses, familiar with the smell of aloes, and induced to swallow it with difficulty, show much less antipathy to the inodorous aloin. Definite and uniform in composition, more concentrated in form, and now offered by the discoverers, Messrs T. & H. Smith, at a reduced rate, which renders it scarcely more expensive than the best qualities of the crude drug, aloin should come into more general use as a cathartic for horses.

ALUMINIUM AND ITS MEDICINAL COMPOUNDS.

POTASH ALUM. ALUMEN. Aluminium and Potassium Sulphate.

$\text{AlK}(\text{SO}_4)_2$. 12 Aq.

SODA ALUM. $\text{AlNa}(\text{SO}_4)_2$. 12 Aq.

AMMONIA ALUM. $\text{AlNH}_4(\text{SO}_4)_2$. 12 Aq.

ALUMINA. Al_2O_3 .

The alums are a series of double salts in which aluminium sulphate is conjoined with potassium sodium or ammonium sulphate. They are found in limited quantity on the surface of soils and rocks, especially in volcanic districts, and are largely prepared from aluminous clay, shale, or schist, which mainly consists of aluminium silicate and iron sulphide. Near Paisley, where alum is extensively manufactured, the schist lies between the coal and limestone strata. When slowly roasted it absorbs oxygen, and the sulphur is converted into sulphuric acid, which unites with the iron and aluminium. Water is added, and a large portion of the less soluble iron sulphate crystallises out.

To make potash alum this residual solution is treated with potassium chloride, usually obtained as a bi-product from the soap-boilers, saltpetre refineries, and glass-houses; double decomposition results. The remaining iron sulphate is converted into iron chloride, which continues in solution; while potassium sulphate unites with aluminium sulphate to form potash alum, which crystallises, and is further purified by repeated solution and crystallisation. In the North of England the clay schist is calcined, placed in iron chambers, and sulphuric acid poured over it; a temperature of 140° Fahr. is kept up by steam as well as by fire underneath, and ammonia vapour is blown into the chambers. The solution is drawn off into coolers, agitated to prevent formation of large crystals, and the alum flour washed and redissolved by steam. To prepare soda alum, sodium chloride, instead of potassium chloride, is added to the dissolved iron and aluminium sulphate extracted from the roasted clay. To produce the corresponding ammonia alum, which, on account of its cheapness, has generally superseded the other alums in dyeing, calico-printing, and paper-

making, as well as in medicine, ammonia sulphate, the refuse of the gasworks, is added to the roasted lixiviated shale.

PROPERTIES.—The alums occur in transparent, colourless cubes, or octahedral crystals, have a sweet, acidulous, astringent taste, act like acids on colouring matter, and, when heated, fuse and part with their twelve molecules of water of crystallisation. They are soluble in one-third of their own weight of water at 212° Fahr., and in seven parts of cold water (Bloxam). Like other aluminium salts, they are distinguished by negative action with hydrogen sulphide, and by white precipitates of aluminium hydrate thrown down by ammonium sulphide, and by caustic potash or soda, but soluble in excess. Moistened with cobalt solution, and heated in the blow-pipe flame, alum salts develop a blue colour.

Alumina (Al_2O_3), obtained by burning ammonia alum, or treating an alum solution with excess of ammonia, has neither colour, smell, nor taste, but it exhibits great affinity for water, attracts from the atmosphere one-third of its own weight of moisture, has a strong affinity for colouring matters, and hence is much used in dyeing and calico-printing. Conjoined with silica it constitutes **clay**, which, on account of its plasticity and slight fusibility, is employed for making the many varieties of pottery and porcelain. Alumina in crystalline form, coloured with traces of chrome or iron oxides, constitutes the ruby and sapphire. Corundum and emery are impure alumina.

ACTIONS AND USES.—Alum is slightly irritant, astringent, and antiseptic, and is chiefly used externally as an astringent styptic and desiccant.

TOXIC EFFECTS.—One or two ounces given to dogs cause vomiting. But when the œsophagus was tied, and vomiting prevented, Orfila found that two ounces occasioned death in five hours, with great exhaustion; the intestines were found extensively inflamed. Devergie (quoted by Pereira) found that four drachms of burnt alum killed a dog when the gullet was tied. An ounce introduced into the areolar tissue of a dog's thigh caused excessive suppuration, and death in fifteen hours. Moiroud says that large doses given for some time continuously exhaust the digestive organs, diminish cutaneous

transpiration, and produce grave disorders. Bourgelât states that it causes chronic lung irritation in horses. Several ounces are occasionally given to cows to arrest the lacteal secretion, and although continued for several weeks, do not produce any obvious bad effects. Alum is decomposed in its passage through the intestines, rendering the fæces firmer and odourless. Overdoses are decomposed and rendered inert by small and repeated doses of sodium carbonate, followed by demulcents.

MEDICINAL USES.—The alums closely resemble the copper and zinc salts, but are not so active. They are occasionally given to the dog as **emetics**. Applied in a dry state, they absorb water from the soft tissues, and hence act as **mild caustics**. They have little effect upon the unbroken skin. They coagulate albumin and gelatin, and hence invest the abraded skin and mucous membranes with a protective film, diminish their blood supply, and thus relieve congestion and lessen secretion. In virtue of these **astringent** properties, they are used as lotions for aphthous ulcerated conditions of the mouth; as gargles and spray for sore-throat; as soothing dressings for blistered surfaces; as stimulant injections for leucorrhœa; and in many of these cases are conjoined with borax. They are occasionally prescribed along with opium in diarrhœa and dysentery, but vegetable astringents are preferable. When alums enter the blood they form albuminates, and hence lose their astringency. In the kidneys, however, the albuminates are redissolved, and thus alums are valuable in hæmaturia. They were formerly given in polyuria in horses, but iodine and iron salts are greatly more effectual. In powder, mixed with two or three parts of wheat flour, they are sometimes applied to **arrest bleeding**, and flow of **synovia** from open bursæ or joints. They have been recommended for the purification of drinking water.

DOSES, &c.—As astringents for horses and cattle, ℥ij. to ℥iv.; sheep and pigs, grs. xx. to ℥ij.; dogs, grs. x. to grs. xx., given either in bolus or solution. **Externally** there are used powdered alum or alum flour, a watery solution and an ointment made with one part of alum to three or four of lard or vaselin. The burnt or dried alum of the B.P. is little used.

Alums are incompatible with alkalis and their carbonates, with lime salts, phosphates, salts of lead and mercury, and tannin-containing bodies.

Pipeclay and **fuller's earth**, both aluminium silicates, are useful desiccants, mild astringents, and antiseptics, and are much used for wrung shoulders, harness galls, and simple wounds. **Aluminium sulphate** ($Al_2 3SO_4 \cdot 18 Aq.$) is occasionally used as a mild caustic, antiseptic, and astringent.

ALUMINIUM CHLORIDE. CHLORIDE OF ALUMINIUM. CHLORALUM.



When a mixture of alumina and charcoal is heated in a current of chlorine gas, the white volatile aluminium chloride is produced. When aluminium sulphate and calcium chloride are dissolved together, double decomposition ensues, and there remains in solution an impure hydrated aluminium chloride—a colourless, oily fluid, with a sweet astringent taste, sold as chloralum.

ACTIONS AND USES.—Like many metallic chlorides, chloralum is corrosive, astringent, and antiseptic. It has been recommended in influenza, typhoid complaints, and farcy in horses, in dysentery in cattle, and in distemper in dogs. Drachm doses suffice for horses or cattle, grs. v. to grs. x. for dogs. It may be used either in bolus made with meal, or dissolved in water or gruel. **Externally** it may be applied for the several astringent purposes for which alum or zinc sulphate are serviceable. As an antiseptic it has been more used on the Continent than in this country. Dr Angus Smith, in his experiments undertaken for the Cattle Plague Commissioners, found that for the preservation of night-soil, chloralum proved inferior to common salt, carbolic acid, and zinc and iron chlorides. As a deodoriser it proved more effectual than alum, but less effectual than tar oils, sodium sulphite, or bleaching powder. Unlike such volatile bodies as carbolic or sulphurous acids, it does not diffuse through the air and attack floating contagious germs. Diluted solutions destroy the parasites of mange and scab, and kill fleas and ticks.

AMMONIUM AND ITS MEDICINAL COMPOUNDS.

AMMONIUM HYDRATE. Ammonia. Caustic Ammonia. Hartshorn. Spirit of Hartshorn. Liquor or Aqua Ammoniaë. Gaseous Ammonia (NH_3) dissolved in water.

Traces of ammonia exist in the air, and in rain. It occurs in the excretions of living animals, from the breaking down of their nitrogenous tissues, and is evolved from the putrefaction and destructive distillation alike of vegetable and animal matters. It is formed directly from the nitrogen of the air by the growth of micro-organisms. But the coal beds are the great commercial source of ammonia and its compounds. Coal when distilled in the making of gas leaves a waste liquor, which, if treated with hydrochloric acid, yields ammonium chloride or sal-ammoniac.

Three parts coarsely powdered sal-ammoniac are mixed with four of dry slaked lime, the mixture is transferred to large retorts, and gradually increasing heat applied, when ammonia gas is evolved, and conducted into receivers containing water, one volume of which at 60° Fahr. absorbs upwards of 700 volumes of the colourless, light, irritant, irrespirable, gaseous ammonia (NH_3). Exposed to a temperature of 40° Fahr. gaseous ammonia condenses into a clear liquid which at -103° Fahr. becomes a white crystalline solid.

PROPERTIES.—The liquor ammoniaë fortior is colourless, pungent, and caustic, and consists of 32.5 per cent. of gaseous ammonia dissolved in water. Its specific gravity is 0.891; 52.3 grains by weight require for neutralisation 1000 grain measures of the volumetric solution of oxalic acid. One fluid drachm contains 15.83 grains of gaseous ammonia. Purity is ensured when the sample, diluted with four times its volume of distilled water, gives no precipitate with solution of lime, ammonium sulphide, or copper ammonio-sulphate, and, when treated with an excess of nitric acid, it is not rendered turbid by silver nitrate or barium chloride (B.P.) It has strong alkaline reactions, and unites with fats and oils, forming soaps and liniments.

Ammonium salts are not acted upon by many reagents, but are distinguished by their volatility and odour.

For most medicinal and pharmaceutical purposes the liquor ammoniæ fortior is too concentrated, and a diluted solution is made by adding to the fortior two measures of distilled water. This medicinal solution is entitled **liquor ammoniæ**, contains 10 per cent. by weight of gaseous ammonia, and has the specific gravity .959.

A **spirit of ammonia** of corresponding strength, containing 10 per cent. of gas in rectified spirit, is recognised by the U.S.P.

Aromatic spirit of ammonia, popularly known as sal-volatile, is a solution of ammonia fortior and ammonium carbonate in rectified spirit and water, usually flavoured with oils of nutmeg and lemon.

GENERAL ACTION OF AMMONIUM SALTS.—They resemble potassium and sodium salts, but being more volatile are more prompt and powerful. Unlike caustic potash and soda, ammonium hydrate does not dissolve the epidermis, and consequently does not cauterise, but, if evaporation be prevented, it passes through the epidermis, irritates the dermis, and vesicates.

Dr Lauder Brunton thus describes their actions:—"Ammonium is considerably modified by the acid radicle with which it is combined. All the ammonium salts have an action on the spinal cord, motor nerves, and muscles, and, in advanced poisoning, paralyse these structures. They do not, however, affect all these structures with equal readiness. The organ first affected, and consequently the symptoms of poisoning, vary with the salt employed. Some salts affect the spinal cord first, others the motor nerves. Ammonia and ammonium chloride produce tetanus. The bromide produces hyperæsthesia, with some clonic spasm, passing into tetanus, which, however, comes on very late. . . . They appear to form a series, at one end of which the members stimulate the spinal cord, and have no marked paralyzing action on the motor nerves; while those at the other end have no marked stimulating action on the cord, but, on the contrary, have a marked paralyzing action both on the cord and on motor nerves. At the stimulating end of this series are ammonia and ammonium chloride, and at the paralyzing end ammonium iodide: whilst

the bromide, phosphate, and sulphate lie between" (*Pharmacology, Therapeutics, and Materia Medica*).

In their primary stimulation and secondary paresis, ammonium salts resemble the mono-hydric alcohols and ethers; but they act more markedly on the cord and motor centres, and less on the higher cerebral centres. Their **antidotes** are dilute acids, milk, and oils. Ammonium salts increase the secretion of the bronchial and intestinal glands, and also of the sweat glands and kidneys, by which they are mainly excreted. In the blood of mammals ammonia is converted almost entirely into urea, in the blood of birds into uric acid. It increases the formation of glycogen in the liver, and of acidity in the urine (Brunton.)

ACTIONS AND USES OF AMMONIA.—Ammonia causes topical irritation. Tolerably concentrated solutions abstract water from the tissues, dissolve their epidermal or epithelial scales, liquify their albumin, and saponify their fats. They hence act as caustics. Full doses stimulate the spinal cord, motor nerves, and muscles, cause tetanus, subsequently paralyse the cord, but, unlike ammonium chloride, do not markedly paralyse motor nerves. Ammonia vapour entering the air-passages causes suffocation. Strong solutions swallowed produce gastro-enteritis, while, from absorption, paralysis of the brain centres and coma occasionally ensue. Reflexly, when applied to the nostrils or stomach, it stimulates the vaso-motor centre, and raises blood-pressure, and, after absorption, directly stimulates the circulatory and respiratory nerve-centres, and promotes secretion alike from the mucous surfaces and skin. It is administered as an antacid, diffusible stimulant, and antispasmodic, and used externally as a stimulant and counter-irritant.

TOXIC EFFECTS.—Hertwig found that half an ounce of the strong solution, given diluted, had no bad effects on horses, but that one ounce proved fatal in sixteen hours, and three ounces in fifty minutes, the latter quantity causing violent cramps and difficult breathing. Half a drachm introduced into the stomach, and retained by tying the œsophagus, destroyed a dog in twenty-four hours, causing much uneasiness, agitation, and stupor, and leaving after death slight redness of the villous coat of the stomach (Orfila). The most effectual

antidotes are vinegar and other diluted acids, with diluents and demulcents.

MEDICINAL USES.—Its **antacid and stimulant** properties recommend ammonia in indigestion, tympanitis, and spasmodic colic, especially in ruminants. Stimulating the vaso-motor and respiratory centres, it is a diffusible stimulant, valuable in antagonising syncope or apnoea in influenza and other typhoid complaints. As in human practice, ammonia fumes are occasionally used to rouse animals from faint, shock, or narcotic poisoning, but must be used cautiously, lest excessive irritation of the respiratory mucous membrane be produced. It is a promptly-acting **antidote** in poisoning by opium, aconite, digitalis, and other narcotic and sedative drugs. It is administered in the usual way, is injected intravenously, and is also applied externally in the treatment of snake-bites; but its success is uncertain, especially in the case of the cobra and other venomous snakes. On account of its promoting bronchial secretion, and assisting in its expulsion, ammonia is serviceable as a **stimulating expectorant** (p. 79). To develop its more general effects, it is frequently prescribed with alcoholic stimulants, as in the convenient forms of the spirit and aromatic spirit.

EXTERNAL USES.—Owing to its rapid evaporation, ammonia has not much rubefacient effect, unless it is smartly rubbed in, when it proves a useful **counter-irritant** for rheumatic muscles or joints, for sore-throat and bronchitis; for maintaining the stimulation produced by mustard or cantharides; for influenza, purpura, and scarlatina cases, where the more irritant mustard and cantharides are unsuitable; and for preventing the chilling of fomented surfaces. If a pledget of lint saturated with ammonia is applied to the skin, and evaporation prevented by covering with a piece of oiled silk, the ammonia penetrates the epidermis, and quickly **vesicates**. It neutralises the acid virus, and relieves the irritation caused by stings of nettles, wasps and other insects, and by bites of some snakes.

DOSES, &c.—Of the liquor ammoniæ fortior as a diffusible stimulant and antispasmodic, horses take fʒj. to fʒij.; cattle, fʒij. to fʒvi.; sheep and pigs, fʒj.; and dogs, ℥v. to ℥x. The liquor ammoniæ, the spirit, and aromatic spirit being one-

third the strength, are given in proportionally larger doses. In order to sustain their transient effects they require to be repeated at intervals of two or three hours. On account of their pungency, they must be largely diluted with water, or, better still, with cold gruel or mucilage. A useful stimulant draught, either for horses or cattle, is made with half an ounce each of liquor ammoniæ, sweet spirit of nitre, and tincture of gentian, given in a quart of ale or of cold gruel. For colic and indigestion in horses, Mr Greaves of Manchester recommends a draught composed of half an ounce of medicinal ammonia, with four or five drachms of aloes, given in water. For **external** application the liquor fortior is generally used, mixed with four to six parts of oil. A convenient **stimulating liniment** is made with one part each of ammoniæ fortior, oil of turpentine, and water, mixed with four to six parts of linseed oil. A drachm of ammoniæ fortior, with half a pint of soap liniment, makes a useful stimulant embrocation for sore-throat.

AMMONIUM CARBONATE. Carbonate of Ammonia. Ammoniæ Sesquicarbonas. Hartshorn Salt. Smelling Salts.

Professor Rose of Berlin has described twelve ammonium carbonates. The commercial and Pharmacopœia carbonate is prepared by heating about one part of either ammonium chloride or of sulphate with two parts of chalk. It is believed to be a compound of acid ammonium carbonate (NH_4HCO_3), with ammonium carbamate ($\text{NH}_4\text{NH}_2\text{CO}_2$), and the B.P. gives the formula $\text{N}_3\text{H}_{11}\text{C}_2\text{O}_5$.

It occurs in colourless, translucent, fibrous, crystalline, concavo-convex cakes, the shape of the receivers in which it is condensed. It has a pungent alkaline taste, and a strong ammoniacal odour; is soluble in four parts of cold water and rather less of tepid water; dissolves sparingly in alcohol; decomposes in boiling water, with evolution of ammonia and carbonic acid; sublimes when heated, and when exposed to the air becomes opaque, friable, and covered with a white powder of bicarbonate. It is little liable to adulteration.

ACTIONS AND USES.—The carbonate closely resembles am-

monia hydrate, but is less volatile, less powerful, and rather more permanent in its effects. Large doses produce, however, the same primary stimulation, and secondary paralysis of the spinal cord and motor centres. Orfila records that two and a half drachms given to a dog caused gastric inflammation, tetanic convulsions, and death.

MEDICINAL USES.—It is given to all animals in atonic dyspepsia; conjoins the actions of an **antacid and diffusible stimulant**; in small doses promotes secretion of gastric juice, and in larger relieves flatulence and spasm. A few doses materially help the extra rug, warm bran mash, and other hygienic remedies in combating chill, blowing, and other premonitory symptoms of disease of the air-passages in hard-worked horses. It **stimulates** both **cardiac and respiratory functions**, and hence is prescribed in influenza, scarlatina, and other typhoid cases, and in the later stages of various acute debilitating inflammatory complaints, in many such patients being substituted for or conjoined with alcoholic stimulants. It **promotes bronchial secretion and expectoration**, and hence relieves bronchial congestion, being especially serviceable where the lower bronchi are choked with mucus, and cardiac action is weak. It is sometimes given to **dogs** as a **stimulant emetic**; acts without nausea, and usually promptly; but as it is somewhat uncertain is best used in conjunction with ipecacuanha, or other such emetic. In respiratory diseases, while sustaining the action of the heart, it clears away excessive bronchial secretion, and relieves congestion. It sometimes averts epileptic fits in weakly dogs. It neutralises the poison of wasps' stings and insects' bites. A useful dressing for removing the scales of psoriasis is made by adding one part to ten of unguentum simplex.

Doses, &c.—Horses take ℥ij. to ℥iv.; cattle, ℥iij. to ℥vj.; sheep and pigs, grs. xv. to grs. lx.; dogs, grs. iij. to grs. viij. It is given either in bolus with linseed meal, or dissolved in gruel, which, to prevent volatilising of the ammonia, must be used cold. Where prompt stimulant effects are required, ammonium carbonate is conjoined with alcohol or ether; where febrifuge and expectorant effects are sought, it is prescribed with sweet spirit of nitre, potassium chlorate, and camphor;

while in chronic gastric derangements it is given with gentian, ginger, or cinchona bark. **Smelling salts** are prepared by adding to the carbonate half its weight of ammonia fortior, and mixing some bergamot, lavender, or other aromatic oil.

AMMONIUM CHLORIDE. Sal-Ammoniac. Chloride of Ammonium. Muriate or Hydrochlorate of Ammonia. NH_4Cl .

This salt, from which most ammonium compounds are procured, is chiefly prepared from the ammoniacal liquor of the gasworks, by treating it with diluted hydrochloric acid, or in some manufactories with common salt or impure calcium chloride. The solution, when slowly evaporated, yields brown crystals of chloride, which are purified by sublimation. The salt thus prepared occurs in colourless, translucent, tough, fibrous masses. It is devoid of odour, has a saline, acid taste, a slightly acid reaction on colouring matter; is soluble in about one part of boiling, and three of temperate, water. During solution it abstracts much heat, and is consequently an ingredient of many freezing mixtures. When heated it sublimes unchanged. Mixed with lime or potash it evolves ammonia.

ACTIONS AND USES.—Large doses exhibit the stimulant and subsequent paralyzing effects of ammonium salts. Two ounces given to a horse caused muco-enteritis (Moiroud); two drachms destroyed a small dog in an hour. The alimentary mucous membrane was found congested and swollen (Orfila). The symptoms described as occurring in dogs are "muscular weakness, slow breathing, violent action of the heart, and tetanic spasms" (Christison *On Poisons*). The same symptoms and post-mortem appearances result when the salt is applied to wounds.

Medicinal doses stimulate the alimentary and respiratory mucous membranes, promote their secretions, and relieve gastric as well as bronchial catarrh, especially in patients where pyrexia has not been serious, or has abated. They are also recommended in torpidity of the liver and rheumatism. The **doses** are the same as those of the carbonate.

Dissolved in water or spirit, it is used as a stimulant gargle and **refrigerant** lotion for inflammatory swellings, bruises, and sprains. A cooling mixture, stated to lower the thermometer

from 50° to 10° Fahr. (Pereira), is made with four ounces each of sal-ammoniac and nitre, dissolved in eight ounces of water; but for ordinary refrigerant purposes six or eight times this amount of water may be used.

LIQUOR AMMONII ACETATIS FORTIOR. Strong solution of Ammonium Acetate. $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$.

LIQUOR AMMONII ACETATIS. Solution of Ammonium Acetate. Mindererus Spirit.

Ammonium carbonates, when gradually treated with acetic acid until a neutral liquid is produced, and diluted with a definite proportion of water, produce the **liquor ammonii acetatis fortior**, which has the specific gravity 1.073. This liquor fortior, further diluted with five parts of water, forms the **liquor ammonii acetatis**. This weaker solution is clear, colourless, and nearly odourless, but has a mawkish, unpleasant taste. Its specific gravity is 1.022. These solutions are identified by the ammoniacal odour developed by admixture of caustic potash, and the acetous odour produced when treated with sulphuric acid.

ACTIONS AND USES.—Ammonium acetate, although not so powerful a stimulant as the liquor ammoniæ or carbonate, is a valuable **diaphoretic and antipyretic**, and a mild **diuretic and expectorant**. It is much used in febrile and inflammatory attacks, especially affecting the respiratory organs—in catarrh, bronchitis, and pneumonia, in influenza, strangles, purpura, and scarlatina. In these and other such cases it abates fever, promotes skin and bronchial secretion, and helps to clean the tongue and improve the appetite in typhoid cases. In the outset of local inflammations in horses, when pyrexia is considerable, two to four ounces of the liquor ammonii acetatis are given, with a drachm of potassium nitrate or chlorate three or four times daily. When the bowels are confined and the urine high-coloured, two or three ounces of Epsom salt are added to the febrifuge mixture. When bronchial secretion is scanty the acetate is conjoined with ipecacuanha or potassium iodide, and its good effects furthered by the inhalation of moist warm air and by hot applications externally. When the smaller bronchial tubes are choked with mucus, belladonna,

balsams, turpentine, and squills are useful additions, along with moderate external stimulation. When there is sore-throat and cough, belladonna extract and camphor are serviceable adjuncts. In many forms of troublesome cough opium is appropriate. In convalescence, when the appetite is indifferent, powdered gentian or cinchona bark are combined or alternated with the acetate and salines. When the patient is weak and exhausted, alcohol, sweet spirit of nitre, or ether are fitting additions. In cerebro-spinal fever Professor Robertson prescribed iodine and strychnine with the ammonia acetate.

For cattle similar prescriptions are suitable, given usually in somewhat larger doses. **In dogs** the diuretic action of ammonium acetate is more notable than the diaphoretic. A convenient antipyretic and expectorant is made with liquor ammonii acetatis fortior $\text{f}\mathfrak{z}\text{iv.}$; spiritus ætheris nitrosi $\text{f}\mathfrak{z}\text{ij.}$; spiritus camphoræ $\text{f}\mathfrak{z}\text{i.}$ For large dogs the dose is half a fluid ounce; for small a fluid drachm, in either case given diluted with five or six parts of water. This mixture is adapted for special cases by such additions as are above indicated for horses.

Doses, &c.—For horses and cattle the dose of the liquor ammonii acetatis is $\text{f}\mathfrak{z}\text{ij.}$ to $\text{f}\mathfrak{z}\text{iv.}$; for dogs, $\text{f}\mathfrak{z}\text{ij.}$ to $\text{f}\mathfrak{z}\text{iv.}$, given in five or six parts of water, diluted spirit, or linseed tea. Many horses and cattle readily take it in their drinking water. Like the chloride, the solution of the acetate is sometimes used **externally** as a refrigerant discutient.

AMYL-NITRITE.

AMYL-NITRIS. Nitrite of Amyl. $\text{C}_5\text{H}_{11}\text{NO}_2$

Amyl-nitrite is prepared by passing nitrous acid (N_2O_3) into amyl-alcohol ($\text{C}_5\text{H}_{11}\text{OH}$) (p. 206). It bears to amyl-alcohol the same relation that nitrous ether does to ethyl-alcohol. It is a yellow, ethereal, limpid, volatile liquid, with a pear-like flavour, the specific gravity .880; it is nearly insoluble in water, but soluble in rectified spirit, ether, and chloroform, and is itself a solvent for oils. It speedily undergoes decomposition; must be kept in well-stoppered bottles in a cool, dark place; a few weeks' keeping greatly reduces its activity.

ACTIONS AND USES.—It has in marked degree the actions of

a nitrite, relaxing and paralysing non-stripped muscle. It is hence an antispasmodic of involuntary muscles, dilates arterioles, and is prescribed chiefly in angina pectoris.

GENERAL ACTIONS.—Whether swallowed or inhaled, it quickly converts the **hæmoglobin** of the blood into **methæmoglobin**, which does not readily part with oxygen; internal respiration is accordingly interfered with; convulsions and asphyxia ensue; both arterial and venous blood acquire a chocolate hue. From paresis of their unstripped muscular walls, **the arterioles** are rapidly and greatly **relaxed and dilated**, and blood pressure is diminished. Secretion of perspiration and urine is increased, and the urine contains sugar. Human patients receiving one to two minims within a few minutes are flushed; perspiration overspreads the head and neck, extending sometimes over the body; there is general vascular dilatation; arterial pressure is reduced; the pulse becomes soft, quickened, and dicrotic; breathing is accelerated, and sometimes panting. Similar symptoms are produced in dogs, in which temperature is, besides, lowered 3° or 4° Fahr. The **antidotes** are stimulants, alternate hot and cold douches, and artificial respiration.

MEDICINAL USES.—It has been successfully used by Professor Williams in angina pectoris in horses, and by other practitioners in spasmodic breathing occasionally occurring as a sequel of sore-throat and bronchitis. In such asthmatic cases in horses and also in dogs it was used by Professor Robertson. Experiments on rabbits made artificially epileptic have shown that it not only prevents the impending fit, but cuts it short when it has begun. It hence deserves more extended trial in epilepsy in dogs and young cattle. Dr B. W. Richardson found that rabbits and frogs which received lethal doses of strychnine had the tetanic spasms relieved, and recovery generally ensured, by prompt administration of amyl-nitrite; but it has not been successful in the treatment of tetanus in other animals.

DOSES, &c.—Horses and cattle take ℥iij. to ℥x.; dogs, ℥ss. to ℥ij. A minimum dose should first be tried. When given hypodermically half doses generally suffice. Repeated use does not interfere with its efficacy. It is inhaled or administered on a piece of sugar, or in draught with rectified

spirit or ether. Ether, chloral, or full doses of alcohol intensify its effects. The drug must be freshly prepared; when kept even for a few days, depreciation occurs from evaporation, decomposition of the etherous principle, or conversion of nitrite into nitrate.

SODIUM NITRITE, now added to the B.P., has the same actions as amyl-nitrite, is given in the same doses, and is more stable and convenient. Its effects are not so rapidly produced, but persist longer, often continuing for half an hour.

NITRO-GLYCERINE, or glonoine, $C_3H_5(NO_3)_3$ is prepared by dropping pure glycerine into a mixture of sulphuric and nitric acids kept cool by ice, and washing it in water. It is a colourless, transparent, explosive liquid, soluble in absolute alcohol, ether, and oils. Its **actions** resemble those of amyl-nitrite and nitrites, but are more persistent, while full doses affect the voluntary as well as the involuntary muscles. To ensure full effects, the drug is put up in suitable dose in hermetically sealed tubes, encased in flannel. When the tube is broken the volatile liquid is absorbed by the flannel and inhaled by the patient. It diminishes the oxidising power of the blood, and lessens blood pressure. Although itself a nitrate and absorbed as such, it is in part decomposed by the alkali of the blood and reduced to the condition of a nitrite. Like other nitrites, it is a muscular poison (Dr Lauder Brunton).

It is **used** for the same purposes as amyl-nitrite. A one per cent. solution in alcohol is the preparation generally prescribed. The dose for human patients is π i., and may be gradually increased. For dogs 20 lbs. weight, suffering from spasmodic asthma or epilepsy, $\pi \frac{1}{4}$ suffices to begin with.

A N I S E.

ANISI FRUCTUS. Aniseed. The dried fruit of *Pimpinella Anisum*. *Nat. Ord.*—*Umbelliferae*.

OLEUM ANISI. Oil of Anise. The oil distilled in Europe from anise fruit, or in China from Star-anise fruit. (B.P.)

The natural order *Umbelliferae* yields many aromatic fruits, such as anise, caraway, coriander, dill, and fennel, as well as the aromatic gum-resins, asafoetida, galbanum, and ammoniacum.

These aromatic umbelliferous fruits, like the fruits, leaves, and other parts of various plants of such orders as the Myrtaceæ, Labiatae, and Coniferæ, owe their medicinal value chiefly to their yielding **volatile oils** (p. 163). These oils possess certain properties and actions in common, and the student should be familiar with their group characters.

Volatile oils are readily diffusible; their in-contact effects are produced, not only when they are applied topically, but when they are absorbed and distributed in the blood stream. When concentrated they are local irritants; when diluted they paralyse peripheral nerve-endings, and hence are anodyne, local anæsthetic, carminative, and antispasmodic. They are also antiseptic and parasiticide. When absorbed they stimulate circulation and secretion. As with other stimulants, large doses paralyse the heart. They increase the white blood corpuscles. They reduce inordinate reflex activity of the spinal cord. They are eliminated chiefly—(1) by the respiratory mucous membrane, lessening bronchial secretion, and counteracting septic conditions of the membrane; and (2) by the kidneys, in moderate doses producing diuresis and antiseptis throughout the urinary tract, but in large doses causing overstimulation and strangury.

Anise is chiefly imported from Spain, Germany, and Southern Russia. It is an ovoid, oblong, grey-brown fruit, one-fifth of an inch in length, and covered with minute hairs. Like other fruits of this order, it is separable into two symmetrical mericarps, each of which is encircled by five slender ridges, while its transverse section exhibits about fifteen vittæ, which elaborate the oil. This oil is also prepared from the dried fruit of the Star-anise—the *Illicium anisatum*, belonging to the *Nat. Ord.* Mangoliaceæ, and grown in China.

Both anise fruits yield about five per cent. of a mixture, in nearly equal proportion, of a fixed oil, and a volatile **anethol** or camphor-like body, common to the Umbelliferæ, and some other plants, and having the formula $C_{10}H_{12}O$. It is believed to be a phenol derivative, with some of its hydrogen atoms displaced by methyl and allyl, and having the rational formula $C_6H_4 \cdot C_3H_5 \cdot OCH_3$. It is colourless, but becomes yellow on keeping; exhibits intensely the characteristic odour and taste

of the fruit, and is soluble in alcohol and ether. The oil from the *pimpinella* solidifies at from 50° to 60° Fahr.; that from the star-anise at about 36° Fahr.

ACTIONS AND USES.—Anise is an aromatic stimulant, stomachic, and carminative. It is used to relieve indigestion and flatulence, to communicate an agreeable flavour to many medicines, and to diminish the nauseating and griping of purgatives.

DOSES, &c.—Horses receive about ℥i.; cattle, ℥i. to ℥ij.; sheep and swine, ℥ij. to ℥iij.; dogs, grs. xx. to grs. l., given powdered, repeated several times a day, often conjoined with ginger or other aromatics, and conveniently administered in ale or in spirit and water. **Oil of anise**, like oils of caraway, coriander, cumin, and other umbelliferæ, is a diffusible stimulant, antiseptic, carminative, and antispasmodic. For such purposes cheaper remedies are generally, however, employed; but it is occasionally used as a flavouring ingredient, more especially for ball masses, and mixed with a little spirit and bland oil, for the destruction of lice in pet dogs and other small animals.

Caraway, cardamoms, coriander, fennel, and fenugreek also contain aromatic, antiseptic, stimulating, essential oils, resemble anise in their actions and uses, and may be given in similar doses. These seeds are sometimes used by feeders of pigs, sheep, and cattle, and by waggons and others, for improving the coat and condition of their charges. Fenugreek especially is prized for such purposes, is a constituent of various “drinks,” and, with ground peas, locust bean, and linseed cake, forms several vaunted “nourishing foods.”

ANTIFEBRIN.

ACETANILIDE. ACETANILIDUM. C_8H_9NO . PHENYL-ACETAMIDE.
 $C_6H_5 \cdot NH \cdot C_2H_3O$. (B.P.)

Antifebrin is one of the most serviceable of the benzol or aromatic carbon series, and has been introduced into the 1891 Edition of the B.P. It is a crystalline substance, prepared by the action of glacial acetic acid on aniline and subsequent purification. It is colourless, odourless, with a slightly burning

taste, oily to the touch, soluble in 189 parts of water, but freely soluble in benzol and chloroform.

ACTIONS AND USES.—It is **antipyretic**, diaphoretic, and slightly antiseptic. It is neither irritant nor nauseous, and has, moreover, the merit of cheapness. It is two to three times as powerful as antipyrin, while its effects are more lasting. Fröhner and other German authorities testify to its febrifuge effects both on horses and dogs, and prescribe it in febrile cases, cramps, neuralgia, and also in rheumatism, in which it is not, however, so effectual as salicin or sodium salicylate. Mr J. A. Nunn of the Army Veterinary Department has prescribed it in Natal in several of the continued fevers which affect animals in that country, especially during autumn; has given cattle drachm doses, and dogs 5 grains, dissolved in ether, repeated every four hours; and reports marked lowering of temperature, unaccompanied by nausea or other untoward effects (*Veterinary Journal*, August 1888). Its anodyne actions are not so marked as those of opium, cocaine, or conium.

The doses for horses are ℥i. to ℥ij.; for sheep, ℥ss. to ℥j.; for dogs, grs. v. to grs. xv., given in powder, pill, or electuary, several times daily, in critical cases every second hour.

ANTIMONY AND ITS MEDICINAL SALTS.

The salts and preparations of antimony in their physiological as well as their chemical relations **resemble** those of **arsenic and bismuth**. They combine with albumin, are precipitated by acid solutions, and consequently exert their irritant effects on those parts where they are acted upon by acid secretions, as in the stomach and around the orifices of the sweat glands. With the exception of the chloride, which is a powerful escharotic, antimony salts, locally applied, produce inflammation of isolated spots, causing first papules, and subsequently pustules. The solubility of the several preparations mainly determines their activity. In animals that vomit they cause emesis, cardiac and vascular depression, and increased secretion. Large doses produce gastro-enteritis, and paresis of the spinal cord. Given for a considerable period, they induce fatty degeneration.

The geese in the Duchy of Brunswick, fed for their fatty livers, receive daily doses of antimony oxide. Tartar emetic is almost the only antimonial prescribed internally.

ANTIMONY OXIDES. Oxides of Antimony.

The medicinal oxide, also known as native white or flowers of antimony (Sb_2O_3), is often used as a paint instead of white lead. It is prepared, by direction of the B.P., by decomposing the chloride with water, and carefully washing the precipitated basic chloride with water and a solution of an alkaline carbonate, and drying. It is a greyish-white, tasteless, heavy, crystalline powder, insoluble in water, but soluble in hydrochloric, tartaric, and acetic acids, and forms, by oxidation with nitric acid, antimony tetroxide (Sb_2O_4), and antimony pentoxide (Sb_2O_5). The B.P. imitation of the patent James' powder is made by mixing thoroughly one part of antimony oxide and two parts of calcium phosphate.

ACTIONS AND USES.—Antimony oxide is chiefly important on account of its employment in the preparation of tartar emetic, which it closely resembles in its actions and uses.

ANTIMONY SULPHIDES. Sulphurets of Antimony. Antimonium Sulphuratum.

The sulphide or stibnite (Sb_2S_3), the most abundant ore of antimony, when purified by fusion, occurs in dark-grey, metallic, heavy, brittle cakes, or as a heavy grey-black, crystalline powder, devoid of odour and taste, insoluble in water, and known as black or crude antimony. The orange-red sulphurated antimony of the B.P. is got by boiling black antimony with sublimed sulphur and caustic soda, neutralising the solution with sulphuric acid, and washing the precipitated sulphide, which is mixed with a small but variable amount of oxide, and has the formula $\text{Sb}_2\text{S}_5 \cdot \text{Sb}_2\text{O}_3$. The following sulphides are used in the arts, and have occasionally been employed in medicine:—Glass of antimony, a red, transparent body, consisting of about eight parts of oxide and one of sulphide; liver of antimony, a double

sulphide of antimony and potassium; and **Kermes mineral**, a red-brown powder containing a variable proportion of oxide and sulphide.

ACTIONS AND USES.—Being uncertain, irregular, and often violent remedies, the antimony sulphides are not now used in human medicine, and should be discarded from veterinary practice. Their irregular action mainly depends on their variable composition and their insolubility in water. They once had the reputation of being alterative and anthelmintic, and were given to horses and cattle in doses of one to three drachms, usually along with sulphur or nitre. They cause emesis in dogs.

ANTIMONY CHLORIDE SOLUTION. Chloride, Terchloride, or Muriate of Antimony. *Liquor Antimonii Chloridi.* Oil or Butter of Antimony. $SbCl_3$.

When native sulphide is boiled with about five times its weight of hydrochloric acid, hydrogen sulphide is evolved, and the chloride remains in solution—a transparent, yellow-red liquid, with a specific gravity of 1.47. The colour darkens by exposure, depending upon oxidation of the iron chloride, which is apt to occur as an impurity. Containing excess of hydrochloric acid, it has an acid reaction, and fumes on exposure to air. Addition of water separates a white precipitate of oxy-chloride ($SbOCl$), which, if persistently washed, yields the oxide. The true butter of antimony—a hard, white, crystalline, fusible solid—is got by evaporating and then distilling the commercial solution.

ACTIONS AND USES.—Although less used than formerly, the chloride solution is still employed as a caustic for thrush, canker, and luxuriant granulations; and for foul in the feet of cattle, and foot-rot in sheep. Except in cautious hands, it is, however, too energetic for general use; and as it cannot be diluted with water without undergoing decomposition, it should be mixed with an equal quantity of compound tincture of myrrh.

ANTIMONY TARTRATE. Potassium and Antimony Tartrate.
Antimonium Tartaratum. Tartarised Antimony. Tartar
Emetic. $(\text{KSbO C}_4\text{H}_4\text{O}_6)_2 + \text{H}_2\text{O}$.

To prepare tartar emetic the native sulphide is converted into chloride by heating with hydrochloric acid; the chloride is decomposed by excess of water, and the resulting oxide purified by washing with water and an alkaline carbonate. With this moist oxide is mixed cream of tartar and water sufficient to form a paste. To ensure complete combination, the mixture is set aside for twenty-four hours, is then boiled with water for fifteen minutes, and filtered; the clear filtrate, as it cools, deposits crystals of tartar emetic. In this process the radicle oxide (SbO . Roscoe) displaces the H in the cream of tartar— $2\text{KH C}_4\text{H}_4\text{O}_6 + \text{Sb}_2\text{O}_3 = 2\text{KSbO C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$.

PROPERTIES.—Tartar emetic is sold as a white powder, and in colourless, transparent crystals, exhibiting triangular facets, becoming opaque when exposed to the air, and crepitating and blackening when heated. It is devoid of odour, has a sweet, styptic, metallic taste, is insoluble in strong alcohol, sparingly soluble in proof spirit, and dissolves in about fifteen parts of water at 60° , and two at 212° Fahr. The watery solution reddens litmus; spoils if long kept; is decomposed by strong acids, alkalies, alkaline earths and their carbonates, and consequently by most spring waters, as also by decoctions of cinchona, galls, and other tannin-containing substances. Iron oxide, the most common impurity, communicates to the salt a yellow or brown colour; cream of tartar diminishes its solubility. If purchased in crystals instead of powder, impurities are more readily discoverable.

TESTS.—Tartar emetic is identified by its acidulated solution, giving with hydrogen sulphide an orange-red precipitate of amorphous antimony sulphide, which is blackened by heat, and, unlike the arsenic sulphide, is soluble in strong hydrochloric acid. From solution of the chloride, water precipitates the oxychloride, yielding the oxide by washing. From coloured organic solutions, antimony salts are separated by boiling with hydrochloric acid and copper shavings, as in Reinche's process for separating arsenic. Metallic antimony is deposited on the copper slips, which are washed, placed in a test-tube, and heat applied, when the white oxide slowly volatilises, condenses low down in the tube, and, unlike the arsenious oxide, is amorphous, insoluble in water, and unaffected by silver ammonio-nitrate. Another ready method of separating antimony, cor-

responding to Marsh's arsenic process, is to add to the solution zinc and sulphuric acid, which cause evolution of antimoniuiretted hydrogen (SbH_3), which may be ignited as it passes from a gas jet. A piece of cold glass or porcelain held in the flame speedily becomes coated with a black mirror of metallic antimony, which may be identified by its insolubility in a solution of bleaching powder, in which the analogous arsenicum spot is freely soluble, and by dissolving it in acidulated water, and treating the solution with hydrogen sulphide.

ACTIONS AND USES.—Tartar emetic when applied to the skin causes eruption of isolated papules, which shortly become pustules. Poisonous doses produce gastro-enteritis, nervous depression, and, when repeated, fatty degeneration. Medicinal doses given to dogs, cats, and pigs are emetic and expectorant, increase secretion from other mucous and skin surfaces, and are cardiac sedatives and antipyretics. Their physiological effects on horses, cattle, and sheep are not so well marked. It is occasionally used externally as a counter-irritant.

GENERAL ACTIONS.—Tartar emetic in the presence of acid solutions, as of the sweat and gastric glands, is precipitated, and thus irritates. It probably combines with albumin. **Horses and cattle**, when receiving even poisonous doses, do not vomit, and doses of one to four drachms sometimes given medicinally do not produce the nausea and depression which are the notable results of medicinal doses in man, dogs, cats, or pigs. **Dogs** receiving two to four grains are nauseated, and vomiting occurs usually within fifteen minutes. Emesis depends upon irritation both of the stomach and vomiting centre, but more especially of the former. Reflexly, from the stomach, as well as by acting directly on the heart and vessels, it produces in men and carnivora cardiac and vascular depression, with lowered blood-pressure; it slightly increases but subsequently diminishes the number of the respirations; reduces temperature; relaxes voluntary and involuntary muscles; and increases secretion from the skin, bronchial and gastro-intestinal mucous membranes. **Poisonous doses** cause gastro-enteritis, and when their action is very violent, after slightly exciting, they paralyse both the motor and sensory tracts of the spinal cord. In many of its actions it resembles phosphorus and arsenic, notably in arresting the glycogenic functions of the liver, and thus causing fatty degeneration of the liver and other organs. It circulates in the blood un-

changed, the acids it meets being insufficient to decompose it. It is eliminated by the mucus of the stomach and bowels, and also by the bile and urine. It increases the excretion of urea. As with arsenic, animals getting small doses acquire a condition of **tolerance**, and with impunity take doses which would otherwise prove dangerous.

THE TOXIC EFFECTS, like the general actions, are less marked in herbivora than in dogs, cats, and pigs, which are acted on much in the same way as men. **Dogs** receiving six grains and even larger doses if left to themselves speedily get rid of the irritant by vomiting. If the œsophagus, however, be tied so as to prevent vomiting, such doses, and sometimes even one grain, cause nausea, accelerated and difficult respiration, fluid dejections, gastro-intestinal inflammation, and death in a few hours. Dr Alfred Taylor, in his volume *On Poisons*, records that three to six grains injected into the jugular vein of dogs caused death in eight or ten hours. Fröhner states that half a grain to a grain injected intravenously proves fatal in half an hour, while small quantities applied to the broken skin also kill.

Pigs are not so susceptible. Hertwig (*Arzneimittellehre*) mentions that ten to twenty grains cause nausea and vomiting, but act neither very rapidly nor very certainly; that one drachm in solution, given to a boar nine months old, caused vomiting, dulness, and uneasiness, which continued for three days; but that two drachms given to a similar animal dissolved in half a litre of water, within an hour and a half caused vomiting five times, loss of appetite, thirst, spasms, prostration, and death the following day. **Poultry** swallowing one to three grains in bolus vomit freely.

Horses take, *per orem*, without injury, thirty to forty times the quantity of tartar emetic which would prove fatal to a man or dog, in whose stomach the dose was retained. Without notable effect they swallow one to four drachms in bolus, and such doses may be repeated night and morning for several days without causing impaired appetite, nausea, or gastric derangement. This insusceptibility of horses to the action of tartar emetic was strongly impressed upon me by a number of experiments made many years ago at the Royal (Dick's)

Veterinary College by the late Mr Barlow and myself. Notes of several of these experiments are subjoined :—

CASE I.—On 9th September 1852, about 10 A.M., a brown mare, unfit for work on account of lameness, with the pulse 38 and respirations 7, got three drachms of tartar emetic in a ball made up with treacle and linseed meal. In the evening the pulse was unaffected, and the dose was repeated.

10th.—The pulse was 40, the respirations 7, appetite good, bowels and kidneys regular. A dose of four drachms was given morning and evening.

11th.—At 10 A.M., the pulse was 42, respirations 7, appetite and bowels quite normal. Got an ounce in a ball as before. In the evening the pulse was 40, no perceptible nausea, appetite good, bowels and kidneys regular. Dose of an ounce repeated.

12th.—In the morning the pulse was 37½, somewhat weaker than yesterday, but still firm. The appetite was very good, and there was no change in the state of the kidneys or bowels. Got a dose of an ounce. In the evening the pulse was 40, and the patient in other respects as in the morning. Gave an ounce, being five ounces six drachms in four days.

13th.—At 10 A.M. the pulse was 35, the appetite good, and the bowels and kidneys normal. About 1 A.M. the animal had dropped or lain down, and while lying the pulse was somewhat irregular, varying between 60 and 70. The respirations were quiet. At 12 the animal was lifted, when the pulse fell in a few minutes to 55, and the respirations to 6. The appetite still remained very good. Gave ten drachms in the usual way. In the evening the pulse was 40, the respirations 6, the appetite and evacuations natural. Gave fourteen drachms.

14th.—10 A.M. No change from last night. Got an ounce; but when having it put over, the animal ran back and went down. At 1 she was raised, still continued to eat, and at 1.30 got another dose of an ounce. She remained down all day, and appeared nauseated. The pulse was not quite regular, probably owing to occasional struggling, but reached about 60 when at its maximum. Respirations about 12. At 6.30 the animal was still eating and drinking, but only sparingly; was much nauseated and lying pretty quiet, with the lips much retracted, and the pulse 75 and weak.

15th.—10 A.M. Found dead, having taken ten ounces and six drachms of tartar emetic in six days. Mr Barlow made the following notes of the post-mortem examination :—The muscular tissue in every part of the body was unusually flaccid, although *rigor mortis* was well established. The right lung, which was lowermost as the animal lay, was much congested in its deeper and central parts; the several margins were comparatively pale; at the anterior part of the anterior lobe there was much emphysema. The left lung was perfectly healthy, and not at all emphysematous. The bronchial tubes and smaller bronchi in both lungs contained frothy mucus. The pleura and pericardium were in every way healthy. The heart was very large, in consequence of all its cavities being filled with firmly coagulated blood. At the junction of the villous and cuticular coats, the stomach was much contracted, and exhibited a slight blush, not amounting to redness. The cuticular coat was marked with several indentations, such as are produced by bots; but in all other respects the stomach was perfectly healthy. The intestines were also perfectly healthy both within and without. The liver was in a state of cirrhosis, such as is often seen in old and worn-out horses. The organs of urination and generation were quite normal. The brain was healthy, but the subarachnoid spaces contained a considerable quantity of fluid.

CASE II.—A mare, about 16 hands high, and in good health and condition, got three drachms of tartar emetic daily, in the form of bolus, for five days, and then four drachms daily for thirteen days—making in all ten ounces and three drachms in eighteen days—but without exhibiting any physiological effect. The animal was destroyed by cutting the carotid artery, but the post-mortem examination discovered nothing at all abnormal. It may be mentioned that, on the twelfth day of experiment, twenty ounces of urine were removed, and found to contain a perceptible but not very large quantity of antimony.

CASE III.—A black mare, of sound, healthy constitution, took ten ounces and a half of tartar emetic (in doses of four drachms, repeated twice and thrice a day) during ten consecutive days; yet she was in no way affected by it: her pulse and respiration were scarcely at all altered; her appetite throughout was voracious; her evacuations natural in appearance and quantity; and her condition considerably improved. She was poisoned by a fluid drachm of Fleming's tincture of aconite. On dissection not a single morbid appearance referable to the tartar emetic was observed. The stomach and intestines were carefully examined, and found "beautifully healthy."

CASE IV.—A healthy, well-bred horse got ten ounces of tartar emetic in solution, and after showing a good deal of nausea, uneasiness, and pain, died in about six hours. The only notable appearances on post-mortem examination were softness and vascularity of the intestines, analogous to what is seen in patients that have died while affected by diarrhœa. Neither in this nor in any of the other cases were the lungs congested or inflamed, as is said to have occurred in Magendie's experiments.

Fröhner's recent experiments show similar results. Healthy horses, he states, take one to two drachms without causing any notable effect but increased discharge from the bowels; but these doses if continued are said to slow the pulse and cause palpitation, lassitude, diarrhœa, polyuria, and, when further continued, great weakness. An ounce in pill or electuary was not fatal, but in solution caused spasms, and death in eight days; while sixty grammes (nearly two ounces) in solution proved fatal in two and a half hours (*Lehrbuch de Arzneimittellehre für Thierärzte*, 1890). Hertwig records that four drachms in solution in water induced colic, trembling, and acceleration of the pulse; the symptoms after a few hours abated, but death resulted after six or eight days. Much greater activity is, however, observed when tartar emetic is administered to horses intravenously. One drachm thus given raised the pulse to 120 beats per minute, caused difficult breathing, purging, sweating, flow of tears and saliva, eructation, retching, and muscular spasms. Two drachms further produced severe fits, vertigo, paralysis, and death in one and a half to three hours, but without action of the bowels. Kaufmann states that horses receiv-

ing 15 grains intravenously in a few minutes exhibited efforts to vomit, great inquietude, dilatation of the nostrils, and lowering of the neck, as if abdominal pains were experienced.

Cattle, like horses, take large doses with impunity. Hertwig and Viborg gave quantities varying from two to ten drachms, and Gilbert gave ten drachms in solution—all without effect (Hertwig, *Arzneimittellehre*). I have repeatedly administered an ounce twice a day to cattle, and, except in a few cases where purgation occurred, have not observed any evidence of its action. Mr Balfour, V.S., Kirkcaldy, informed me that he has given half a pound in solution without any very obvious effects. **Sheep** exhibit similar insusceptibility. Viborg gave one drachm, and Gilbert three drachms in solution, and four in the solid state, without effect (Hertwig). But Gilbert found that four to six drachms in solution destroyed one-year-old sheep. Intravenous injection of 5 to 6 grains produce, however, lassitude, small, frequent pulse, difficult breathing, and purgation (Fröhner).

No very satisfactory explanation has been given of this insusceptibility of horses, ruminants, and also of rabbits. It is evidently connected in great part with imperfect development of the vomiting centre (p. 92); but the gastric functions have also, doubtless, something to do with it, as is shown by the drug being about ten times as active when administered intravenously as when it is given by the mouth.

The **antidotal treatment** consists in the removal of any unabsorbed poison by promoting vomiting or using the stomach pump, and subsequently giving tannin-containing solutions, which form an insoluble compound, and thus delay absorption. Demulcents abate gastric irritation, which, with irritation of the vomiting centre, may also be relieved by morphine and chloral, while tendency to collapse is treated by stimulants.

MEDICINAL USES.—As tartar emetic in safe doses produces no very marked physiological actions in horses and cattle, it can scarcely exert any marked curative effects on these animals. The febrifuge and sedative virtues formerly ascribed to it were doubtless the result of other medicinal or hygienic remedies with which it was used. As a vermifuge it is still occasionally given to horses with aloes, and to cattle with Epsom salt; but

although increasing the activity of such purgatives, it has no special vermicide action.

When the stomach of the dog, cat, or pig is to be emptied of undigested food, irritants, or poisons, ipecacuanha, mustard, or zinc sulphate, being more prompt and less nauseating, is preferred. But tartarised antimony is occasionally used as a nauseating emetic for robust subjects at the outset of febrile and inflammatory complaints. It promotes copious bronchial and gastric mucous secretions, and relieves engorgement of the stomach, liver, throat, and chest. It hence mitigates the early acute catarrhal symptoms of distemper, and relieves bilious attacks in pampered plethoric dogs.

As an **external irritant**, unless employed with much caution, it is apt to induce painful, deep-seated inflammation, sloughing, and blemishing, and is consequently unsuitable either for horses or dogs. For cattle, however, it is sometimes applied as a pustulant in chest diseases and chronic rheumatism. Unlike cantharides, it does not act on the kidneys; but if it be absorbed, it produces in dogs, cats, and pigs nauseating effects similar to those which follow its administration by the mouth.

Doses, &c.—When given to horses or cattle with the view of producing sedative, alterative, or expectorant effects, \mathfrak{z} i. to \mathfrak{z} iv. are administered three or four times daily, either in bolus or solution. It used to be sometimes conjoined with nitre, Epsom salt, calomel, or aloes. As an emetic for dogs or cats, gr. i. to grs. iv., and for pigs, grs. iv. to grs. x. are given in bolus or rolled in a piece of meat, but are most effectual when dissolved in tepid water. One to two grains, with about the same quantity of calomel, or twenty grains of jalap, are sometimes given to strong dogs at the outset of inflammatory complaints. Such a mixture causes vomiting, and subsequently purging, accompanied by cardiac and vascular depression. Doses considerably less than one grain, and sometimes conjoined with ipecacuanha, regulated so as to produce diaphoresis, with very slight nausea, are occasionally prescribed for carnivora as anti-pyretics and expectorants in acute attacks of bronchitis and pneumonia.

Externally it is occasionally used in the form of saturated **watery solution** or of **ointment**, which is made with one part

of tartar emetic and four of lard, and is sometimes added to ordinary blisters to increase their activity. **Antimonial wine** is prepared by dissolving forty grains tartar emetic in a pint of sherry.

ANTIPYRIN.

PHENAZONE. PHENAZONUM. Commonly known as "antipyrine," which is a registered trade-mark in the United Kingdom. Phenyl-dimethyl-pyrazolone. $C_8H_5(CH_3)_2C_3H N_2O$. (B.P., 1891 Edition).

It is obtainable from phenyl-hydrazine. It occurs in colourless, inodourless, scaly crystals, with a bitter taste and an alkaline reaction. It is soluble in about one part of water, alcohol, or chloroform. A one per cent. aqueous solution yields a white precipitate with tannin; is coloured green by concentrated hydrochloric acid; and the hydrochloric acid solution is red-dened by ferric chloride.

ACTIONS AND USES.—Antipyrin is an active member of the benzol or aromatic carbon group, and, like others of the series, it is **antiseptic, antipyretic, and analgesic**. It diminishes metabolism. It is a local anæsthetic and hæmostatic. Strong doses irritate the mucous surfaces, and hence when swallowed sometimes cause vomiting and other evidences of gastro-intestinal disturbance in men and dogs. Fröhner reports that dogs receiving two drachms exhibited excitement, and subsequently paralysis of the central nervous centres, tetanic or epileptic fits, cyanosis, muscular weakness, paralysis beginning in the hind-quarters, with serious lowering of temperature. Although **elimination by the kidneys** begins within half an hour after administration, it is slowly excreted. The urine of dogs receiving full doses, for several days contained the drug, as evidenced by its being coloured red-brown by ferric chloride solution. Fröhner further states that, although medicinal doses have little effect in lowering the temperature of healthy animals, they **reduce abnormal temperature** usually within half an hour, and their effects continue two or more hours (*Arzneimittellehre für Thierärzte*). Kaufmann records that one gramme (15·4 grains) given hypodermically reduced the temperature of dogs

from 38·9° to 38·2° Cent., of horses from 38·7° to 38·2° Cent., and of rabbits from 40° to 37° Cent. These antipyretic effects are ascribed to diminished production of heat (p. 131). Observation shows that less oxygen is taken in, while less urea and carbonic acid are excreted. It produces its actions whether it is swallowed or introduced subcutaneously or intratracheally, and seems to develop no untoward effects, not even irritation at the point of injection.

It has been prescribed for the several domestic animals in most febrile and inflammatory cases. German veterinarians commend it for **horses, in influenza**, as well as in muscular and articular rheumatism; but as an antirheumatic it is not as effectual as the salicylates. Dogs are brought under its antipyretic action more effectually than cattle or horses, and it deserves to be more generally used in canine practice. French veterinarians prescribe it as a carminative in irritable conditions of the central nervous system, and as a general analgesic as well as a local anæsthetic in neuralgic cases. A five per cent. solution is frequently used to check capillary hæmorrhages, and hypodermically for local pains.

The doses are about double those of antifebrin. Horses take ℥ij. to ℥iv.; cattle, ℥iij. to ℥vi.; sheep, ℥i; dogs, grs. xv. to grs. xx., given in bolus, solution, or electuary. For hypodermic and intratracheal injection about one-third of these doses suffice.

ARECA-NUT.

ARECÆ SEMINA. Seeds of Areca Catechu. Betel-Nut. *Nat. Ord.*
—Palmacæ.

The catechu or betel-nut palm is a straight, slender tree, forty or fifty feet high, growing on the Coromandel and Malabar coasts, and throughout the warmer parts of Asia. Within a fibrous fruit lies the hard, ovoid, red-brown seed, of the size and appearance of a nutmeg. When ground, the powder is brown, astringent, and partially soluble in hot water and spirit. It contains besides tannin two alkaloids, one inert, the other arecoline ($C_8H_{13}NO_2$), a liquid resembling muscarine in its paralysing the cardiac muscle, diminishing the activity of the

respiratory centre, and contracting the pupil (*Journal of Chemical Society*, 1890). A portion of areca-nut rolled up with a little lime in the aromatic pungent leaf of the Piper betel constitutes the betel or pawn so extensively chewed in Eastern countries.

ACTIONS AND USES.—Areca-nut is an **astrigent** resembling catechu, and an effective **vermicide**, especially for dogs, proving destructive alike to tape and round worms. Its effects in horses and cattle are not so certain. Mr Hanley (*Veterinarian*, May 1862) states that he gave a bitch, which had fasted twenty-four hours, two drachms of powdered areca-nut in milk. In fifteen minutes she passed a mass of tape-worms, varying in size from one inch to three feet, and numbering forty-three, each stated to have a perfect head! Mr Hanley also records the case of a greyhound bitch, which passed, after the use of the nut, a tape-worm thirteen yards and two feet long. Such rapid riddance of the worms is not, however, always attainable; and it is usually desirable to conjoin with the areca ℥x. to ℥xv. of male shield fern fluid extract. This combination, Professor Williams testifies, is the most effectual remedy for tape-worm in dogs. If the parasites are not removed, a second dose of the mixture should be given several days later. If the results are still unsatisfactory, the patient vigorous, and the bowels not unduly relaxed, a moderate dose of castor oil and turpentine will sometimes bring away worms which were previously immovable.

DOSES, &c.—For dogs, grs. xv. to ℥ij.; for horses, ℥iv. to ℥vi. It is convenient to note Mr Mayhew's observation that the dose of the powder for the dog is about two grains for every pound of the animal's weight. It is administered in soup, mucilage, or milk, to the last of which worms are particularly partial. Previous to the administration of areca to a verminous patient, the bowels should be cleared out by any simple laxative, and their further emptiness ensured by several hours' fasting. The parasite, thus starved, greedily swallows the poison prepared for it.

ARNICA.

ARNICÆ RHIZOMA. The dried rhizome and rootlets of *Arnica montana*. (B.P.) Leopard's Bane. Mountain Tobacco. *Nat. Ord.*—Compositæ.

Arnica montana is a perennial, growing in many of the mountainous parts of Central and Southern Europe, and also in Asia and America. It has a hairy stem about one foot high, composite yellow flowers, used in America for making the tincture, obovate leaves, and a cylindrical, contorted, brown root, one to three inches long, two or three lines thick, distinguished by a peculiar aromatic, offensive odour, and a bitter, peppery, acrid taste. It contains mucin, extractive matter, two volatile oils, and an active, bitter, yellow, amorphous principle, **arnicin**.

ACTIONS AND USES.—*Arnica* is irritant and stimulant, has been credited with alterative properties, and is used externally as a stimulant for strains, bruises, and wounds.

Viborg gave a horse six drachms of the flowers in infusion, and records production of quickened circulation and diuresis. Professor Williams recommends one to two ounces of the tincture in congestion of the lungs and lymphangitis in horses, stating that it stimulates cutaneous circulation. Other practitioners have administered it in the second stages of pleurisy, in weakness of the loins, in muscular strains, and in rheumatism. Mr Dollar, of New Bond Street, London, has, however, repeatedly tried it, without benefit, in horses suffering alike from acute and chronic rheumatism. In the several forms of rheumatic kennel lameness in dogs, and in stiffness produced from over-exertion, it has been employed empirically both externally and internally. It is a favourite homœopathic remedy.

Externally, *arnica* is a popular vulnerary in strains, bruises, and wounds, and especially in broken knees and sore shoulders. An ounce of the tincture is dissolved in twelve to twenty ounces of cold water. A more effectual lotion is made with a drachm of *arnica* tincture and one or two drachms of zinc sulphate or lead acetate, diluted with ten or twelve ounces of water. For painful or irritable wounds the tincture is

employed with chloroform, belladonna tincture, or laudanum, diluted with water according to circumstances. Along with liberal feeding and tonics, a drop of arnica tincture placed daily within the eyelids is one of the remedies for those troublesome ulcerations of the cornea which affect weakly dogs recovering from distemper. Arnica has, however, been over-estimated; the evidence of its value as an internal remedy requires confirmation, while the healing properties ascribed to it appear to depend on the other drugs, spirit, or cold water with which it is generally used.

Doses, &c.—Horses take fʒiv. to fʒi. of the tincture; cattle, double that quantity; dogs, ℥v. to ℥viij., mixed with water, ale, or gruel. The flowers, leaves, and root are occasionally used powdered, especially for making poultices; the **tincture** is usually made with an ounce of the coarsely powdered root to a pint of rectified spirit. Watery infusions can be of little efficacy, for neither the arnicin or volatile oils are soluble in water.

ARSENIC.

ARSENICUM ALBUM. Arsenious Anhydride. Arsenious Acid.

White Arsenic. Oxide or Trioxide of Arsenic. As_2O_3 .

Arsenic is found associated with iron cobalt and nickel sulphides, constituting arsenides and arsenio-sulphides. Mispickel (FeS_2 , $FeAs_2$), obtained from the mines of Silesia and Cornwall, is its most common source, is roasted in ovens, iron oxide and sulphide remain, while the crude arsenious anhydride is conducted into condensing chambers, and purified by sublimation. When the anhydride is heated with charcoal, the metal arsenicum (As) is obtained, resembling in its affinities and properties phosphorus, and the triatomic metals, antimony and bismuth. It forms two series of salts: the arsenious or triatomic arsenites (NaH_2AsO_3), and the less soluble and less poisonous penatonic arsenates (Na_2HAsO_4 , 7Aq.)

PROPERTIES.—The anhydride, white, or common arsenic, used in medicine, as well as in the manufacture of glass, colours, and shot, is generally met with as a lustrous white powder, of the specific gravity 3·8, consisting of minute glassy fragments

and octahedral crystals. It is odourless and tasteless, rough and gritty between the teeth, and if held in the mouth shortly causes irritation. When long kept it loses its transparency, and becomes opaque. At a temperature not exceeding 400° Fahr. it is entirely volatilised. Sprinkled on a red-hot coal or shovel it is decomposed, and the metal in vapour gives off a characteristic garlic odour. Arsenic is very sparingly soluble, either in water or alcohol. A pint of cold water at 60° Fahr. does not take up more than 20 grains; a pint of boiling water added to arsenic, and allowed to cool, takes up 22 grains; but when boiled in water for two or three hours, the ordinary crystalline arsenic is converted into the vitreous form, and in each pint 219 grains are dissolved (Bloxam). Solubility is diminished by organic matters, but increased by acids, alkalies, and alkaline arsenites.

TESTS.—Arsenic is readily identified—(1) by sublimation, producing the characteristic crystals of trioxide; (2) by reduction, developing a distinctive mirror of metallic arsenic, which may be again oxidised; and (3) by chemical reactions in solution.

1. A few grains of arsenic, placed in a common test-tube, and heated in a spirit-lamp flame to about 380° Fahr., sublime unchanged, and condense again in the cool part of the tube in shining crystals, which, examined with a pocket lens, are found to be regular octahedrons, or portions of such octahedrons exhibiting facets which are equilateral triangles. The corresponding antimony oxide, with which arsenic may be confounded, is less volatile, and condenses slowly in needles low down in the tube.

2. A mixture of arsenic and dry charcoal, a little cyanide of potassium, or, still better, some black flux, which is a mixture of carbon and potassium carbonate, obtained by heating cream of tartar in close vessels, is introduced into a test-tube the size of a crow-quill, or into one of those tubes specially made for testing arsenic, and having a narrow neck and small bulb. The mixture being heated to redness, oxygen is abstracted from the arsenious oxide, and metallic arsenicum volatilises as a colourless gas with a distinctive garlic odour, and condenses in the narrow part of the tube, forming a brilliant steel-grey incrustation. This is dark-coloured and smooth externally, and lighter and more crystalline, rough, and shining internally. When the narrow part of the tube is cut out, placed in a common test-tube, and heated, the arsenicum regains the oxygen previously lost, and a crust of white arsenic in the characteristic octahedral crystals forms in the cool part of the tube.

3. When this white crust of oxide is boiled with a little water acidulated with hydrochloric acid, or when arsenic is otherwise in a state of solution, there are three other tests by which it may be readily identified—(a) Hydrogen sulphide, in an acidulated solution, gives a yellow precipitate of arsenious sulphide (As_2S_3) or yellow orpiment. Arsenious sulphide differs from the yellow persulphide of tin in being soluble in ammonium carbonate; unlike the yellow cadmium sulphide, it is soluble in alkaline solutions; unlike the orange-coloured antimony sulphide, it is insoluble in hydrochloric acid. (b) Silver ammonio-nitrate (prepared by

adding ammonia to silver nitrate dissolved in about forty parts of water until the precipitate which first falls is almost wholly redissolved) gives a primrose yellow precipitate of the silver arsenite (Ag_3AsO_3). (c) Cupric ammonio-sulphate (prepared in a similar manner to the silver ammonio-nitrate) gives an apple-green precipitate of copper arsenite (CuHAsO_3), largely used as a pigment, and commonly known as Scheele's green. Both the silver and copper arsenites are soluble in ammonia and nitric acid. Although these liquid tests, taken individually, are not quite free from fallacy, still all of them together afford adequate evidence of the presence of arsenic; and this evidence is of course still further strengthened by obtaining the distinctive crystals of oxide, and afterwards reducing them to the metallic state.

When arsenic, in combination, is present in the contents of the stomach, the tissues of the body, or in coloured organic mixtures, the tests mentioned are inapplicable until the arsenic is isolated. To effect this, the following processes are in common use:—

1st. The mixture is boiled, with addition of water if necessary. It is then filtered, acidulated with hydrochloric or acetic acid, subjected to a stream of hydrogen sulphide, and again boiled. A yellow precipitate of arsenic sulphide or orpiment gradually appears, and its nature may be readily demonstrated by washing, drying, and heating it in a tube as above described, with a mixture of charcoal and potassium carbonate, when metallic arsenic volatilises, oxidises, and condenses in the characteristic crystals of white arsenic, which may further be reduced to the metallic state, or subjected to the liquid tests already mentioned.

2nd. The mixture is acidulated with pure hydrochloric acid, and boiled with a few clean copper clippings, on which there collects a steel-grey coating of arsenide of copper. The clippings are put into a test-tube, and cautiously heated until a ring of white arsenic lines the cool part of the tube. Indubitable evidence of the nature of this sublimate may be had by dissolving it in acidulated water, and applying the tests for arsenic in solution. This is generally known as Reinsch's process, and it is so delicate that it will detect 1-250,000th part of arsenic in solution (Christison).

3rd. The mixture, placed in a Wolf's bottle, a Döbereiner's lamp, or other convenient apparatus, is treated with zinc and sulphuric acid (which must themselves be free from any traces of arsenic, as ascertained by the hydrogen they evolve being uncontaminated by arseniuretted hydrogen). Hydrogen is set free from decomposition of the water, and unites with the arsenicum of any arsenical compound present. The arseniuretted hydrogen or arsenious hydride (AsH_3) so formed may be decomposed by heating with a spirit lamp the glass tube through which it is passing off, when a crust of metallic arsenic is deposited, and may be subjected to examination in the usual way. Or, if the end of the exit tube be narrowed, and the gas ignited, it burns with a livid blue flame, while a piece of glass or porcelain held over the flame soon becomes incrustated, either with metallic arsenic or arsenious acid, according to the distance at which it is kept from the flame. This elegant method of extracting arsenic from complex fluids is called Marsh's process. The late Mr Morton, of the Royal Veterinary College, proposed a delicate and ingenious method of evolving arseniuretted hydrogen from fluids containing arsenic, without the use of zinc and sulphuric acid, by passing a galvanic current through them. The gas thus evolved is subjected to the same examination as in Marsh's process.

4th. The fluid is placed in a retort, together with some common salt, sulphuric acid is added in small portions through the tubuline and heat

applied. Chloride of arsenic distils over, together with water, and collects in the receiver, the contents of which are submitted to any of the foregoing tests, preferably to No. 3.

The quantitative estimation of arsenic is generally determined by ascertaining the number of grain measures of the standard solution of iodine which the arsenical solution decolorises.

ACTIONS AND USES.—Arsenious acid is a corrosive irritant poison, killing either by gastro-enteritis or by nervous paresis. Continued doses cause fatty degeneration. It is prescribed as a gastro-intestinal tonic, as a stimulant and alterative, acting especially on the digestive and respiratory mucous membranes and skin, as an antiperiodic and tonic, and as an antispasmodic in nervous diseases. It is used externally as a stimulant, caustic, antiseptic, and parasiticide.

GENERAL ACTIONS.—Arsenic belongs to the triatomic group, which also comprises phosphorus, antimony, and bismuth. These agents diminish oxidation, decompose albuminoid tissues, produce fatty degeneration, and impair the glycogenic functions of the liver. With the exception of bismuth, which forms few soluble compounds, the members of this group are irritant, corrosive poisons. Their hydrogen compounds are specially active.

Locally applied, arsenic causes congestion, heat, and pain, with destruction of tissue, but the slough is preserved by the antiseptic effect of the poison. **It is absorbed** from any mucous, serous, or skin-abraded surface, and exerts its effects by whatever channel it enters the body. Small medicinal doses stimulate the stomach and promote gastric secretion. Beginning with small doses, animals shortly acquire a **tolerance** of arsenic, and take with impunity doses which would prove fatal to those not accustomed to them. Full doses irritate the surfaces with which they come into contact; cause gastro-intestinal derangement; in dogs and other carnivora vomiting, quickened weakened cardiac action, reduced temperature, cramps, general œdema, delirium, coma, and death. Although its power to produce **fatty degeneration** is not so great as that of phosphorus, it softens the protoplasm of the columnar cells of the epidermis of frogs. A similar fatty degeneration is also often observed in the epithelial lining of the alveoli of the lungs of animals poisoned by arsenic. The glycogenic functions of the liver are impaired by continued doses, and in pigs

fowls, and rabbits the fatty degeneration in three or four weeks invades most of the soft textures and attacks the bones. It is **quickly eliminated**, chiefly in the urine, and to a less extent by the liver, skin, and glands generally. Five to six hours after administration it may be found in the urine and milk, and its elimination is complete in two or three days.

All arsenical compounds are poisonous, and the most soluble are the most active. Deadliest of all is arseniuretted hydrogen, which has occasioned the death of three chemists, who unfortunately inhaled it. Orfila found that the sulphides, in doses of forty to seventy grains, destroyed dogs in two to six days, and had much the same effect whether they were swallowed or applied to a wound. Metallic arsenic, although itself innocuous, unites so readily with hydrogen and oxygen that it speedily acquires poisonous activity.

The toxic dose for the horse is liable to considerable variation. Berthe gave a mare affected with inveterate mange two, and afterwards three, drachms without injury (*Recueil de Médecine Vétérinaire*, October 1825). Beissenhirz gave one, four, three, two, and eight drachms, on successive days; but death occurred twenty-four hours after the last dose (Pereira's *Elements of Materia Medica*). Hertwig gave eight horses doses, beginning with 20 grains and gradually increasing to a drachm; continued the administration in some cases for thirty days, in others for forty days, but observed no bad consequences, either during the use of the poison or afterwards; the pulse became a little stronger and harder, and some of the animals improved in condition (*Praktische Arzneimittellehre für Thierärzte*, Berlin). Mr William Percivall, experimenting on a horse affected with glanders, began with one drachm daily, made into bolus with linseed oil and treacle, increased this dose by 20 grains per day, and continued the medicine for seventeen days, when the animal got, in one dose, 380 grains, and had then taken upwards of seven ounces of arsenic. Yet no physiological effect was obvious, no loss of appetite, no uneasiness or pain, and no alteration of the pulse or respiration (*Veterinarian*, 1843, p. 347).

Although such large doses sometimes have little effect, much smaller doses occasionally act with greater violence. Thus,

Gerlach saw 20 grains cause active diarrhoea; and Mr Percivall mentions that two glandered horses, getting five grains daily in bolus, were attacked, one on the eighth, the other on the ninth day, with shivering, loss of appetite, nausea, purging, and other symptoms of abdominal irritation, imperceptibility of the pulse, and prostration of strength. One died, the other recovered (*Veterinarian* for 1843, pp. 349-351). These very different effects depend partially on varying susceptibility; mainly on the amount of food present in the alimentary canal; on the fact that animals receiving arsenic regularly gradually acquire a tolerance of it, and take with impunity at one dose as much as would kill a patient unused to it; whilst large doses, moreover, produce inflammatory changes in the coats of the alimentary canal which greatly retard absorption. Arsenic given in solution is, however, more certain, regular, and active than in the solid state. Thirty grains given daily, dissolved in potassium carbonate, destroyed a horse in four days (*Veterinarian*, 1843, p. 350).

Mr Baldwin, in the *Veterinarian* for January 1858, reports the case of six horses poisoned by drinking from a pail in which some arsenical sheep-dipping mixture had been dissolved. Two died, and there were found on examination inflammation of the mucous coat of the stomach, and patches of inflammation extending throughout the whole alimentary canal. The others suffered from dulness, colicky pains, and purging; the pulse was upwards of 70, and wiry; the extremities cold; the visible mucous membranes highly injected. One mare was ill for three or four days. The treatment consisted of opiates and lime-water.

Eleven cart horses were poisoned at Edgware in August 1874, from drinking water containing arsenic (*Veterinarian*, September 1874). They had been drawing heavy loads of building materials fully eight miles from London, were tired, and their stomachs empty, which doubtless accounts for the rapid and serious results. Although arsenic is not known to have proved fatal in the human subject under seven hours, one of those horses dropped and died ten minutes after drinking, and several were dead within an hour. The symptoms recorded were colic, staggering gait, pallid membranes, cold ears, pulse 40 to 60,

breathing quickened, and latterly coma. Brandy and ammonia were the remedies prescribed.

Cattle take with impunity even larger doses than horses, for the comparatively insoluble poison mixes with the large bulk of food in the first stomach, and hence tardily reaches the absorbing walls of the fourth stomach; while the small amounts thus gradually introduced into the circulation are continuously excreted, and thus toxic effects are warded off. Mr J. V. Blake, Ryde, Isle of Wight, records the death of fourteen in-calf cows, which had an arsenical dip powder mixed with their hay. Poisoning symptoms appeared in twenty hours, and consisted of "acute abdominal pains, profuse diarrhoea, heavy breathing, staggering gait, cold extremities," &c. Thirteen of the cows died within three days, while one survived a week (*Veterinarian*, March 1892).

A strong **sheep** received an ounce of arsenic dissolved with a handful of salt, and exhibited most of the symptoms mentioned as occurring in horses, and death after five days (*Veterinarian*, 1843, p. 345). Hertwig states that 5 to 10 grains given in solution to healthy sheep produced gastrointestinal irritation; that a second dose of 10 to 20 grains, given twenty-four hours after, caused death; and that, on examination, the poison was found in the blood, urine, lungs, liver, and muscles. The carcasses of sheep poisoned by arsenic have, however, been eaten by dogs with impunity (*Veterinarian*, 1843, p. 345).

Chronic arsenical poisoning, with symptoms of indigestion, thirst, wasting, and chronic disease of the joints and bones, is sometimes met with amongst both cattle and horses in the neighbourhood of the tin and copper smelting furnaces of Cornwall and Wales. Mr W. H. Michael, of Swansea, one of the witnesses examined before the Select Committee of the House of Lords on the injurious effects of noxious vapours, stated: "I have known rabbits, sheep, and horses poisoned. I have seen a great amount of injury done to ponies. The gentleman who occupied the farm of which I am speaking kept several hundred ponies, which he bought very young generally, and fattened them for sale. He was obliged to give up keeping them, owing to the peculiarly starved and shaggy appearance

those animals acquired. The knee-joints began to swell, they got lame and hide-bound, the hair fell off, the teeth became black and fell out, necrosis of the bones occurred, and the result was that he gave up grazing on a large tract of land" (*Report*, 1st August 1862). Arsenical green paper left in the way of animals has sometimes been eaten in quantities sufficient to cause death. Rabbits at shows have been destroyed by nibbling the bright green prize cards. An aged donkey is recorded to have died in three hours, poisoned by eating green paper (*Veterinarian* for June and July 1865, and July 1871).

Dogs and cats are more quickly and powerfully acted upon than horses or cattle, and relatively to their weight exhibit about the same susceptibility as human patients, in whom 2·5 grains is the smallest dose known to have proved fatal. Dogs to which I administered 3 to 10 grains in solution within a few minutes exhibited nausea, vomiting, moaning, difficult breathing, a wiry, rapid pulse of 120 or upwards, and shortly passed black evacuations with considerable pain; while death with convulsions followed in from six to thirty hours. Dogs receiving a quarter of a grain to a grain, repeated twice daily, and continued during eight to fourteen days, exhibit gradually diminishing appetite and increased vomiting. From the sixth to the tenth day, diarrhoea, lowered temperature, rapid emaciation, and painful cough ensue, and death occurs in twenty or thirty days. Half an ounce of Fowler's solution injected into the jugular vein of a dog, although it caused immediate vomiting, proved fatal in eighteen hours, and left the stomach and intestines reddened and injected. Full doses increase disintegration of albuminoids. A. Kossel gave sodium arsenite to dogs in doses of $1\frac{1}{2}$ to 3 grains for ten days, and found that the amount of nitrogen excreted rose, even in inanition, to 48 or 60 grains, and in healthy dogs getting arsenic reached 110 to 120 grains (*Centralblatt für die Med. Wiss.* No. 18, 1876).

Pigs and poultry are acted on in the same manner as dogs.

The post-mortem appearances of poisoning by arsenic, although very similar in all animals, differ a good deal with

the severity and duration of the case. In the horse the cuticular portion of the stomach is not usually much altered; but the villous portion is reddened, softened, thickened, and disorganised by patches of inflammation and extravasation of blood, which, excepting in rapidly fatal cases, extend into the duodenum, and are also observable in the colon, cæcum, and rectum; indeed, excepting in very acute cases, the posterior portions of the digestive tract are much inflamed from the poison during excretion being eliminated into them. The lungs are usually congested, and their mucous membrane, with that of the urino-genital organs, is red and vascular. In chronic poisoning the body becomes dry and mummified, while fatty degeneration affects the epithelial tissues, the brain, lungs, and liver.

In treating acute cases of **arsenical poisoning**, the stomach must be washed out with copious draughts of tepid water, and emptied, in carnivora by emetics, such as mustard or zinc sulphate, in horses or cattle by the stomach pump. The **best chemical antidote** is prepared by precipitating a ferric chloride solution with ammonia, washing the precipitate with warm water, and administering it moist and freshly made. Some authorities recommend precipitation of two to three ounces of ferric chloride solution with one ounce of sodium carbonate crystals; these quantities, freshly prepared, suffice to neutralise ten grains of arsenic, converting it into the insoluble iron arsenate ($\text{Fe}_3 2\text{AsO}_4$). Dialysed iron, which has the advantage of being ready in most pharmacies, is nearly as effectual as the ferric oxide or carbonate. Either of these iron antidotes should be given as soon as possible, in repeated doses, at intervals of ten minutes, until a quantity has been swallowed at least twelve times greater than that of the poison. **Magnesia** in its hydrated or gelatinous form, prepared by precipitating a solution of Epsom salt with caustic potash, also diminishes greatly the solubility of arsenic. Insoluble powders, charcoal and clay, envelop the particles of poison, and retard absorption; but such mechanical antidotes to be of service must be given before, along with, or immediately after the poison. Oils, lard, glycerine, mucilage, and milk exercise similar mechanical effect, and some of these bodies also slightly diminish the

solubility of arsenic. Subcutaneous injection of morphine, repeated at intervals of fifteen to twenty minutes, in the first stages retards absorption of the poison, and in later stages antagonises irritation. Demulcents and opium are given to combat gastro-intestinal irritation. In chronic cases oleaginous laxatives and enemata relieve griping and constipation; while easily-digested, nutritive food helps to sustain the powers of life, and occasional diuretics hasten excretion of the poison by the kidneys.

MEDICINAL USES.—Arsenic is administered in all animals as a **gastric tonic** in irritative dyspepsia and gastralgia, and in chronic catarrhal diarrhœa, where imperfectly-digested food is hurried through the intestines. In such cases it is frequently conjoined with antacids and opium. It often assists the removal of worms.

Chronic diseases of the air-passages, notably chronic catarrh and ozæna in horses, are often benefited by a course of arsenic. It promotes recovery from tedious influenza attacks, hastens removal of lung consolidations, and relieves irritable cough and roaring in its early stages, as well as thick and broken wind. Professor Robertson spoke strongly of its value in roaring; in abating the dyspnœa and cough of thick and broken wind, he enjoined its use daily for ten days or a fortnight, when some other remedy was directed to be substituted; and in broken wind, frequently with advantage, persisted with two to three grains twice a week for months (*Equine Medicine*).

As an **alterative**, modifying tissue changes, it is prescribed in the earlier stages of tuberculosis, in farcy and rheumatism, in chorea and epilepsy, and in *maladie du cit*, in which Continental veterinarians conjoin it with iron, and alternate with oil of turpentine. In febrile attacks manifesting periodicity, arsenic is sometimes as effectual as quinine. Dr Lauder Brunton believes that its efficacy in phthisis depends upon its hastening the removal of the effused products of pneumonia which form a suitable nidus for the bacillus tuberculosis (*Pharmacology, Therapeutics, and Materia Medica*). Professor Williams prescribes arsenic and *nux vomica* in farcy. In anæmia medicinal doses probably increase both the white and

red corpuscles, especially when conjoined, as it usually is in such cases, with iron. When mixed with freshly-drawn blood it retards coagulation and putrefaction, and preserves the globules, and possibly exerts similar effects when administered internally. Full doses freely diluted are prescribed thrice daily, immediately after meals, for dogs suffering from chorea, and are sometimes also serviceable in epilepsy. Its value in these nervous disorders appears to depend partly on its alterative actions, and partly on its diminishing irritability of motor nerves. **It stimulates the dermis**, hastens removal of morbid epidermal cells, and is hence useful in chronic eczema, psoriasis, impetigo, scab, and mange, and in such cases is used both internally and externally. In chronic scaly skin complaints Professor Williams prescribes it with mercury and iodine.

In Styria it is **eaten by the peasantry**, with the view of improving the complexion, producing plumpness, preventing breathlessness in running or ascending hills, and increasing general vigour. In various parts of England, as well as in Southern Europe, small doses are sometimes regularly **given to horses**, and as it diminishes oxidation, muscle waste, and production of carbonic acid, active exertion is performed with a minimum of fatigue. So long as it is used cautiously and regularly, the animals appear to be in excellent health, and have fine sleek coats; but when, after being used for several months or for years, the arsenic is withdrawn, they fall off in appearance, and for many months are greatly more difficult to keep in condition. A small portion of arsenic in a thin bag is sometimes attached to the bit, to produce the frothy muzzles which seem to be admired in high-stepping carriage horses. These practices should not, however, be tolerated, for they are attended with much risk of poisoning, and are, moreover, liable to injure the horse's constitution.

Externally, arsenic is occasionally used to eradicate warts and slough out fistulæ and malignant tumours, one-fifth to one-fourth being used with unguentum simplex or other emollient. For the cure of foot-root, Professor Williams recommends that the affected sheep be slowly driven through troughs containing a tolerably strong solution of arsenic in carbonated alkali (*Principles and Practice of Veterinary Surgery*).

In solution it is sometimes applied to remove the scurfiness of psoriasis. Used incautiously, it causes destruction and sloughing of tissue, and if absorbed may produce constitutional effects. In virtue of its **antiseptic** properties it is used in the form of powder solution and soap for the preservation of skins and natural history specimens.

For sheep dips arsenic is much used. Such dips destroy ticks and keds more effectually than solutions of tobacco, spirit of tar, alkaline and other non-poisonous dips, and are safer and more convenient than mercurial baths or ointments. Two to two and a half pounds of arsenic, with about the same quantities of soda ash or impure sodium carbonate, soft soap, and sulphur, are dissolved in a hundred gallons of water. Three, four, and even five pounds of arsenic are sometimes used without evil results. In many parts of England, pearl ash or impure potassium carbonate is substituted for the soda ash, and makes a more cleansing and softening ley. Some flockmasters double or quadruple the quantity of soap, which, with the alkaline carbonate, aids in dissolving the arsenic, while the sulphur whitens and softens the fleece, and also for a considerable time prevents attacks of flies, which are further deterred by addition of a pint or two of naphtha, or of impure carbolic acid. The ingredients are best dissolved in five to ten gallons of boiling water; cold water is added to make up a hundred gallons, which, with careful dripping, will dip about a hundred sheep. The head must of course be kept out of the dip, in which the sheep is held during forty to sixty seconds, is lifted on to a sparred drainer placed over a second tub, or over a trough communicating with the dipping tub, and the wool well squeezed with the hands, and with a scraper such as is used for cleaning horses.

Serious and fatal consequences sometimes, however, result from the use of arsenical dipping mixtures. A Lincolnshire friend, twenty hours after dipping 150 half-bred Leicester hogs, lost eleven, and several some days later. A greatly more serious case occurred at Burton, in Northumberland, during the summer of 1858. Mr Black of Burton purchased from Mr J. Elliot, chemist, Berwick-on-Tweed, fifteen packets of dipping mixture. Every packet contained 20 ounces each of

arsenic and soda ash, and two ounces of sulphur, and was directed to be dissolved, with four pounds of soft soap, in three or four gallons of boiling water. With 45 gallons of cold water subsequently added, this made quantity sufficient for fifty sheep. On 14th August Mr Black had 869 sheep dipped in the usual manner; the apparatus and arrangements were good, and the dripping performed with care. In two days, however, the sheep began to die; they were seized much in the same order as they had been dipped, and within a month 850 had perished. In many cases the symptoms came on suddenly; and Mr Bird, the veterinary surgeon in attendance, records that several died in twenty minutes after he had observed them eating or ruminating, and apparently well. The usual symptoms were dulness and nausea, frothing at mouth, blood-shot eyes, pain in the bowels, the passage of black and bloody urine, laboured breathing, blackening of the skin, with the wool falling off in patches, especially about the back and loins. Post-mortem examination discovered the bowels inflamed, and covered with patches of extravasated blood, the lungs blackened and inflamed, the liver black, soft, and friable, the spleen congested, the bladder empty. Arsenic was found, on analysis, in the stomachs and bowels.

The case came to trial at Newcastle in February 1859, and the jury found a verdict for Mr Black, with damages amounting to £1400. Mr Black's case rested mainly on the fact that his sheep had been carefully dipped in the usual manner, and according to the printed instructions sent out with each packet of the dipping mixture. It was sought to be proved that the mixture might in some way have been improperly made up, and was of such poisonous strength that it had become absorbed through the skin. The poisoning of a donkey which had carried the skins of the dead sheep, some sores and gangrenous patches on the hands and arms of several of the men employed in the dipping, were also adduced as evidence of the undue strength of the mixture.

In defence of Mr Elliot, it was shown, on the other hand, that thousands of sheep had with impunity been dipped in mixtures of the same strength as that sold to Mr Black; that, indeed, on the same day as the Burton sheep were dipped

another gentleman in the neighbourhood, without any bad effect whatever, used eight packages of the same mixture made in the same way and at the same time. Professor John Gamgee and Dr Stevenson Macadam made various experiments, using, in two instances, arsenic in the proportion of 28 and 68 ounces for fifty sheep, instead of the 20 ounces present in Mr Elliot's dip. An Oxfordshire sheep-dipper, who annually passed through his hands several thousand sheep without losing one, for years employed $2\frac{1}{2}$ lbs. of arsenic for fifty sheep, or exactly double the strength of Elliot's mixture. I made in 1859, and have repeated and verified them since, experiments with dips three and four times the strength of Elliot's; some of the sheep I kept immersed for several minutes, and had these concentrated solutions well rubbed into the skin. I abstained in several instances from pressing or drying the wool, dipped the same sheep twice within two hours, and several times within a week, and yet failed in destroying or injuring in the smallest degree any one of the sheep subjected to these severe trials.

Arsenical sheep-dipping mixtures obviously **are not absorbed through the sound skin**. Their danger depends on portions of the poisonous fluid being retained by the fleece, from which it drips on the grass or other food over which the animals stray. In this manner undoubtedly the serious mortality at Burton is explained. The sheep were rapidly dipped at the rate of eighty per hour; and, according to the usual calculation, each sheep carries away in its fleece, even after it has been reasonably drained, about a gallon of the fluid, which, of Elliot's strength, would contain nearly 200 grains of arsenic—a quantity sufficient, if swallowed, to destroy eight or ten sheep.

Sheep after dipping are turned out hungry, and at once begin to eat; while **the drippings fall on the grass**, which, in the Burton case, appears to have been still further contaminated by rain during the night following the dipping, freely washing the poisonous solution out of the fleeces on to the pastures. Here it was found in three sods, removed ten days after and examined by Sir Douglas Maclagan, who failed, however, to find any arsenic in sods brought from an adjoining pasture, where no dipped sheep had grazed. It is evident

how the donkey, two oxen, and two horses shared the fate of the sheep; whilst the drippings, left in the yards before the flocks were turned out, would account for the mortality stated to have also taken place amongst the poultry.

It is an error to suppose that sheep, pigs, or other animals refuse to eat food over which arsenical dipping mixtures with their nauseous soft soap and alkali have fallen. I have seen sheep eat grass watered, for the purpose of experiment, with such solutions, and afterwards die from their poisoned meal. I have known horses, pigs, and poultry die from getting access to yards where recently-dipped sheep have been confined. Two colts came under my cognisance poisoned by eating a few vetches carelessly left in a yard where some sheep had been placed to drip.

The practical precautions enforced by such cases are as follows:—Yards into which freshly-dipped sheep are to be turned should previously be cleared of all green food, hay, and even fresh litter; if perfectly empty they are still safer. When the dipping is finished, they should be cleaned, washed, and swept, and any of the unused dipping solution at once poured down the drains. Obviously, however, no such poison should be run into drains emptying into pools or streams accessible to live stock. Dipped sheep should remain, if possible, in an airy, exposed place, as on a dry road, or in a large open yard. Overcrowding should be avoided, and every facility given for rapid drying, which is greatly expedited by selecting for the operation fine, clear, sunny weather. On no account should sheep be returned to their grazings until they are dry, and there is no risk of their poisoning the pastures.

Doses, &c.—Horses and cattle take grs. i. to grs. vj.; sheep, gr. j. to grs. ij.; and dogs, gr. $\frac{1}{15}$ to gr. $\frac{1}{10}$. When it is desired to produce its local actions on the stomach and intestines, small doses are given before eating; when its absorption is required, it is administered immediately after meals. It is usually given once daily, and persisted with for a week or ten days, when a change of prescription is often desirable. When it causes acceleration or hardness of the pulse, tenderness of the conjunctiva, indigestion, diarrhœa, or other physiological actions, the doses must be discontinued, materially reduced, or given at longer intervals.

It is most active and uniform in its effects when **used in solution**, and is given dissolved either in diluted acid or alkali. The liquor arsenici hydrochloricus contains one per cent., or about $4\frac{1}{2}$ grains arsenic in the fluid ounce. **The liquor arsenicalis**, or Fowler's solution, the preparation most frequently used in veterinary practice, contains about one per cent., or about $4\frac{1}{2}$ grains to the ounce. The B.P. gives the following instructions for its preparation:—Heat 87 grains each of arsenious acid in powder and potassium carbonate in a flask, with 10 fluid ounces of distilled water, until a clear solution is obtained. When cold, add 5 fluid drachms of tincture of lavender, and as much water as will make the bulk 1 pint. The dose for horses or cattle is from half an ounce to an ounce.

The liquor arsenici et hydrargyri iodidi, the B.P. imitation of Donovan's solution, contains about one per cent. by weight of arsenious iodide and of mercuric iodide, and is useful in chronic skin and rheumatic complaints, the dose for horses and cattle being 1 to 2 ounces. Professor Williams, after a purgative, and softening the hard cracks with oil and alkalis, treats the scaly eruptions of psoriasis, both internally and externally with a triple compound of iodine, arsenic, and mercury, each ounce of which contains 1 grain arsenic, 2 grains mercurous oxide, and rather more than 6 grains hydriodic acid (*Principles and Practice of Veterinary Surgery*). Arsenical preparations being generally devoid of taste, are frequently administered in the drinking water, or in mash.

Whether for internal or external purposes, arsenic must be used with great circumspection. Under the Act regulating the sale of poisons, every purchase of arsenic must be registered in a book kept for the purpose; the purchaser must be of full age, and either known to the seller or to a witness who is also known to the seller; while, to lessen the risks of a white powder being mistaken for flour, or other harmless substance, it is enacted that, unless in quantities of 10 lbs., one ounce of soot, or half an ounce of indigo, shall be mixed with every pound of arsenic.

ARTEMISIA.

ARTEMISIA ABSINTHIUM. Wormwood.

ARTEMISIA MARITIMA. The Santonica or Wormseed Plant.

Nat. Ord.—Compositæ (Corymbifera).

The Artemisia are low shrubby plants, characterised by their aroma and bitterness, and belonging to the natural order Compositæ, which comprises the familiar southernwood and tansy, the mildly anodyne lettuce, and the harmless dandelion.

The dried Artemisia absinthium contains a volatile, camphoraceous oil, **absinthol**, and a bitter extract, yielding the neutral crystalline **absinthin**, which is a narcotic poison and spinal stimulant, causing in dogs and rabbits trembling, stupor, and epileptiform convulsions, which may prove fatal. In medicinal doses, it is an aromatic bitter tonic, and a popular remedy for worms. It is the chief active constituent of the liqueur absinthe.

The unexpanded minute flower-heads of Artemisia maritima are imported from Russia, contain a volatile oil, a resin, and about two per cent. of a crystalline neutral principle, **santonin** ($C_{15}H_{18}O_2$). It is almost insoluble in cold water, is soluble in chloroform, boiling spirits, fixed oils, and alkaline solutions, and hence in the intestinal juices. It is rendered yellow by sunlight, and gives a violet colour when added to a warm solution of potash in alcohol. It imparts a blood-red colour to the urine. Large doses cause in dogs giddiness, vomiting, and convulsions. It is a vermicide, without effect on tænia, but destructive to round and thread worms—given for the former by the mouth, for the latter by enemata. It is less effective in horses than in dogs, for which the dose is 3 to 4 grains, conjoined with aloes or jalap. As in human practice, it is effectual in checking incontinence of urine in young patients, for this purpose being equal to belladonna and superior to nuxvomica.

ASAFŒTIDA.

A Gum Resin obtained by incision from the living root of Ferula Narthex, Ferula Scorodosma, and probably other species. (B.P.) *Nat. Ord.*—Umbellifera.

The Ferula or Narthex Asafœtida has a massive perennial root, several inches in diameter, black externally, white within ;

large peony-like annual leaves, which are cooked and eaten; and a tall, fleshy, flowering stem, often ten feet high, throwing off from near its base branches which terminate in umbels of yellow flowers. The plant, all parts of which emit a penetrating, foetid odour, grows luxuriantly in Persia and the hill districts of Upper India, and several fine specimens have flowered in the Edinburgh Botanic Gardens. When the plants are four years old, the leaves and stems are removed, and six weeks later, towards the end of May, a slice is cut from the upper part of the root; the slicing is repeated several times at intervals, when the plant is exhausted, after yielding from a half to two pounds of a foetid milky juice, which concretes, is scraped off, and is worth 2s. to 4s. a pound.

The yellow-brown tears are mixed with soft earth and made into irregular masses, which are red-brown externally, and within are opaque and milk-white, but gradually change to a dull yellow-brown. Asafœtida has a disagreeable, penetrating, garlic odour, and a taste becoming intensely bitter and acrid. It is pulverised with difficulty, is sparingly soluble, but forms an emulsion with water, is dissolved in rectified spirit, and also in potash and ammonia. Besides water, it contains 50 to 60 per cent. of resin; 25 to 30 of gum; about 10 of earthy matters; 3 to 5 of an active alliaceous, **acrid volatile oil**, consisting of two ferulyl sulphides— $2(C_2H_{11})S$ and $C_6H_{10}S$.

ACTIONS AND USES.—Asafœtida is a mild stimulant, expectorant, carminative, antispasmodic, and vermifuge. It is speedily absorbed, its disagreeable odour indicating its general distribution; it is eliminated from the pulmonary mucous surfaces, the skin, and kidneys, gently stimulating their secretions. Professor Robertson used asafœtida, with aloes and nux vomica, in constipation and torpidity of the bowels in horses, and in flatulent colic prescribed the tincture along with oils of linseed and of turpentine. The spiritus ammoniæ foetidus, made with $1\frac{1}{2}$ ounce asafœtida, 2 ounces strong solution of ammonia, and 1 pint rectified spirit, is sometimes prescribed in colic and chronic cough. Like other substances containing odorous volatile oils, asafœtida is a vermifuge, but its action is uncertain. It is allied in some of its actions to valerian, and to ferula

sumbul, and closely resembles the two gum-resins, **ammoniac** and **galbanum**, which are scarcely so active, and are chiefly used for making charges and plasters.

Doses, &c.—Horses take ℥ij. to ℥iv.; cattle, ℥j.; sheep, ℥i.; and dogs, grs. x. to grs. xx. It is given several times a day; may be made into bolus with camphor and ammonium carbonate; is frequently prescribed in draught with watery or alcoholic solution of ammonia; and, to prevent their misappropriation, is usefully added to alcoholic and ethereal preparations intended for veterinary patients.

A X U N G E.

ADEPS. ADEPS PREPARATUS. Hog's Lard. The purified fat of the hog—*Sus Scrofa*.

To prepare purified lard, the fat about the hog's internal organs is cut into small pieces, is generally beat in a stone mortar, washed with cold water, drained, melted over a slow fire, strained through flannel or coarse cheese-cloth; is kept stirred in a steam-heated pan at about 130° Fahr. until it is clear and free from water, strained again through flannel, and preserved in casks, pots, or bladders. When pure, it is white or yellowish-white, granular, without odour, but with a sweet taste. It melts at about 100° Fahr., forming a clear, transparent fluid, which is a good solvent for wax and resins, and when boiled with alkalis forms soaps. Like other fats and oils, lard is insoluble in water, slightly soluble in alcohol, but perfectly soluble in ether. Exposed to the air, it becomes rancid, and in this state is unfit for emollient purposes. It contains about 62 per cent. of olein and 38 of palmitin and stearin. Distilled water, in which purified lard has been boiled, when cooled and filtered, gives no precipitate with silver nitrate, indicating absence of common salt; and no blue coloration with iodine solution, proving freedom from starch, of which about 20 per cent. is found in some inferior specimens; 10 per cent. of water is sometimes incorporated; alum and lime are occasionally added to secure whiteness and increase weight; while many brands of American lard are largely mixed with cotton-seed oil.

Benzoated lard, preferable on account of its agreeable odour and diminished liability to rancidity, is made by melting purified lard over a water-bath, and stirring in one-fiftieth part of benzoin. **Suet**—the fat around the kidneys of sheep or oxen—differs from lard chiefly in being firmer, harder, and more difficult to melt. **Horse's fat** is more easily melted, but firmer than that of swine. **Goose grease**, much used as a popular remedy for sprains and bruises, is more fluid, from its greater percentage of olein.

ACTIONS AND USES.—Fats and mild fixed oils, when given without other food, are inadequate to support life; thus, dogs, receiving only butter and olive oil, with distilled water to drink, died in about thirty-six days. In a well-regulated system of diet, fats serve, however, important purposes; along with albuminoids they form cells; they build up the nervous structures, so largely composed of fatty matters; are consumed in the body for the evolution of nervous, muscular, or digestive force, and for the support of animal heat, or, if in excess for these constant requirements, are stored away for investing and protecting internal organs. Fats are emulsified by the alkaline intestinal secretions, more thoroughly dissolved by the bile, and absorbed mainly through the lacteals. Although small doses are easy of digestion, large quantities disorder digestion and cause diarrhœa.

Hog's lard is occasionally used as an internal **demulcent**, as an **antidote** for poisoning with alkalies, and as a laxative clyster. It is applied as a **lubricant** in examination of the rectum or uterus, and in cases of parturition. In reducing enlarged joints or bursæ by vigorous rubbing, the hand is occasionally moistened with lard to prevent undue skin irritation. In congested, inflamed, thickened, and indurated states of the skin, when the sebaceous and sudoriparous glands act tardily, the application of lard, bland oil, or vaselin usefully replaces the deficient natural oil, and protects abraded surfaces from the action of air or of acrid discharges. Most animal and vegetable fats, freely used, and remaining long in contact with the warm skin, oxidise, and become rancid and irritating. Such results are retarded by addition of a little benzoic acid, and are obviated by the substitution of the mineral vaselin.

Lard is occasionally employed as a dressing in mange and scab, but is ineffectual in destroying the acari. It is much used for making ointments and liniments.

BARLEY.

HORDEUM. Pearl Barley. Malt. Yeast. *Nat. Ord.*—
Graminaceæ.

Barley is used as food for most of the domesticated animals; and, when stripped of its outer husk, is recognised by the B.P. as **pearl barley**. Ground to meal, it is used for making poultices and infusions. Good **barley-meal** contains 68 per cent. of starch, 14 gluten and albumin, 2 fatty matter, 2 saline matter, and 14 water. When moistened and exposed to a temperature of about 100° Fahr., barley germinates, the starch in great part being converted into dextrin and sugar, and, if the process be arrested by drying, malt is formed.

Malt—a sweet, mucilaginous substance, which is more easily digested, but weight for weight is rather less nutritive than barley—forms a palatable and digestible article of diet for sick or convalescent horses, and is used for making poultices and demulcent laxative drinks. Barley-water, infusions of malt, and soft mashies prove especially serviceable in febrile cases, both in horses and cattle. **Malt extracts** are occasionally prescribed for dyspeptic calves, and when well prepared are rich in diastase, and hence useful in aiding digestion of starch.

When a solution of malt is fermented, as in the preparation of beer, ale, or porter, there rises to the surface of the liquor a yellow-brown frothy scum, known as **yeast** or **barm**, the *Cerevisiæ fermentum* of the B.P., readily putrefying when moist, but when carefully dried remaining for a long time unchanged, and owing its reproductive properties, and its characteristic power of converting cane into grape sugar, and thence into alcohol, to the presence of ovoid, confervoid cells of *Torula cerevisiæ*. Yeast is occasionally used as a purgative, especially for cattle, and is given in quantities of about a pint. Antiseptic and deodorising poultices are made by stirring together one part each of boiling water and of yeast with two

parts of bran or linseed meal, and allowing the mixture to stand near a fire until it rises, when it is fit for use.

BELLADONNA.

BELLADONNÆ FOLIA. Deadly Nightshade. The fresh leaves, with the branches to which they are attached, of *Atropa Belladonna*; also the leaves, separated from the branches, carefully dried, gathered when the fruit has begun to form, from plants growing wild or cultivated in Britain. (B.P.) *Nat. Ord.*—*Atropaceæ*.

BELLADONNÆ RADIX. The root of *Atropa Belladonna*, growing wild or cultivated in Britain, and carefully dried, or imported in a dry state from Germany. (B.P.)

ATROPINE. *Atropina.* *Atropia.* $C_{17}H_{23}NO_3$. An alkaloid obtained from belladonna. (B.P.)

HYDROBROMATE OF HOMATROPINE. *Homatropinæ Hydrobromas.* $C_{18}H_{21}NO_3 \cdot HBr$. The hydrobromate of an alkaloid prepared from tropine. (B.P.)

Belladonna grows wild in most parts of Great Britain, especially about old walls, edges of plantations, and ruinous shady places; but the great demand for its preparations necessitates its extensive cultivation, and the cultivated are as active as the wild specimens. It has a fleshy, wrinkled, branching, perennial root, 12 to 18 inches long and 1 to 2 inches thick; a round, branched, reddish, downy, annual stem, 3 to 5 feet high; broadly ovate, acute, entire, smooth leaves, 3 to 8 inches long, alternate below, in pairs of unequal size above, supported on short leaf stalks of a sombre-green colour, and a faint bitter taste; pendulous dark-purple, bell-shaped flowers, appearing in June or July; a round, violet, berried, mawkish-tasted fruit, the size of a small cherry, ripe in September, and containing numerous kidney-shaped seeds. The plant has greatest activity towards the end of June and throughout July, when flowering is over, but before the fruit and seeds are developed. It is cut down and speedily dried; and so liable is it to deterioration from heating and moulding, that it is advised immediately to make the medicinal prepara-

tions. When the young branches as well as the leaves are used, the preparations are found to keep better, and to be more uniform and active.

The active alkaloid **atropine** occurs in the plant as a bimalate. The leaves contain 0.46 per cent., the younger roots as much as 0.60 per cent. It is prepared from a strong tincture. It occurs in colourless acicular crystals, is volatile, has a bitter taste, is sparingly soluble in water, more readily in alcohol and ether, and perfectly in chloroform. The easily soluble sulphate is used in preference to the alkaloid. It gives a citron-yellow precipitate with gold perchloride. An alcohol solution of mercuric chloride added to a crystal or strong solution of atropine causes a precipitate, which becomes red on standing or when boiled. Its most **distinctive test**, however, is its dilating the pupil.

Atropine can be split up into tropic acid and tropine, and this base, reunited with other acids, forms **tropeines**. When combined with oxytoluylic acid, the crystalline **homatropine** is produced, and is used as the soluble hydrobromate. It is a weak atropine, and the solution is preferred by oculists, as its effects, although as promptly and effectually produced, are not so inconveniently persistent as those of atropine sulphate.

ACTIONS AND USES.—Belladonna and atropine, applied topically, paralyse sensory nerves, and hence relieve irritability and pain. Mainly by paralysing the third nerve, they dilate the pupil, and are serviceable in relieving congestion and inflammation of the eye, and in facilitating its examination. Atropine is readily absorbed, and exerts its physiological effects on the organs with which it is brought into contact. Toxic doses, after stimulating, paralyse the spinal cord, brain, and medullary centres, causing irregular movements and delirium, with coma from impaired respiration, and kill by asphyxia. Medicinal doses stimulate respiratory and cardiac action, and hence combat collapse, respiratory emergencies, and poisoning by ptomaines. They diminish secretion of all glands—the salivary, perspiratory, mucous, and mammary; but not the kidneys, by which atropine is quickly excreted unchanged.

GENERAL ACTIONS.—Atropine diminishes the sensibility

of **sensory nerves** when brought into contact with them, and hence allays irritability and pain when applied to the itching erythematous or erysipelalous skin, when injected subcutaneously into a tender muscle, or into the neighbourhood of an irritated nerve, and also in large doses when carried in the blood-stream to internal organs. Moderate or large doses **increase heart action**, probably in two ways—(1) by paralysis of the vagus centrally and peripherally, and (2) by stimulation of the intracardiac ganglia. They **stimulate the respiratory centre** more directly and powerfully than any other drug. These cardiac and respiratory actions explain the value of atropine in the treatment of collapse, difficult or impaired breathing, and depression from ptomaines and other sedative poisons.

Paralysing the special secretory ganglia and nerves of glands, it is a powerful **antisecretory**, diminishing or arresting secretion from the salivary, sweat, milk, and mucous glands, as well as from the liver and pancreas, and exerting this effect in whatever way the drug is used. Although devoid of action on voluntary muscles, moderate and large doses paralyse involuntary muscles. In almost all animals they **contract the iris**, render the eye bright, dry, and injected, produce long-sightedness, paralyse the power of accommodation, and increase intraocular tension. These effects result alike from the local and internal use of atropine, and depend upon its paralysing the third nerve and stimulating the sympathetic branches (p. 76). This dilatation of the pupil reaches its **maximum** in dogs in twenty to twenty-five minutes, in herbivora in thirty-five to forty-five minutes. The effects of full doses of atropine last several days, but those of homatropine, although as quickly produced, pass off more rapidly.

Full doses cause dryness of the mouth, dilatation of the pupils, a scarlatina-like rash (more noticeable in men than in the lower animals), quickened pulse, delirium, with tendency to irregular movements. The brain centres are stimulated, but the ends of motor nerves are paralysed, and hence result the concurrence of delirium, irregular movements, and lassitude. Like the members of the alcohol series, they exert **primary stimulant and secondary paralytant action**. They stimulate

and then paralyse the several strands of the spinal cord, and **death** results chiefly from **paralysis of respiration**. Small doses stimulate, but large paralyse the centres of the medulla. The vaso-motor medullary centres, as well as the peripheral vaso-motor ganglia, and probably the muscular fibres of the arteries, are stimulated by small, but paralysed by large doses. Small doses consequently raise blood-pressure and temperature, while large doses lower them. Large doses diminish secretion of urine, but small doses do not materially affect it, although the kidneys are the channel through which atropine is chiefly excreted.

Belladonna resembles the other atropaceæ, hyoscyamus and stramonium, but is more active. It is **allied to opium** in its antispasmodic and anodyne effects; but the distinctions between the two are marked and various. Large but not lethal doses of belladonna or atropine paralyse the brain centres, but still more prominently the centres of the medulla and cord, and produce delirium, restlessness, and continued movements; while similar doses of opium or morphine paralyse more particularly the brain centres and cause coma. Belladonna paralyse the vagus and inhibitory ganglia of the heart, and hence accelerates the pulse, while opium slows it. Atropine stimulates, while morphine depresses the respiratory centre. Atropine dilates, morphine contracts the pupil. The secondary effects of belladonna in paralysing the ends of motor nerves ally it to hemlock, which it also resembles in dilating the pupil and paralysing the ends of sensory nerves. Atropine has no direct **physiological antagonists**, but caffeine, Calabar bean, prussic acid, and jaborandi antagonise some of its actions. Methyl and ethyl atropine, although paralysing the ends of motor nerves and retaining the specific effects of atropine on the eye, heart, and respiratory centre, have no tendency to tetanise.

Toxic Effects.—**Horses** were experimented on by Hertwig. Upwards of twenty received four to six ounces of the dry pulverised herb, given with meal and water, in four separate doses, at intervals varying from four to eight hours. In four or five hours, and still more on the succeeding day, he observed dulness, languor, uneasiness, dilated pupils, and a feverish

mouth; appetite was gone, digestion impaired, gas abundantly evolved in the stomach and intestines. The pulse numbered about 90, was small, hard, and scarcely perceptible; breathing was short, quick, and accompanied by flapping of the nostrils; sensibility was slightly diminished, but there was no drowsiness. Some of the cases exhibited much abdominal pain; others imperfect power of moving the hind extremities; others terminated fatally in thirty to fifty hours after exhibition of the first dose; but in most the symptoms gradually retrograded, and after thirty-six or forty-eight hours the animals were perfectly well. Two to three ounces of the dried root acted on horses in a similar manner, and six ounces usually proved fatal (*Arzneimittellehre*).

With atropine sulphate, subcutaneously injected, Dr John Harley and Messrs F. & J. Mavor, of Park Street, London, in 1867 made an extended series of experiments on a healthy six-year-old horse and a weakly two-year-old thoroughbred. These experiments were detailed in *The Old Vegetable Neurotics*, by Dr John Harley, published in 1869.

One-twelfth of a grain dissolved in water caused in about half an hour acceleration of the pulse from 32 to 42 beats; after another half-hour a further rise of ten beats had generally been reached. The tongue and mouth were dry, and the temperature increased. The pupils began dilating after thirty-five minutes, and reached their maximum in an hour, when the iris was scarcely visible. The symptoms gradually receded, and in two to three hours had disappeared.

One-sixth of a grain caused restlessness and dryness of the mouth, and in thirty-five minutes an increase of 34 beats in the pulse, which was full, soft, and compressible, and only fell to its original number after six hours; the dilated pupils returned to their normal state after three hours; upon the secretions no effects were notable.

One-fourth of a grain in twelve minutes increased the pulsations from 38 to 56, producing also slight irregularity; the pupils gradually dilated, and in an hour reached their fullest expansion. These effects on the pulse and pupils, with dryness of the mouth and lips, continued unabated during three hours. For eighteen hours the animal remained dull and quiet.

Half a grain in twelve minutes fully dilated the pupils; the pulse rose to 68; the mouth, tongue, and lips became dry; the horse gaped occasionally, and stood perfectly quiet; after three hours showed considerable nervousness, and was restless when disturbed; for six hours the pulse continued weak and compressible, but the effects gradually declined.

Two grains, also introduced subcutaneously, after fifteen minutes raised the pulse 35 beats, and rendered it weak; there were dryness of the mouth, yawning, restlessness, and nervousness. The animal was partially blind, misjudged distances, and appeared under the influence of illusions; the membranes of the eye were injected. Occasional hiccough, tremulousness, and twitching of the intercostal muscles and panuscorium continued for fourteen hours, when the symptoms generally declined; but the pupils remained dilated for twenty-four hours. Urine was frequently voided, and in rather increased amount; the mucous secretions of the bowels and the bile were slightly augmented, the skin secretions unaffected, the respiratory functions not disturbed.

These and other experiments of Dr Harley's demonstrate that the maximum stimulation of the heart results from doses insufficient to produce nervous excitement. Medicinal doses quiet the cerebro-spinal nervous system, but over-doses cause increased sensibility to external impressions, wakefulness, and in extreme cases delirium.

Professors Fred. Smith and Charles Rutherford, of the A.V.D., experimenting on healthy horses with the B.P. liquor atropinæ sulphatis, which contains one grain of the alkaloid to 100 fluid grains of water, injected into the chest quantities ranging from 15 to 30 minims without producing any notable effects. Injections of 30 to 60 minims reduced the pulse two or three beats, but had scarcely any effect on the pupil. Injections of 120 to 180 minims slightly slowed the pulse and rendered it softer, and increased the diameter of the pupil from three-eighth to half an inch. Most patients were quiet, some slightly sleepy, but all easily roused. Two experiments were made, introducing **intratracheally** three-tenth of a grain of atropine sulphate, which caused immediately a gulp and cough; but the only appearances were dryness of the mouth, with

slightly increased fulness and quickening of the pulse—conditions which were observable for about three-quarters of an hour, and shortly disappeared.

Cattle are stated by Hertwig to be as susceptible of the action of belladonna as horses. He records that two to four ounces of the root caused in cows violent symptoms lasting forty-eight hours, and that larger doses were dangerous.

Dogs receiving full doses of belladonna exhibit less marked cerebral, but **more pronounced and prolonged cardiac effects than horses**. This apparently depends upon the heart of dogs being more under the regulating influence of the vagi and inhibitory ganglia, which the drug specially paralyses. Dr John Harley found that while half a grain of atropine sulphate doubled the pulsations in horses, a quarter of a grain trebled them in dogs. Doses of one ninety-sixth to one-fourth of a grain raised the dog's pulse in a few minutes from 120 to 400, the beats continuing strong and regular; the pupils were so fully dilated that vision was imperfect, owing to the want of the regulation power of the iris; the mouth and nose were dry and hot. The larger doses further caused slowness and unsteadiness of movement, but no loss of sense or intelligence.

A Scotch terrier weighing 16 lbs. received $\frac{1}{80}$ grain atropine sulphate, injected under the skin of the back; in four minutes the pulse rose from 118 to 280; the respirations advanced from 19 to 30; the pupils were dilated to their full extent, the mucous membranes were dry, the animal excited and whining; the effects continued four hours. Dogs weighing 15 lbs. and 16 lbs. were killed in three hours by three-quarters of a grain, with symptoms of prostration, the pulse rapid and feeble, respiration irregular and shallow, muscular twitchings, the sphincters paralysed, death occurring in convulsions (*The Old Vegetable Neurotics*).

Hertwig found that 30 to 50 grains of the dried herb or root given to dogs in thirty minutes contracted the iris, so that it was out of view, and rendered the eye insensible to bright light. Vomiting sometimes occurred, the nose became dry and hot, and the gait tottering from inability to move the hind extremities. In one to three hours the symptoms began to abate, but contraction and diminished irritability of the iris

remained even after twenty-four hours. Orfila poisoned dogs with 15 grains of extract. Professor Christison recorded that half an ounce of the watery extract killed dogs in about thirty hours when given by the mouth, half that quantity in twenty-four hours when introduced into a wound, while even smaller doses were more speedily fatal when injected into the jugular vein (*On Poisons*).

Rodents, such as rabbits, guinea-pigs, and rats, as well as **pigeons**, do not exhibit the marked acceleration of the pulse-rate so remarkable in dogs and cats, for the vagus in rodents and birds exerts much less regulating effect on the heart. Rabbits require 15 grains of green extract to poison them, pigeons 2 grains. The mydriatic action is much less marked in rabbits than in dogs or cats, and is scarcely noticeable in birds.

The post-mortem appearances are those of asphyxia. The blood is dark-coloured, and coagulates slowly; the ventricles are generally empty and firmly contracted.

The antidotes consist in the administration of alcohol, ammonia, strong coffee, or other diffusible stimulants. Subcutaneous injection of caffeine is enjoined in human patients, with the cautious use of physostigma, and artificial respiration if necessary (Brunton). Stupor, if impending, is combated by moving the animal about, or by the galvanic battery. As atropine is rapidly eliminated by the kidneys, recovery usually results if dangerous symptoms can be relieved, and life preserved for a few hours. Where urination is difficult, the water should be removed by the catheter.

MEDICINAL USES.—In virtue of their stimulating the respiratory centre, abating excessive mucous secretion, combating spasms of involuntary muscles, and **soothing irritability**, belladonna and atropine are serviceable in catarrh, pharyngitis, laryngitis, and bronchitis in all patients, and are used in the several forms of inhalation, spray, electuary, and hypodermic injection. In influenza in horses, they besides beneficially **stimulate the weakened heart**. Professor Robertson prescribed belladonna, with small doses of aconite, in the acute stages of respiratory diseases in horses; but it is chiefly serviceable in the second stages, when secretion is over-abundant, swallowing difficult, and the throat irritable.

The noisy respiration accompanying some cases of epizootic **sore-throat**, and the loud, prolonged, **spasmodic cough** of laryngitis, are usually relieved by its use. Along with ether or ammonium carbonate, belladonna abates the distressed breathing and cough occurring in bronchitis, as well as in distemper in dogs.

Paralysing involuntary muscles, belladonna and atropine control **palpitation**, especially when depending upon cardiac strain, and in such cases are given internally, while belladonna plaster is used externally. In cardiac syncope they are also useful. Professor Robertson was wont to prescribe in **spasmodic colic** in horses half a drachm of belladonna extract in four ounces of liquor ammoniæ acetatis, sometimes adding four to six minims of Fleming's tincture of aconite. In colic cases which have defied other remedies, as well as in enteritis, belladonna is conjoined with opium, and is stated to be specially indicated when the glandular structures of the bowels are implicated (*Equine Medicine*). No antispasmodic and anodyne is more effectual in such cases than **atropine and morphine**, used **hypodermically**. Small doses of belladonna are occasionally given in obstinate constipation and obstruction of the bowels, with the view of relieving griping, and aiding the action of laxatives.

Belladonna is the remedy most relied on in **tetanus** in horses. As soon as a dose of physic is given, Professor Williams begins its administration, and continues with small doses, also applying it locally to any wound. Professor Robertson regarded it as the best anodyne in tetanus, and prescribed ℥i. to ℥iij. of extract, placed within the teeth, several times a day. Other practitioners besides rub in the liniment down each side of the spine. In cerebro-spinal meningitis, Professor Williams prescribes belladonna or atropine, sometimes conjoined with ergotin and the use of the spinal ice-bag; while Professor Robertson, after applying rugs wrung out of hot water along the spine, applied belladonna plaster. Neither the crude drug nor the alkaloid effects permanent benefit in hydrophobia, epilepsy, or chorea.

Whether prescribed internally, or as an injection, they allay **irritation of the urinary bladder, rectum, and uterus**. The

extract is sometimes applied to the neck of the uterus when it is rigid and unyielding in cases of delayed parturition. In **mammitis** it beneficially checks secretion of milk, and, paralyzing nerve-endings, allays congestion and inflammation. For such purposes it is used both generally and locally, and the hypodermic injection of atropine is specially serviceable on account of its stimulating the heart and respiratory centre. Belladonna and atropine are **antidotes for poisoning** by opium, Calabar bean, pilocarpine, and anæsthetics, as well as by ptomaines.

In examinations and diseases of the eye atropine sulphate and homatropine hydrobromate are used locally for dilating the pupil, assisting in the detection of cataract, and testing the condition of the refracting media. For such purposes solutions of about $\frac{1}{20}$ grain to the ounce of water are used, and are sometimes conjoined with cocaine. They prevent prolapse of the iris, or restore it to its normal position in lesions of the cornea, or in perforating ulcer, which is frequent in dogs. In **iritis** they relieve congestion, and prevent or break down adhesions between the iris and the capsule of the lens, in such cases being sometimes alternated with myotics. They must be avoided in cases where there is increased tension in the globe of the eye.

External topical applications often determine and increase the effects produced by internal administration, belladonna plasters being applied to the spine in tetanus, to the loins in irritation of the kidneys or bladder, and to the throat in spasmodic cough. Belladonna and atropine reduce congestion, irritability and pain in **wounds, glandular swellings**, and injuries of the œsophagus, in **rheumatism**, and in those over-sensitive conditions of the skin and muscles which sometimes occur in horses and hounds from severe exertion. To secure these results active preparations should be applied as near as possible to the painful spot. For the removal of rheumatic and neuralgic pains and old-standing neuroses, in conjunction with local applications, one or two full doses are administered, and no alarm need be caused by restlessness, dilatation of the pupil, or other slighter phenomena of poisoning. In many of these cases belladonna is conjoined with opium or chloral, occasion-

ally with aconite. In all cases of emergency atropine is preferable to any belladonna preparation, and is used hypodermically.

DOSES, &c.—Of the dried powdered leaves horses and cattle take ℥iv. to ℥j.; dogs, grs. v. to grs. x. The plant is seldom, however, used in the crude form, but is made into extracts, succus, or tincture. Exposure to elevated temperature or long keeping often spoils belladonna preparations. An active, well-keeping **green extract** is made by the B.P. process, by which 100 lbs. of trimmed leaves and young branches yield 6 lbs. to 7 lbs. of green extract (p. 159). The dose for horses is ℥i. to ℥ij.; for cattle, ℥ij. to ℥iij.; for sheep, grs. x. to grs. xx.; for dogs, grs. i. to grs. iij. In catarrhal and influenza cases the extract is frequently prescribed with alcohol, ether, or camphor. A convenient **electuary** is made with liquor ammoniæ acetatis and treacle. Professor Robertson used a belladonna and camphor electuary made with powdered myrrh, nitre, powdered liquorice root, and treacle. An **alcoholic extract**, made by maceration and percolation with rectified spirit, is about four times the strength of the ordinary extract.

The **succus** is got by bruising the fresh leaves and branches in a stone mortar, pressing out the juice, and adding to it one-third of spirit. An ounce is the dose for the larger animals, ℥v. to ℥xx. for the smaller. The **tincture**, made by maceration and subsequent percolation of one ounce of belladonna leaves with a pint of proof spirit, is given in similar doses.

For **external** application the **linimentum belladonnæ** is prepared with 20 ounces of the root in No. 40 powder, and sufficient rectified spirit to make 30 ounces, treated in the same manner as in the preparation of the tincture, and allowed to pass into a receiver containing one ounce of camphor. Veterinarians frequently extemporise an ointment by melting by the heat of a water-bath one part of extract and four of vaselin, adding, as the mixture cools, half a part of camphor. Mr Squire has introduced a soothing and readily-absorbed liniment, made by mixing with the tincture one-seventh part of chloroform. **Belladonna plaster** is made by melting, by the heat of a water-bath, two parts each of resin and soap plasters, adding one of the alcoholic extract, and mixing thoroughly.

Atropine, being sparingly soluble in water, the sulphate is generally used, and is about fifty times the strength of the green extract. The B.P. **liquor atropinæ sulphatis** in general use consists of one part of atropine sulphate and 99 of camphor water, and contains four grains in one fluid ounce. For horses and cattle the dose is fʒi. to fʒij.; for dogs, ℥i. to ℥v. When used hypodermically, the minimum or still smaller doses should be prescribed. Specially prompt and marked anti-spasmodic and anodyne effects are secured, as stated, by conjoining about equal proportions of atropine and morphine solutions. For ophthalmic and other purposes, tissue papers containing $\frac{1}{250}$, and lammellæ of gelatin containing $\frac{1}{5000}$ grain are convenient. An **ointment** is occasionally used, one part atropine being dissolved in $3\frac{1}{2}$ parts rectified spirit and 55 parts benzoated lard.

Homatropine hydrobromate, as above indicated, is sometimes substituted for atropine sulphate for internal administration, and still more frequently for eye cases.

BENZOIN.

BENZOINUM. Gum Benjamin. A balsamic resin obtained from *Styrax* Benzoin, and probably from one or more other species of *Styrax*. It is generally procured by making incisions into the bark of the trees and allowing the liquid that exudes to concreate by exposure to the air. (B.P.) *Nat. Ord.*—*Styracaceæ*.

The *styrax* benzoin abounds in Siam, Sumatra, and Borneo. When six years old it reaches the thickness of a man's body, and, for ten years, each tree annually yields about 3 lbs. of resin. Incisions are made through the bark, when the thick, white, resinous juice exudes, and concretes in tears, which are subsequently made into larger masses, and imported in wooden cases. Two sorts occur in the drug stores, the Siam and the Sumatra, the first being most esteemed. The first three or four years' yield of the tree is paler, more translucent, and of finer quality. The colourless or reddish tears are embedded in an amber-brown transparent resin. Inferior qualities are dark-brown or nearly black, and devoid of amygdaloid structure.

Benzoïn is brittle and easily pulverised, slightly heavier than water, of a faint sweet taste, and an agreeable balsamic odour, much increased when the masses are rubbed or burned. It is dissolved by alcohol, alkalies, and acids, but imperfectly by water.

Besides traces of volatile oil, benzoïn contains about 80 per cent. of three **resins**, distinguished by differences of solubility, and from 14 to 20 of **benzoic acid** ($\text{HC}_7\text{H}_5\text{O}_2$)—an acid, crystalline acid, prepared by dry distillation of benzoïn, or by boiling it with lime and decomposing the calcium benzoate. The acid is now also prepared from naphthalin (C_{10}H_8), and also from hippuric acid, obtained from the urine of herbivora. Some samples of benzoïn contain as much as 10 per cent. of the allied cinnamic acid ($\text{HC}_9\text{H}_7\text{O}_2$).

ACTIONS AND USES.—Benzoïn is a pure balsam and a mild stimulant, expectorant, and antiseptic. It resembles such balsams as storax, and balsams of Peru and Tolu, and although not used as formerly indiscriminately in all diseases of the air-passages, its volatile oil and acid, evolved by placing portions of benzoïn in the steam-kettle, are advantageously inhaled as antiseptic expectorants in bronchitis. It is excreted mainly in the urine, part of the benzoic acid being converted in the kidneys into hippuric acid. If given internally, horses and cattle take half an ounce, dogs two to ten grains. It was used as a **vulnerary** long before carbolic, salicylic, or boric acids were known. Freely applied to recent bleeding wounds, an odorous antiseptic coagulum is formed, superficial bleeding vessels are closed, and when tow or cotton-wool, well wetted with the antiseptic solution, is strapped on with some mackintosh covering, recent wounds may be thus maintained aseptic.

Benzoïn is chiefly used in the form of **friar's balsam**, or its pharmaceutical imitation, **the compound tincture**, which is thus prepared:—Take of benzoïn, in coarse powder, two ounces; prepared storax, one and a half ounce; balsam of Tolu, half an ounce; Socotrine aloes, 160 grains; rectified spirit, 17 fluid ounces. Macerate for seven days with occasional agitation, then filter, and add sufficient rectified spirit to make one pint (B.P.) This tincture is extensively used, both professionally and popularly, as a **stimulant and antiseptic** for

wounds, ulcers, and various skin complaints in all classes of patients. **Benzoated lard** is made with 10 grains benzoin to each ounce of lard.

Storax, or **styrax**, a balsam from the inner bark of liquidambar orientalis, contains styrol, cinnamic acid, styracin, and resin, and is a stimulant, expectorant, antiseptic, and parasiticide.

Balsam of Peru is obtained from the Myroxylon Pereiræ, a papilionaceous legume, contains volatile oil, resin, benzoic and cinnamic acids, and has the same actions as styrax.

Balsam of Tolu is yielded by the Myroxylon Toluifera, contains a volatile oil and resin, and is occasionally used as a stimulant and expectorant.

BENZOL OR BENZENE SERIES OF AROMATIC CARBON COMPOUNDS.

The benzol, benzene, or aromatic series of carbon compounds includes a number of **antiseptics** and **antipyretics**. The lowest members of this series contain six carbon atoms, five of which have their affinities satisfied by hydrogen, constituting the organic radicle phenyl (C_6H_5). The hydride is benzene (C_6H_6). Substitution of hydroxyl (OH) for the separate hydrogen atom produces the alcohol—carbolic acid (C_6H_5OH). A like substitution of one or more of the hydrogen atoms for other organic radicles forms other aromatic bodies. Further variety of constitution is determined according to which of the six atoms of carbon in the so-called carbon ring assume the hydroxyl or other radicle. Still further variety appears to result from fusion of molecules of the same or of different members of the group; two benzene molecules appear to form naphthalin ($C_{10}H_8$); a benzene and pyridine molecule chinoline (C_9H_7), which is allied to quinine; indeed, it is generally believed that many of the organic alkaloids are closely related to this aromatic series (Dr Lauder Brunton). The higher members appear to be the most active. Slight rearrangement of the atoms of these bodies, and substitution of various radicles, will doubtless produce other valuable artificial substances.

A list of the more important medicinal members of this aromatic group is subjoined. Brief notice is here given of

several; the others receive consideration under their alphabetical headings. The lower members of the series are the most useful medicinally. They are **antiseptic**, usually **antipyretic**, frequently **analgesic**; they chiefly affect the **motor centres**; excessive doses cause tremors, convulsions, and paralysis. They exhibit a marked contrast to the lower members of the fatty carbon or marsh-gas series (CH_4), which chiefly affect sensory nerve-centres and are stimulants and anæsthetics.

Benzol or benzene	C_6H_6 , H
Phenol or carbolic acid (<i>see after</i>)	C_6H_5 , OH
Creolin (<i>see after</i>)	
Creosote (<i>see after</i>)	
Benzoic or phenyl formic acid	C_6H_5 , CO. OH
Resorcin. Oxyphenol	C_6H_4 , (OH) ₂
Hydroquinone	C_6H_4 , (OH) ₂
Pyrocatechin	C_6H_4 , (OH) ₂
Pyrogallic acid	C_6H_3 , (OH) ₃
Saccharin. Glusidum	C_6H_4 , CO. SO ₂ . NH
Salicylic acid (<i>see after</i>)	{ C_6H_4 , OH. CO. OH, or HC ₇ H ₅ O ₃
Salol. Salicylate of phenol	{ C_6H_4 , OH. CO. OH C ₆ H ₅
Naphthalin	C_{10}H_8
Naphthol	C_{10}H_7 , (OH)
Hydronaphthol	C_{10}H_7 , OH
Antipyrin. Phenazone (p. 255)	{ C_6H_5 , (C ₅ H ₇ N ₂ O), or C ₁₁ H ₁₂ N ₂ O
Antifebrin. Acetanilide (p. 244)	C_6H_5 , NH. CH ₃ CO
Phenacetin	$\text{C}_{10}\text{H}_{13}\text{NO}_2$
Exalgine. Methyl acetanilide	C_6H_5 , NCH ₃ . CH ₃ . CO ₂
Chinoline. Quinoleine	$\text{C}_9\text{H}_7\text{NO}$
Thallin	{ C_9H_6 , OCH ₃ . H ₄ N, or C ₁₀ H ₁₃ NO
Kairin	{ C_9H_6 , OH. H ₃ CK ₃ N, or C ₁₀ H ₁₃ NO
Pyridine	$\text{C}_5\text{H}_5\text{N}$

BENZOL or **BENZENE** derived its name from its being distilled from benzoic acid and slaked lime, but it is now chiefly

obtained from the fractional distillation of coal-tar. It is an ethereal, inflammable liquid, with the odour of coal-gas, and the specific gravity .878. It is insoluble in water, soluble in alcohol and ether, and a useful solvent for sulphur, phosphorus, chlorine, iodine, alkaloids, fats, resins, and caoutchouc. Benzene is a **perfectly distinct body from benzin**, petroleum benzin, or petroleum ether, which is a purified distillate obtained from American petroleum—a paraffin of the marsh gas series, consisting chiefly of C_5H_{12} , and sometimes used as an anæsthetic, anthelmintic, and parasiticide.

Benzol or coal-tar benzene is antiseptic, irritant, and parasiticide. Its irritant effects are especially noted on mucous and skin-abraded surfaces, or when applied with friction. Moderate doses, when swallowed, produce slight temporary pyrexia. It is **excreted in the urine**, to which it imparts the odour of violets. Larger doses accelerate cardiac and respiratory movements, while toxic doses cause nervous depression, muscular trembling, convulsions, lowered temperature, and loss of sensibility. Benzene is an effectual **poison for various skin parasites** in all classes of patients, and is usually applied after a thorough wash with soap and water, either undiluted, or in young and delicate subjects, or in cats, dogs, or fowls, which are sensitive to its irritant effects, mixed with one to three parts of oil or vaselin. Weaker solutions are sometimes used to allay irritation in prurigo and urticaria, and as solvents for fats and resins.

Benzoic Acid (p. 292) occurs in light feathery plates or needles, which have an agreeable benzoic odour, are sparingly soluble in cold water, more readily in hot water, and fully soluble in rectified spirit, volatile oils, and alkaline solutions. It is **antiseptic, stimulant, and expectorant**. It is as effectual as carbolic acid in arresting the action of enzymes and destroying bacteria. It appears to act on the proteids of the body, and diminishes excretion of urea. Professor Rutherford found that 20 grains increased the biliary secretion of dogs. It is **eliminated** chiefly by the skin and kidneys; in the latter, uniting with glyccol, it is excreted as hippuric acid, exerting slight antiseptis in bladder catarrh, and also increasing the quantity and acidity of the urine. It **retards decomposition**

of decoctions, infusions, and unguents. Ammonium and sodium benzoates, as well as benzoic acid itself, are given to horses and cattle in doses of grs. xxx. to ζ i., and to dogs in grs. iii. to grs. x.

RESORCIN is obtained by the distillation of galbanum ammoniacum, asafœtida, or extract of Brazil wood, with caustic alkalis. It occurs in colourless, crystalline plates, which become pink on exposure to the air. It has a harsh, sweet taste, and is freely soluble in water, alcohol, and oils. It is found of different degrees of purity; some specimens contain phenol. It coagulates albumin, and is an effectual **antiseptic**. Concentrated solutions irritate the skin and mucous surfaces, but it is not so irritant as its analogues, carbolic acid and creosote, while, like them, it has a slight topical anæsthetic effect. Lethal doses, given to dogs and rabbits, cause clonic convulsions, dyspnœa, and paralysis. Its antipyretic action is of short duration. As an **intestinal antiseptic**, calves and other young animals suffering from gastric catarrh receive 30 to 60 grains, while four times these doses are occasionally prescribed for horses. It is used as an antiseptic in surgical cases—in inflammation of the eyes, mammæ, urino-genital organs, and other sensitive parts. Kaufmann commends it in erythema, herpes, and eczema, especially of the seborrhœal type, and in dogs. The solutions and ointments applied contain 1 to 10 parts per 100.

HYDROQUINONE is chemically para-di-hydroxy-benzene, resembles resorcin, but is about four times stronger. As it is excreted in the urine, it exerts a stimulant and antiseptic action on the urino-genital mucous membrane (p. 306).

PYROCATECHIN, or ortho-di-hydroxy-benzene, resembles resorcin in its actions and uses, but is about three times stronger.

PYROGALLIC ACID, or tri-hydroxy-benzene, is obtained by heating gallic acid, and is readily soluble in water and alcohol. It is more irritant than most of the series, but is a doubtful antiseptic. A few grains produce in dogs, as well as in man, vomiting, purging, and collapse. It decomposes the red corpuscles. Mixed with fatty matters or starch, it is sometimes used as a caustic. A 15 per cent. ointment has been applied with good effect in psoriasis.

SACCHARIN, or benzol-sulphonic-imide, is derived from the toluene of coal-tar. It is a colourless, crystalline powder, 220 times sweeter than sugar, soluble in alcohol and ether, slightly soluble in water, but the solubility is increased by the addition of a saline. It is **slightly antiseptic**. It is very stable, passes through the body unchanged, and is eliminated in the urine. As it is inconvertible into sugar, it is used in tabellæ for **sweetening the food**, and flavouring the medicines of human patients suffering from diabetes mellitus, being given in quantities of one-fifth to half a grain.

SALOL is a white, crystalline, aromatic powder—a phenol ether of salicylic acid. It is **antiseptic** and **antipyretic**. It is not so effectual an anti-rheumatic as sodium salicylate. It is decomposed, and its actions are in great part produced only after it is dissolved in the pancreatic and alkaline intestinal fluids, when it exerts beneficial in-contact effects in **intestinal diarrhoea**. Its phenol frequently browns the urine. Kaufmann commends it as a substitute for iodiform in surgical cases, notably in diseases of the urino-genital organs, and in otorrhœa. Horses take ℥ij. to ℥iv.; dogs, grs. iii. to grs. xii., in pill or electuary.

NAPHTHALIN is prepared from tar and tar oils, and occurs in colourless, soft, peculiar-smelling, but tasteless crystals. It is **antiseptic**, **feebly antipyretic**, and **parasiticide**. Moderate doses are non-poisonous, but when given for several months they cause wasting, with ulceration of the cornea, opacity of the lens, and spots on the retina (Kaufmann). It is used as an **intestinal antiseptic**, serviceable in diarrhœa and dysentery, in protracted cases of influenza and purpura, and is prescribed either with mucilage or castor-oil. It is occasionally given as an anthelmintic. Being **excreted** in part by the urine, it exerts antiseptis in diseases of the bladder. It is used for antiseptic dressings, and in all animals for the destruction of skin parasites. The dose for horses and cattle is ℥i. to ℥iij.; for sheep and dogs, grs. ii. to grs. xv., administered in electuary or bolus. Externally it is applied with vaselin, or glycerine and water.

NAPHTHOL is prepared from tar. The β variety is chiefly used; is a colourless, crystalline, phenol-smelling powder, in-

soluble in water, but soluble in alcohol, ether, and oils. Its actions and uses are the same as those of naphthalin, and also closely resemble those of resorcin. It is **antiseptic** and **anti-parasitic**. One part in 3000 prevents the development of anthrax, glanders, and other microbes. For such antiseptic purposes it is five times more effectual than carbolic acid. Small doses stimulate the mucous and glandular secretions. Somewhat larger doses induce nausea, diarrhoea, and dysuria. Powerful doses, exceeding 1 gramme for every 10 kilogrammes of body weight, cause epileptiform convulsions in cats and horses, but in dogs there occur instead coma and reduced temperature. All animals usually also exhibit nephritis, albuminuria, and hæmoglobinuria. Rabbits relatively to their weight will stand three times the dose borne by dogs and cats. Naphthol is administered internally to destroy tænia and ascarides (Willenz), as well as putrefactive and infective materials lodged in the intestines. As it is not readily soluble, full doses exert antiseptis throughout the greater portion of the intestinal tract, lessening the smell and irritant characters of the fæces, and hence checking diarrhoea. Externally it is used as an antiseptic and parasiticide, one part being usually mixed with 25 of oil or vaselin.

HYDRONAPHTHOL is a useful **antiseptic** and **germicide**, soluble in 100 parts of water and 20 of oil, and often conveniently applied as a dry dressing, mixed with 20 to 30 parts of fuller's earth.

PHENACETIN, added to the 1891 Edition of the B.P., is produced by the action of glacial acetic acid on para-phenetidin, a body obtained from phenol. It is colourless, tasteless, inodorous, occurs in glistening, scaly crystals, sparingly soluble in cold water, more freely in boiling water, alcohol, chloroform, and acetic acid. Like antifebrin and antipyryn, it **lowers temperature and diminishes pain**. Although its action is less rapid, it is more prolonged, and less liable than either of these analogues to produce collapse, while in human patients it has also slight soporific effects (Brunton). Fröhner and other German observers state that grs. iii. to grs. vii. given to dogs in a febrile condition lower the temperature 2° Fahr., also slow the pulse, and relieve respiratory difficulty. These effects continued for

four hours. Horses and cattle take $\mathfrak{z}\text{ii}$. to $\mathfrak{z}\text{iv}$., dogs, grs. iii . to grs. xv ., repeated every few hours in bolus or electuary.

EXALGINE occurs in nearly colourless crystals, is odourless, almost tasteless, slightly soluble in water and freely in alcohol. It is **slightly antiseptic**, distinctly **antipyretic**, and markedly **analgesic**. As an antipyretic it resembles antifebrin; it impairs perception of painful impressions; but large doses are dangerous, and produce epileptiform convulsions, dyspnoea, stupor, and death. Small, perfectly safe doses, such as one or two grains in human patients, or half a grain in dogs, repeated hourly, relieve most descriptions of pain; but for quieting the pain of acute rheumatism it is not so effectual as salicylates. It does not appear to produce any disagreeable secondary symptoms. It has been used with some benefit in epilepsy and chorea in man, and may be serviceable in such cases in dogs. It is generally administered dissolved in weak spirit.

CHINOLINE, or quinoleine, is an oily liquid, obtained synthetically from aniline and allied substances. It is related to quinine, from which it may also be produced. It appears to be formed by the union of a benzene and pyridine molecule. It is colourless or yellow, bitter and acrid, almost insoluble in water, but soluble in alcohol, ether, chloroform, and benzene. It is **antiseptic and antipyretic**, but other drugs of this aromatic series are more effectual and safe. Dogs and cats, receiving 3 to 6 grains per kilogramme of body weight, exhibit increased secretion of saliva and bile, and suffer from vomiting and general enfeeblement.

THALLIN is a synthetically prepared alkaloid, chemically known as tetra-hydro-para-methyl-oxy-chinoline. It is crystalline and colourless, has a piquant, bitter, anise-like taste, is soluble in 5 parts of cold water and 100 of alcohol. Both the watery and alcoholic solutions are inflammable. It combines with acids, and is used as a sulphate. It is **antiseptic, anti-fermentic, and antipyretic**. It resembles antifebrin, but Dr Lauder Brunton does not think it as effectual. Professor Thomas Fraser, Edinburgh, regards it as probably the most trustworthy antipyretic of the series. Both Kaufmann and Friedberger testify to its febrifuge effects on veterinary patients, and state that it causes neither digestive nor nervous disturbance.

Moderate doses given to horses and dogs, in one hour reduce abnormal temperature 3° Cent., and such reduction is stated to be maintained for several hours. It slows respiration, diminishes the number of the pulsations, and lessens arterial pressure. These effects appear to depend upon **diminished oxidation**, and consequent lessened elimination of carbonic acid and urea. Thallin is stated to communicate a dark-red colour to the blood, and sometimes causes a red eruption on the tongue (Kaufmann). It is **slowly excreted in the urine**, which acquires a greenish-brown hue, and is coloured purple by ferric chloride solution. Friedberger prescribes it in fibrinous and contagious pneumonia in horses, both *per orem* and hypodermically. Horses take ℥ii. to ℥iii.; cattle, ℥ii. to ℥iv.; sheep and pigs, grs. xv. to grs. xxx.; dogs, grs. ii. to grs. iv., given, as the sulphate, in bolus or solution. One-half to one-third of these doses usually suffice when given hypodermically.

KAIRIN is derived from chinoline. It is crystalline, greyish-white, with a bitter taste and aromatic odour, soluble in six parts of water and in alcohol. The hydrochlorate has generally been used. It is **slightly antiseptic**, has no analgesic action, and is not a safe antipyretic. Fröhner states that its antipyretic effects do not last more than fifteen minutes, and that the frequently repeated doses hence needful are apt to cause weakness, dangerous collapse, and sometimes hyperexcitability and convulsions, both clonic and tonic. Kaufmann states that a dog of three kilogrammes was killed by a hypodermic injection of 15 grammes, while another of seven kilogrammes succumbed from the internal administration of 45 grammes. Therapeutic doses for horses are ℥i. to ℥ii., and for dogs grs. iii. to grs. xii.

PYRIDINE is obtained from the destructive distillation of bones and amyl-nitrite, and is one of the empyreumatic constituents of tobacco smoke. It is a typical member of the alkali-like bases found in coal-tar, and from it various bodies of the aromatic series are prepared. It is a colourless, strong-smelling, volatile liquid. It **diminishes the reflex activity** of the spinal cord and respiratory centre, causes death by asphyxia, and is the most lethal of this series of compounds. It has been used in asthma and other difficulties of breathing.

BISMUTH AND ITS SALTS.

Bismuth and its salts belong to the group comprising phosphorous and salts of antimony and arsenic, and characterised by their producing in full and continued doses gastro-enteritis and fatty degeneration of the liver and other organs (p. 262). But salts of bismuth being sparingly soluble are weak members of this group, and have no toxic effects. The sub-nitrate ($\text{BiONO}_3 \cdot \text{H}_2\text{O}$) **allays irritation in dyspepsia**, vomiting, and gastro-intestinal catarrh, probably in virtue of mechanical action analogous to that of charcoal or manganese binoxide. It is also used, in combination with starch, boric or salicylic acids, to relieve irritability of abraded itching conditions of the skin (Brunton). If given to horses, the dose is \mathfrak{z} i. to \mathfrak{z} ii.; for dogs, grs. iii. to grs. x.

BORIC ACID.

ACIDUM BORICUM. Boric Anhydride. Boric or Boracic Acid.
 H_3BO_3

Boric acid is obtained from sodium baborate by the action of sulphuric acid. In volcanic regions in Italy and in the Lipari Islands, through natural fissures or holes bored in the earth, there issue vapours and jets of steam, which are passed through water, and the solution, subsequently evaporated, yields colourless, pearly, lamellar crystals of boric acid. They are feebly acid, and bitter, with a sweetish after-taste, and dissolve in 25 parts of cold water, in 3 of boiling water, in 10 of rectified spirit, and 5 of glycerine, and communicate a green colour to an alcohol flame. Aiding the fusion of other bodies, it is much used as a blow-pipe test; mixed with 7 parts of acid potassium tartrate, it constitutes the soluble cream of tartar of the shops. When heated, the three molecules of water of crystallisation are driven off, and anhydrous vitreous boric acid remains (B_2O_3).

ACTIONS AND USES.—Boric acid is a non-volatile, unirritating antiseptic, which has more effect on organised than on chemical ferments. It is occasionally prescribed in fermentive diarrhœa in foals, calves, and dogs, usually conjoined with

diluted spirit or ether. It is excreted in the urine, and hence exerts its antiseptic effects in cystic catarrh.

As an **antiseptic** it has about the same strength as carbolic acid. Koch found that one part in 1250 of water hindered, and one part in 800 prevented, development of anthrax bacillus. The carcase of a horse, which had lain four months in a Californian soil rich in borax, was completely preserved and free from odour (Robottom). Being non-poisonous, it is used for the preservation of milk, fish, and other articles of food. Being non-volatile, its effects are confined to the parts with which it comes into actual contact. Even in concentrated form, it is not so irritant and caustic as carbolic acid, and hence is adapted for wounds which for some time have been treated with carbolic acid, and in which granulation has become tardy. A foul wound or ulcer of moderate size, after thorough washing with corrosive sublimate or zinc chloride, or repeated dressing with carbolic acid, may usually be kept aseptic by boric acid. In the form of **lotion** or **ointment**, it proves a soothing dressing for burns and blistered surfaces; as a spray, it relieves aphthous, irritable, ulcerated throats, and, like borax, checks excessive salivary or pharyngeal secretion. Alternated with weak alkaline lotions or zinc oxide dressings, boric acid, conveniently mixed with six or eight parts of starch or of fuller's earth, abates the erythema and itching of the inflammatory and weeping stages of eczema rubrum in dogs, and is equally useful in similar eczematous conditions in horses. Catarrhal and purulent conjunctivitis are alike benefited by wetting the irritable surfaces three or four times daily with solutions of three to six grains to the ounce of water, alternated with atropine lotions.

DOSES, &c.—Horses and cattle take ℥ii. to ℥v.; foals and calves, grs. xx. to grs. xxx.; dogs, to which it is usefully given in distemper, grs. v. to grs. xx.

A saturated **solution** is made with one part of acid to twenty-six of water, and for surgical purposes is used diluted as required. A few grains of salicylic acid are sometimes added. An **ointment** is prepared by melting four parts soft paraffin and two hard paraffin, and adding one part boric acid in fine powder. **Boric lint** is made by soaking lint, cotton

wool, or oakum in a saturated boiling watery solution, from which the acid crystallises, adhering to the fibrous material. Like carbolic lint, eight or ten folds are applied, either wet or dry, over the wound; being unirritating, no protection is needed; in order to prevent evaporation and access of ubiquitous micro-organisms, a piece of mackintosh is laid on with the oiled surface inwards; unless the discharges are excessive, an ample and properly applied dressing does not require to be disturbed for several days. A few folds of lint applied wet to a wound or ulcer, and covered with oiled silk or mackintosh, acts as an antiseptic poultice, and its effects may be kept up by pouring the lotion from time to time between the folds of lint.

Boro-glyceride is made by heating 92 parts glycerine with 62 boric acid. Solutions of 1 to 20 of hot water are used as antiseptic gargles, lotions for purulent ophthalmia, and dressings for wounds.

BROMINE AND BROMIDES.

BROMINE. BROMUM. A liquid, non-metallic element obtained from sea-water, and from some saline springs. (B.P.)

BROMIDE OF POTASSIUM. POTASSII BROMIDUM. KBr.

Bromine, like its analogues chlorine and iodine, has a great affinity for hydrogen, removes it from its several combinations, and hence is **antiseptic** and indirectly an **oxidiser**. It is very diffusible. In point of activity it stands midway between the more active chlorine and the weaker iodine. But this gradation of the halogens is reversed in their compounds, depending mainly upon the iodine holding its combinations more firmly than the bromine, and the bromine than the chlorine. This is well illustrated in their several alkaline salts. These three halogens are antiseptic, disinfectant, and topically irritant and stimulant.

BROMINE is a dark red-brown volatile liquid, has a strong disagreeable odour and taste, and produces a yellow colour when added to starch water cold. It is occasionally used as a caustic in malignant and fungoid diseases, one part being dissolved in 10 to 15 parts of rectified spirit.

HYDROBROMIC ACID is devoid of irritant action, and is occasionally prescribed as a nerve sedative, but is not so convenient or effectual as potassium bromide (p. 189).

THE BROMIDES, including those of potassium, sodium, ammonium, calcium, and lithium, do not differ materially in their action. They have very slight topical effect on the skin or mucous surfaces, but are rapidly absorbed, and readily decomposed, the potassium bromide forming in the stomach sodium bromide and potassium chloride. They are **quickly eliminated** by all the excreting channels, chiefly by the kidneys. Large doses act as **depressants of the spinal cord** and reflex portions of the brain, impairing afferent conductivity of nerves. They **weaken heart action** and stop it in diastole. They **contract arterioles**, and thus reduce blood supply. They are hence antithermal. They are devoid of true hypnotic action, such as that of chloral hydrate, but diminish cerebral excitability by reducing the activity of the reflex parts of the brain.

POTASSIUM BROMIDE is the salt in general use. It is prepared by heating bromine and caustic potash with charcoal, and contains 67 per cent. of bromine. It occurs in colourless, cubical, odourless crystals, which have a pungent saline taste, and are freely soluble in water. Horses receiving about an ounce, or dogs 45 grains, become listless, exhibit muscular feebleness, unsteadiness of gait, impaired reflex movements; the pulse is feeble, respiration slowed, rectal and cutaneous temperature are diminished, and secretion of urine increased. Some of these effects, however, are due to the potassium rather than to the bromine. In animals receiving repeated full doses of bromides, mechanical irritation of the cortical substance of the brain fails to produce epileptic convulsions (Brunton). Full doses continued for some time induce **bromism**, a form of chronic poisoning characterised by depression of the cerebral faculties, increased secretion from the mucous glands, feebleness, anæmia, and wasting, dilatation of the pupils, and eczematous eruptions produced as portions of the drug are excreted through the skin. Toxic doses **kill by asphyxia**.

Potassium bromide is used in **nervous disorders** to allay excitement and relieve spasm, and thus indirectly may produce

sleep. Professor Robertson recommended both bromine and bromides in sclerosis of the spinal cord, combined or alternated with iodine, iron, arsenic, or nux vomica. It alleviates and wards off **epileptic convulsions** in dogs, whether connected with distemper or other causes, and is serviceable in violent cases of **chorea**. It has no constant or decided influence in controlling the spasms of tetanus in horses. Kaufmann records that Vogel of Stuttgart gave nine horses suffering from tetanus three to six ounces daily without moderating the spasms. It is of little use in asthma, sometimes checks persistent vomiting, and has considerable anaphrodisiac effect. It is occasionally used with digitalis to quiet cardiac excitement.

DOSES, &c.—Horses and cattle take ℥iv. to ℥i.; dogs, grs. v. to grs. xx., in bolus, electuary, or watery solution, repeated three or four times daily. Where cerebral excitement is great, and sleep is sought, chloral or other hypnotics are conjoined with the bromide. **Bromide of zinc** has been introduced for epileptic cases in the belief that it unites the actions of bromine and zinc.

BROOM.

SCOPARI CACUMINA. The fresh and dried tops of *Cytisus scoparius*. From indigenous plants. (B.P.) *Nat. Ord.*—Leguminosæ.

The tops and other parts of the shrub contain a neutral glucoside, **scoparin** ($C_{21}H_{22}O_{10}$), which has slight diuretic properties, and a volatile, oily, poisonous alkaloid, **sparteine** ($C_{15}H_{26}N_2$), which resembles coneine in some of its actions, like digitalin and strophanthin, is a cardiac paralytant, and hence acts as a diuretic. Kaufmann states that it relieves inordinate heart action, regulates rhythm, and raises blood-pressure. The sulphate and salicylate of sparteine, as well as the succus prepared from the dried broom tops, are occasionally prescribed in dropsies connected with heart disease, the dose of the succus for horses being f ℥j.; for dogs, ℥ xx. to ℥ xxx.

BUCHU.

BUCHU FOLIA. The dried leaves of *Barosma betulina*, *B. crenulata*, and *B. serratifolia*. (B.P.) *Nat. Ord.*—Rutaceæ.

Buchu is a shrub two to four feet high, and a native of the Cape of Good Hope. The leaves are smooth, dull yellow-green, with a strong, penetrating odour, a bitter aromatic taste, and varying in different species from half an inch to an inch and a half in length. They contain a volatile oil, a bitter substance, and much tannin.

ACTIONS AND USES.—Buchu is a **mild tonic and diuretic**, and a **stimulant** and astringent of the **urino-genital mucous membrane**. Professor Robertson gave it to allay irritability in cystitis, using it either alone or along with borax or benzoic acid.

The dose of the leaves for horses or cattle is \mathfrak{z} i. to \mathfrak{z} iv.; for dogs, grs. x. to grs. xxx., infused in a covered vessel with 20 parts water for half an hour. Animals readily take this infusion when it is mixed with linseed tea or barley water. It is sometimes advantageously conjoined with belladonna, opium, hyoscyamus, or potassium bromide.

Bearberry leaves—the leaves of *Arctostaphylos Uva-ursi*—contain the bitter neutral extractive **arbutin**, which within the body is in part converted into hydroquinone (p. 296), and acts as a stimulant and antiseptic in chronic vesical irritation.

The root of **Pareira brava**, although not very reliable, is also used for the same purposes as buchu and uva-ursi.

The root of **Collinsonia canadensis**—stone or knob root—has been largely used in America as a remedy in inflammation of the urino-genital mucous membrane, alike in men and animals; and Dr T. Oliver, Newcastle-on-Tyne, with 15 grains of extract, repeated thrice daily, gradually reduced the pus in several cases of cystitis in man, which had defied other treatment (*Lancet*, 5th May 1888).

BUCKTHORNS.

The recently-expressed juice of the ripe berries of *Rhamnus catharticus*, or purging buckthorn.

The dried bark of *Rhamnus frangula* or Black Alder. Collected from the young trunk and moderate-sized branches, and kept at least one year before being used. (B.P.)

The dried bark of *Rhamnus purshianus* or Cascara sagrada. (B.P.) *Nat. Ord.*—*Rhamnææ*.

The buckthorns are shrubby, spinous trees, eight or ten feet high. The berried fruit and barks contain a glucosidal body, three resins, one concentrating the activity of the drug, with mallic and tannic acids.

The berries of the *R. catharticus* are about the size of black currants, contain an acrid, nauseous, bitter juice, which is evaporated, strained, and gently heated with sugar, ginger, and pimento, forming a **mild cathartic syrup**, of which dogs take $f\zeta i.$ to $f\zeta ij.$, and cats, $f\zeta iv.$ to $f\zeta i.$ A little senna confection, jalap, or castor oil renders this syrup more prompt and certain.

The bark of *R. frangula*, when fresh, acts as a gastrointestinal irritant; but when dried and kept for twelve months, oxidation of the resinoid active matters appears to occur, and the fluid extract and decoction prepared from the bark are used in human practice as **laxatives**.

The *R. purshiani* cortex, or sacred bark, brought from the North Pacific Coast, is useful in habitual constipation; it produces peristalsis, especially of the large intestines, but, unless in very large doses, does not materially increase the glandular secretions. It is generally used as the liquid extract, which American practitioners prescribe for dogs as a stomachic **bitter and tonic**, in doses of $\mathfrak{m} v.$ to $\mathfrak{m} x.$, and as a **laxative** in doses of about $f\zeta i.$ Cascara in many respects resembles rhubarb.

CAFFEINE.

CAFFEINA. An alkaloid usually obtained from the dry leaves of *Camellia thea*, or the dried seeds of *Coffea arabica*, by evaporating aqueous infusions, from which astringent and colouring matters have been removed. (B.P.)
 $C_8H_{10}N_4O_2HO.$ *Nat. Ord.*—*Rubiaceæ*.

Caffeine and theine are now considered identical, and the same alkaloid is also got from the leaves of the Guarana or Paullinia, the *Ilex paraguayensis*, as well as from the Kola

seeds. It is **homologous with theobromine**, which is obtained from the nibs of the *Theobroma cacao*, and chemically is methyl-theobromine. Caffeine occurs in colourless, inodorous, acicular crystals, is sparingly soluble in cold water, more so in boiling water, and very soluble in chloroform. Treated with a crystal of potassium chlorate, and a few drops of hydrochloric acid, and the mixture evaporated to dryness in a porcelain dish, a reddish residue results, which becomes purple when moistened with ammonia.

ACTIONS AND USES.—Caffeine stimulates and subsequently paralyzes the nerve-centres of the cerebrum, cord, and medulla. In dogs, cats, rabbits, and rats, full doses, hypodermically injected, do not, as in man, act prominently on the brain, but chiefly affect the spinal cord, exalt reflex excitability, and cause muscular rigidity, convulsions, and tetanus (Phillips). Large doses swallowed by dogs, moreover, sometimes cause vomiting and gastro-intestinal irritation.

Like theobromine, it exerts a restorative effect on both voluntary and involuntary muscles, enabling them to perform increased work. On account of its stimulating the medulla and cardiac centres, moderate doses increase respiration and pulse rate, and raise blood-pressure, and, resembling strychnine and veratrine, antagonise heart and lung inability and paresis. They hence steady and strengthen the quick action of the weak heart in exhausting diseases, thus acting like digitalis, but more promptly and with more notable diuresis. As a nerve stimulant, caffeine has been given in sleepy staggers in horses, milk fever in cows, and in dogs prostrated with distemper. It is excreted in the urine, increasing alike the amount of the urinary solids and fluids. It is prescribed by German practitioners in cardiac, hepatic, and renal dropsies. It is used as an antidote for the cadaver alkaloids and ptomaines, for the paralysis of curare, and the neuroses of morphine, chloroform, and alcohol. Topically applied, it paralyzes the peripheral endings of nerves. Coffee is not identical in action with caffeine, for besides 0·50 of the alkaloid, it contains aromatic oils and tannic acid. Tea, well diluted with milk, is sometimes serviceable for horses, and still more so for foals, calves, and dogs reduced by acute disease.

DOSES, &c.—For horses and cattle, grs. v. to grs. x.; for dogs, according to size, gr. ss. to grs. ij. When swallowed it is liable to produce gastro-intestinal irritation, and hence should be given hypodermically in the minimum doses mentioned, and for such purposes is dissolved in sodium benzoate or salicylate.

CALABAR BEAN.

PHYSOSTYGMATIS SEMEN. The dried seed of *Physostygma venenosum*. (B.P.) *Nat. Ord.*—Leguminosæ.

PHYSOSTYGMINE. PHYSOSTYGMINA. ESERINE. $C_{15}H_{21}N_3O_2$. An alkaloid obtained from the alcoholic extract of Calabar bean by dissolving the extract in water, adding bicarbonate of sodium, shaking the mixture with ether, and evaporating the ethereal liquid. (B.P.)

The ordeal plant of Western Africa is suffruticose and twining, with a stem often fifty feet long, a hooded stigma, and a legume, in which lie two or three hard, brittle, shining, claret-coloured seeds, about the size of ordinary beans. Their activity depends upon the presence of two alkaloids—(1) **Physostygmine** or eserine, occurring in colourless or pinkish crystals, soluble in alcohol, benzol, chloroform, and dilute acids, and partially in water, paralyzes nerve-centres and stimulates muscular fibre; (2) **calabarine**, soluble in water and alcohol, but not in ether, causes strychnine-like convulsions.

ACTIONS AND USES.—Calabar bean and physostygmine stimulate voluntary and involuntary muscles and paralyze nerve-centres. Tetanic convulsions, such as those caused by strychnine, sometimes occur, depending on the presence of calabarine. As a paralyzant and anodyne only pure physostygmine should be employed. It relieves intestinal spasm and obstruction, deserves further trial in tetanus, and contracts the pupil and diminishes intraocular tension.

GENERAL ACTIONS.—Physostygmine exerts no topical action on mucous or skin surfaces. Full doses swallowed or injected hypodermically **paralyze muscular fibre**, especially of the unstriped variety, and also sensory and, later, motor nerve fibres. Injected into the conjunctiva, it expands the iris and **contracts the pupil**, causing near-sightedness, and reducing intraocular pressure—

conditions due either to stimulation of the fibres of the third pair of nerves, or of the circular fibres of the iris, or of both. This myosis results in horses in twenty-five to thirty-five minutes; in less than half that time in carnivora; in man and other mammals it occurs only slightly and occasionally when the drug is given *per orem* or hypodermically, and is not produced, even by conjunctival injection, in birds, frogs, and fishes.

Its paralyzant effect on muscular fibre in part explains its action on the circulation. Small to moderate doses **contract minute blood-vessels, and reduce the force and frequency of the heart movements.** Kaufmann mentions that a single full dose reduces the pulse of a dog from 100 to 40 beats per minute. Professor Thomas Fraser believes that its action on the heart is threefold—(1) it stimulates peripherally the cardio-inhibitory branches of the vagus; (2) it depresses the cardiac motor ganglia; and (3), in large doses, it paralyzes the cardiac muscular fibres. Respiration is temporarily quickened, apparently from stimulation of the vagi in the lungs, but in fuller doses is slowed from paresis of the medullary respiratory centre. Large doses **increase gastric and intestinal peristalsis**, quickly causing free and fluid evacuations from the bowels, and besides inducing in man and carnivora retching and vomiting. The movements of the other hollow organs—the bladder, uterus, and spleen—are also increased. Glandular secretion is promoted, probably owing to stimulation of the secreting cells (Brunton).

Poisonous doses disturb voluntary motility and paralyse the spinal cord, the posterior column being affected earlier and more fully than the anterior. Hence results the characteristic curare-like paralysis affecting motor and reflex functions, and which, involving the medulla, **kills by respiratory arrest** (Brunton). According to Professor Thomas Fraser, death sometimes results from cardiac paralysis, the heart stopping in systole. Convulsions occasionally occurring from the use of the bean and commercial physostygmine are due to the presence of calabarine. The brain in most animals appears to be irritated, cats and guinea-pigs poisoned exhibiting cerebral excitement, becoming timid, and running wildly about. It is **excreted** mainly by the bile, saliva, and gastric fluids.

Between physostygmine and its **analogues** interesting points of contrast are noted. It resembles pilocarpine in its action on the heart, eye, and glandular secretions, but it does not cause such profuse flow from either the salivary, bronchial, skin, or intestinal glands. Physostygmine, as above indicated, induces secretion by acting on the secreting cells, while pilocarpine, and also muscarine and nicotine, stimulate the peripheral endings of secretory nerves. While physostygmine causes intestinal movements by contracting the muscular fibres, muscarine does so by stimulating the nerves. **Atropine is its physiological opposite**, paralysing muscles, stimulating the respiratory and cardiac medullary centres, and dilating the pupil.

Physostygmine, in virtue of its promptly and effectually **relaxing the muscular fibres of the intestines**, is of practical value in the treatment of intestinal obstruction and obstinate constipation. This was first pointed out by Dieckerhoff of Berlin, and has recently been fully demonstrated by Professors Fred. Smith and Charles Rutherford, of the Army Veterinary School, Aldershot, who made an important series of observations on horses, using physostygmine freed from the convulsant calabarine. From the April number of the *Veterinary Journal* 1888, the following observations are extracted:—

“The earliest indications we have of the action of the drug are loud intestinal murmurs, passage of flatus, with slightly colicky pain; shortly this is followed by evacuation of the contents of the rectum, and the motions then pass at intervals of a few minutes, each becoming gradually softer, more watery, less formed in balls, until we reach the stage when the evacuations are moist and fluid, exactly representing cows' fæces. All this time the abdominal disturbance has become greater, the animal lies down, but seldom rolls, the intestinal murmurs are louder, the passage of flatus almost continuous, straining marked, *fæces are voided with great rapidity*, often ejected with force, and several ounces of a brown-coloured fluid will at this time accompany each motion. About two to two and a half hours from the time of injection the effects are commencing to pass off, and during this short time an almost incredible amount of fæces will have been excreted. Details on this point will be given below. Those who have had no previous experience of the drug and the results obtained will regard it as magical and marvellous. . . .

“A horse received $1\frac{1}{2}$ grains of eserine (physostygmine) subcutaneously; it acted in *twenty-five minutes*, and produced in the first hour seven evacuations, in the second hour seven, the effect passing off in two hours and ten minutes.

“A horse received $1\frac{1}{2}$ grains of eserine hypodermically, which took twelve minutes to act, producing *seven evacuations in the first hour*, and then terminating.

"Another horse received $1\frac{1}{2}$ grains of salicylate of eserine hypodermically, producing a free action of the bowels in one hour. This case terminated fatally from ruptured stomach; and thus it was demonstrated that eserine could act upon the large intestines, in spite of the shock to the abdominal nervous system which a ruptured stomach causes.

"A pony received 1 grain of eserine hypodermically; three evacuations were produced in fifty minutes, and in eighty minutes from the time of injection eight evacuations had occurred. The case was a fatal one, the cause of obstruction being due to a small diaphragmatic hernia. Had the gut not been nipped so tightly, there is reason to believe the increased peristalsis might have withdrawn it.

"A horse received a few drops of a solution of eserine into the conjunctival sac; it shortly produced contraction of the pupil, which lasted fully two days.

"A horse received $1\frac{1}{2}$ grains of eserine by *injection into the trachea*; it took seventeen minutes to act, and produced in the first hour *twelve evacuations*, weighing 11 lb. 13 oz., and a considerable quantity of flatus. The action then passed off.

"A horse received 1 grain of eserine hypodermically; it took forty-two minutes to act, and produced only one evacuation in one hour, accompanied by a considerable quantity of flatus.

"The same horse received 1 grain of eserine and 3 grains of pilocarpine by injection into the trachea; it took twenty-one minutes to act. In the first hour, counting from time of injection, it produced fourteen evacuations, weighing 30 lbs. 6 oz.; in the second hour four evacuations, weighing 7 lbs. $6\frac{1}{2}$ oz.; and in the third hour two evacuations, weighing 2 lbs. $13\frac{1}{2}$ oz.; in *three hours a total of 40 lbs. 10 oz. of ingesta*.

"In comparing these two cases, the value of pilocarpine in addition to eserine is clearly demonstrated.

"A horse received $1\frac{1}{2}$ grains of eserine by the trachea; it acted in forty-one minutes, and produced in the hour five evacuations; during the second hour four evacuations. The weight was unfortunately not obtained, but the quantity of ingesta completely filled a stable bucket. The case was one of most obstinate constipation, and had received 6 drachms of aloes previously, which ultimately acted at the expiration of the usual time.

"Another horse received 1 grain of eserine with 3 grains of pilocarpine by the trachea, which acted in one and a half hours, producing in two and a half hours from time of injection eight evacuations, weighing 26 lbs., exclusive of loss. The pilocarpine produced its salivating effects in four minutes from the time of injection."

Mr R. Rutherford, Edinburgh, gave a horse, 15 hands, weighing about 950 lbs., 5 grains commercial eserine, which within half-an-hour caused profuse perspiration, convulsive breathing, with violent action of the diaphragm. About two hours later, when the symptoms were abating, he gave an additional 3 grains, which proved fatal in half-an-hour.

Kaufmann records that on opening the abdomen of a horse which had received a full dose of physostygmine, energetic contractions of the large intestine were seen. Animals poisoned exhibit pallor, contraction, and hardness of the great intestine;

the urinary bladder is empty and contracted, and the uterus also contracted.

ANTIDOTES.—Neither the bean nor physostygmine are very soluble, and hence the stomach should be evacuated either by an emetic or the stomach-pump. Physostygmine is antagonised by moderate doses of atropine. Professor Fraser found that rabbits receiving one and a half the lethal dose recovered if atropine was given simultaneously in doses of gr. i. to gr. $\frac{1}{20}$. While small doses act as antidotes, larger hasten fatal results. The atropine specially antagonises the cardiac paralysis. To a lesser extent physostygmine counteracts the effect of atropine. Chloral also somewhat antagonises physostygmine.

MEDICINAL USES.—Professors Smith's and Rutherford's observations above detailed testify to the practical value of physostygmine in **combating intestinal spasm, torpidity, and congestion**, and indicate that the relaxing action of the drug may also be serviceable in rectifying some cases of volvulus and intussusception. These gentlemen administer physostygmine hypodermically and intratracheally, preferring the latter method on account of its acting more promptly, enabling more fluid to be introduced, occasioning less loss of the drug, and causing less inconvenience to the patient. They advantageously conjoin two or three grains of pilocarpine, which greatly increase the outpouring of intestinal fluid. Serious intestinal obstruction in all patients is most safely treated by these intestinal paralyzers and anodynes, by enemata, and abstention from solid food. Foreign practitioners have arrived at similar conclusions. Dieckerhoff, Nocard, and Kaufmann recommend physostygmine as an "intestinal anæmiant" in congestion, atony, colic, torpidity, and paralysis of the digestive tract, especially of the large intestines, and also for expulsion of calculi and other foreign bodies. They further note its use to determine contraction of the uterus.

It has been tried in **tetanus**, but Professor Williams, using two to four ounces of the tincture, declares that any relief of the spasm in horses is only temporary. More favourable effects might, however, be obtained by using the paralyzing physostygmine without the convulsant calabarine. The several preparations have been prescribed in chorea and epilepsy, and

as an antidote in poisoning by strychnine and atropine. They should not, however, be used in pregnant animals, in which the muscular fibres of the uterus are liable to be stimulated, with the result of its contents being prematurely expelled.

It is applied as a **myotic to relieve congestion** and inflammation of the globe of the eye, and of wounds and ulcerations of the cornea, and, alternated with atropine, to prevent and break down adhesions caused by iritis. In chronic **dropsical conditions of the joints and bursæ** of tendons in the horse, after evacuation of the fluid by a trocar and canula, Stottmeister, instead of the iodine solutions frequently used, recommends injection of physostygmine $\cdot 05$ — 1 gramme dissolved in 5 — 10 grammes of distilled water, applying subsequently, for two or three days, ice or refrigerant lotions to abate inflammation (*Journal of Comparative Pathology and Therapeutics*, September 1889).

Doses, &c.—The bean is given to horses and cattle in doses of grs. xv. to grs. xxx.; to dogs, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$. As already indicated, the diverse character of the two alkaloids present in the extract and tincture, as well as in the bean, renders it desirable to use, as a paralyser and anodyne, the **pure physostygmine**, which is conveniently employed in the form of salicylate, of which the dose for horses is grs. ii. to grs. iii., and for dogs, gr. $\frac{1}{20}$ to gr. $\frac{1}{10}$. Half these doses suffice when, as recommended by Professors Smith and Rutherford, the salicylate is dissolved, with careful stirring, in about an ounce of warm water, and administered by **hypodermical** or **intra-tracheal injection**. In intestinal obstruction more prompt and certain effects are obtained by addition of 2 to 3 grains of pilocarpine.

Eseridine ($C_{15}H_{23}N_3O_3$), an alkaloid obtained from Calabar bean, described in 1888, has the same properties as physostygmine, but one-sixth the activity.

CALCIUM AND ITS MEDICINAL SALTS.

Calcium belongs to the dyad class of metals, and to the group of alkaline earths, which include also barium and strontium. Its salts resemble chemically and physiologically those

of magnesium and aluminium. Carbonate of lime is the great source of the calcium salts. They are **detectable** in solution by their yielding no precipitate with hydrochloric acid, hydrogen sulphide, or ammonium hydro-sulphide; a white precipitate with an alkaline carbonate; an immediate and abundant white precipitate with oxalic acid, insoluble in acetic but soluble in hydrochloric and nitric acids; but no precipitate with ammonia, which precipitates the compounds of aluminium and magnesium. Calcium salts give a reddish-yellow tinge to flame.

Calcium compounds have little affinity for animal textures, and are slowly absorbed and diffused. As with other metals, the oxide and carbonate nearly resemble each other, and are antacid and desiccant. The phosphate is a restorative and tonic in some forms of malnutrition. The chloride, persevered with for weeks or months, is said to reduce enlarged lymphatics, solidify tubercular deposits, and promote the healing of ulcers. Calx chlorata is stimulant, astringent, and antiseptic. Calx sulphurata, consisting of calcium sulphide and sulphate, is credited with the power of checking formation of pus and hastening its discharge.

CALCIUM OXIDE. Lime. Quick-lime. Calx. CaO.

When limestone, chalk, marble, or other form of calcium carbonate (CaOCO_2 or CaCO_3), is mixed with coal and thoroughly burned, its carbonic acid (CO_2) is driven off, and the metallic oxide (CaO) or quicklime is left. It occurs in greyish-white irregular masses, has an alkaline, caustic taste, and great affinity for water. It combines with about 24 per cent. of water, giving off much heat, and forming the **hydrate** or **slaked lime**, $\text{Ca}(\text{HO})_2$. A pint of water at 32° Fahr. dissolves 13.25 grains of lime; a pint at 69° Fahr., 11.6 grains; a pint at 212° Fahr., 6.7 grains. The presence of sugar increases fully twelve times the solubility of lime in water. **Lime-water** is prepared by slaking a small quantity of freshly-burned lime, agitating it briskly with a large quantity of water, allowing undissolved matters to subside, and, after twelve hours, syphoning off the clear solution. As it readily absorbs carbonic acid, it should be kept in closely-stoppered bottles.

ACTIONS AND USES.—Lime is irritant, astringent by contact, antacid, and sedative. It is a natural constituent of the animal textures, in which it occurs mainly in combination with phosphoric and carbonic acids; but, being present in most articles of food, extra supplies are seldom required. When swallowed, there is probably deposited on the gastric mucous membrane a film of carbonate, which is dissolved by hydrochloric or lactic acid, slowly absorbed as chloride or lactate, reconverted in the blood into carbonate, held in solution by the free carbonic acid, and ultimately excreted by the kidneys, increasing the alkalinity of the urine, diminishing its irritant qualities, and perhaps exerting astringent effects on the urinary mucous membrane. Lime, especially when unslaked, and in contact with mucous and abraded skin surfaces, attracts water, forms a coating of carbonate, and possibly combines with albumin, and, in considerable amount, it irritates and superficially corrodes. Orfila mentions that $1\frac{1}{2}$ drachms administered to a small dog caused vomiting and considerable irritation, which lasted for about a day; and that three drachms caused vomiting, pain, languor, and death in five days.

MEDICINAL USES.—Lime-water is used as **an antacid and sedative** in indigestion and diarrhoea in all classes of patients. Young animals, with which undiluted milk happens to disagree, are usually benefited by mixing the milk with one-fourth to one-half of lime-water, which prevents acidity and coagulation of the casein in large tough masses. Lime-water is appropriate for gastric derangement, while the less soluble chalk, retaining longer its antacid and desiccant properties, is better adapted for intestinal acidity. When acidity concurs with constipation, sodium bicarbonate is preferable in the proportion of a drachm to the pint of milk. Lime-water is occasionally given as **an antidote** in poisoning by the mineral acids and by carbolic and oxalic acids. By itself, but better still when conjoined with turpentine, it **destroys bronchial filariæ**, often so troublesome in calves and lambs, and in the form of enema, brings away ascarides lodged in the lower bowels. Mixed with oil, glycerine, or vaselin, with a little boric or carbolic acid, it is applied in aphtha, and is occasionally substituted

for zinc oxide in cases of eczema. Scalds and burns are often treated by **Carron oil**, which consists of lime-water mixed with an equal quantity of linseed oil. The more recent treatment consists in the immediate application of layers of cotton wadding, with gentle and equable pressure. Lime in solution is used for cleansing and deodorising stables, cow-houses, and piggeries.

DOSES, &c.—Of quicklime, horses and cattle take ℥i. to ℥ij.; sheep, grs. xx. to grs. xxx.; dogs, grs. v. to grs. xx. Of lime-water the larger patients take f℥iv. to f℥v.; and the smaller, f℥ij. to f℥i., given alone, or with glycerine, oil, or milk. Two ounces each of lime-water and gentian infusion, repeated twice or thrice daily, often check diarrhœa amongst feeble calves; half the dose answers for sheep. For calves and dogs, **saccharated lime** is used as an antacid and stomachic. It is made by rubbing an ounce of slaked lime with two ounces of sugar, transferring the mixture to a bottle containing a pint of water, shaking, and separating the clear solution with a syphon. It conveniently renders the milk alkaline, without diluting it, as the lime-water does.

CALCIUM CARBONATE. **CALCIS CARBONAS.** Carbonate of Lime.
Chalk. CaCO_3 .

Calcium carbonate occurs in the several forms of limestone, marble, calcareous spar, and chalk. When chalk is triturated with a little water, agitated with a larger quantity of water, and the mixture allowed to stand, the coarser fragments and foreign matters subside. The clear liquid is poured or syphoned off, and slowly deposits an impalpable powder, which, when dried in blocks, constitutes **whiting**, and when in smaller conical rolls is **creta preparata**. It is a dull-white, amorphous powder, is tasteless, adheres to the tongue, owing to its porosity and its affinity for water, and effervesces with acids. It is a constituent of the bones of animals, of shells, and of corals. It is the common source of hardness in drinking waters, which, when pure, hold about two grains dissolved in the gallon; but carbonic acid increases the solvent power of the water. Sixteen grains are sometimes taken up, and in chalk districts

much more ; but when such hard waters are boiled, the carbonic anhydride is driven off, and calcium carbonate is deposited in the kettles and boilers.

ACTIONS AND USES.—Chalk is a cheap and convenient **ant-acid**, much used for the domesticated animals in the treatment of indigestion and chronic diarrhœa. It resembles lime, but is less irritant, and its effects extend beyond the stomach, throughout the intestines, neutralising acidity, and leaving a protecting film of carbonate. It is an **antidote** for oxalic, carbolic, and the mineral acids. In a dry and finely-divided state it is used as a **desiccant** and **astringent** for abraded skin surfaces, burns, and ulcers.

DOSES, &c.—For horses, ℥i. to ℥ij. ; for cattle, ℥ij. to ℥iv. ; for sheep, ℥ij. to ℥iv. ; for pigs, ℥i. to ℥ij. ; for dogs, grs. viij. to grs. xij. It is conveniently given in bolus, or suspended in milk, gruel, or mucilage. When administered in large or frequently-repeated doses the bowels should be kept open, in order to prevent its accumulation in the intestines. It is frequently conjoined with catechu, kino, and other vegetable astringents to arrest excessive discharges ; with ginger and other carminatives, to control indigestion and diarrhœa ; with opium or belladonna, to diminish irritability or pain. The following formulæ prove serviceable as **antacids, carminatives, and mild astringents** :—For **horses**, half an ounce each of chalk, gentian, and ginger is made up in the usual way with linseed meal and treacle, or with glycerine ; or chalk ℥i., opium ℥i., and creosote ℥x., are made into bolus ; or, again, half an ounce each of chalk, catechu, and ginger are conjoined with one drachm of opium. For **cattle**, similar prescriptions are given, frequently in draught. For **sheep**, the like combinations are used, in about one-fourth the dose. For **dogs**, a convenient pill is made with chalk and ginger, of each grs. x. ; with opium, grs. ij. ; and aromatic confection, q.s. A draught of similar action is made with chalk, grs. x., laudanum and ether, of each ℥xv., given in a little milk or soup. Any of these prescriptions may be repeated several times daily. Where it is sought to act chiefly upon the stomach, such medicines are fittingly given dissolved in starch solution as prepared by the laundress, or in spirit and water, administered, according

to circumstances, either hot or cold. Where the effects are to be extended throughout the intestines, the drugs are generally given in the solid form. For dyspeptic and diabetic horses suffering from acidity, a piece of chalk should be placed in the rack or manger, or in the drinking water.

CALCIUM PHOSPHATE. CALCIS PHOSPHAS. Phosphate of Lime.



Calcium phosphate is prepared by roasting bone earth until animal and carbonaceous matters are removed, dissolving the residue in diluted hydrochloric acid, precipitating the phosphates by ammonia solution, and washing. Thus purified, it is a light, tasteless, white, amorphous powder, insoluble in water, but soluble without effervescence in hydrochloric and nitric acids.

ACTIONS AND USES.—Calcium phosphate is present in bones, nerves, and other animal textures; occurs abundantly in the intercellular fluid, and wherever cell-growth is most active; and is hence **an essential constituent of food and a restorative**. Its absence in the dietary is shown by M. Chossat to induce softening of the bones and general wasting; it is deficient in the bones of pregnant animals. Milne-Edwards found that, when supplied to dogs whose bones had been intentionally fractured, more rapid union occurred.

It conjoins the actions of calcium and phosphorus, is specially useful in chronic diarrhoea, anæmia, and other forms of malnutrition, especially in young animals. It is serviceable for rapidly-growing, rickety subjects, and, conjoined with iron, for anæmic, badly-nourished, scouring young animals, beneficially restoring the phosphates, which in such cases are sometimes too freely removed. For pregnant animals in a weakly state they are also prescribed. Bran and bruised oats owe in part their notable dietetic value for young stock to the large amount of calcium phosphate which they contain.

DOSES, &c.—Horses take ℥ij. to ℥iv.; cattle, ℥iv. to ℥ij.; sheep and pigs, ℥j. to ℥ij.; dogs, grs. v. to grs. x. Small doses are preferable to large, which sometimes derange the bowels. They are conveniently given mixed with food, and in combination with an iron salt.

CALCIUM CHLORATA. CALX CHLORATA. Chlorinated Lime. Bleaching Powder. A mixture, chiefly of calcium hypochlorite $\text{Ca}(\text{ClO})_2$ and calcium chloride CaCl_2 , with calcium hydrate $\text{Ca}(\text{HO})_2$ and water.

Large quantities of this valuable bleaching agent are made in Glasgow, where it was first prepared by Messrs Tennant and Mackintosh in 1798. The process adopted is as follows:—Chlorine gas, produced by the action of sulphuric acid on common salt and manganese black oxide, is transmitted into close chambers, where slaked lime, moistened with water, is spread on tiers of wooden trays. The lime, after being exposed to the chlorine gas for about four days, is found to have absorbed nearly half its weight of it; the precise changes occurring are not well understood, but the fresh bleaching powder consists of about 28 per cent. of calcium hypochlorite, 25·5 of chloride, 23 of calcium hydrate, and 24·5 of water (Fresenius).

PROPERTIES.—It is a soft, dull-white powder, with a feeble odour of chlorine, or rather of hypochlorous acid, and an acrid taste. When exposed to the air it deliquesces, absorbs oxygen, and evolves hypochlorous acid, which in its turn breaks up into the unstable chloric acid and chlorine gas. When heated or mixed with an acid, chlorine is rapidly given off. It evolves oxygen, and hence sometimes bursts closely-stoppered bottles in which it is kept. It is not fully soluble in water, a portion of the lime remaining undissolved. The watery solution is colourless, or of a faint yellow tint, and has at first an alkaline, and subsequently a bleaching action on vegetable colouring matters. The intensity of its odour and the degree of its solubility are simple approximative tests of its strength and purity, and a good specimen yields at least 33 per cent. of chlorine.

ACTIONS AND USES.—Bleaching powder is irritant, stimulant, astringent, antiseptic, and alterative; it is seldom given internally, but is used externally as a stimulant, antiseptic, deodoriser, disinfectant, and parasiticide, and owes its several effects mainly to the hypochlorous acid and chlorine it so readily evolves.

TOXIC EFFECTS.—Hertwig gave horses and cattle one ounce to two pounds; sheep and goats one to eight drachms; and dogs half a drachm to four drachms. The smaller quantities produced scarcely any effect; the larger, besides local irritation, caused acceleration of the pulse, difficult breathing, increased warmth in the mouth, weeping eyes, abundant secretion of urine, having a curious odour of chlorine or prussic acid, and a white sediment, frequent copious alvine discharges, and in dogs vomiting. In horses the effects usually began in twenty or thirty minutes, and lasted two to five hours. Considerable doses, given repeatedly, did not impair appetite, but caused thirst and gradual emaciation.

MEDICINAL USES.—Youatt recommended bleaching powder for hoven in cattle, and tympanitis in horses, in doses varying from two to four drachms, and ascribed its supposed good effects to its decomposing the gases evolved in the alimentary canal. But repeated careful trials made at the Edinburgh Veterinary College indicate that it is of little, if any, service in the majority of cases of hoven or tympanitis, whether in cattle or horses. It is an antidote in poisoning by hydrogen sulphide and ammonium hydrosulphide; and, with a respirator filled with bleaching powder, Mr Roberts explored in safety the sewers of the Bastille, which had not been opened for thirty-seven years, and were full of hydrogen sulphide and other noxious gases.

Externally, it is used as a **stimulant** and **deodoriser** for unhealthy wounds, for removing the fœtor of foul discharges, and for destroying the fungus of ringworm and the parasites of mange and grease. Diluted solutions have been recommended for checking conjunctival ophthalmia, and other circumscribed and superficial inflammations; but are not so effectual as lead or zinc lotions. Although it does not arrest the action of enzymes, or prevent the reproduction of developed bacteria or their spores as promptly and effectually as corrosive sublimate or chlorine, it is superior as an antiseptic to sulphurous acid, bromine, iodine, salicylic and carbolic acids, and the permanganates (Wernitz and Koch). Its active gaseous products, moreover, readily attack and break up the products of putrefaction, and it hence proves an **effectual deodoriser**.

Chlorinated lime, either in powder or solution, is spread about cow-houses and premises where contagious or epizootic diseases prevail. When free and rapid evolution of the hypochlorous and chlorine gases is desired, vessels containing the powder are set about, and sulphuric acid poured over them; a more gradual evolution is effected by the carbonic acid of the air when cloths saturated with a strong solution are suspended about the infected dwellings. Solutions varying from one to ten per cent. are employed for disinfecting hides, flesh, or excreta of diseased animals. It has the disadvantage of a sickly smell, which is disliked both by horses and cattle; it is gradually converted into calcium chloride, which, having great affinity for water, leaves the floors, walls, and other objects to which the deodoriser has been applied in an unsatisfactorily moist state; whilst its decomposing ammonia, urea, and such other unstable nitrogen compounds, greatly diminish the agricultural value of any manure to which it is added. Scattered about stables or cow-houses, it keeps away flies; while neither rats nor mice frequent places where it is sprinkled, especially when mixed with sulphur.

DOSES, &c.—Horses take ℥i. to ℥ij.; cattle, ℥ij. to ℥iv.; sheep, ℥ss. to ℥i.; dogs, grs. ii. to grs. v., given either in bolus, or with cold gruel, mucilage, or milk.

CAMP H O R.

CAMP H O R A. A stearoptine obtained from the wood of *Cinnamomum camphora*. *Camphora officinarum*. Imported in the crude state and purified by sublimation. $C_{10}H_{16}O$. (B.P.) *Nat. Ord.*—Lauraceæ.

The camphor laurel is a tall, handsome evergreen, cultivated in Japan and China, and in many European conservatories. Its wood and leaves evolve a camphoraceous odour when bruised, and yield about $\frac{1}{500}$ of their weight of camphor, which is sometimes extracted by dry distillation. In Formosa, whence comes most of the camphor imported to this country, the branches are cut into chips and boiled with water in wooden troughs; along with the steam the volatile camphor

rises and condenses in earthen pots placed over the troughs, and on reaching this country is purified by mixing with a little charcoal, sand, lime, and iron filings, and re-subliming. Owing chiefly to increased demand, camphor has recently become scarce and dear.

PROPERTIES.—Camphor occurs in concavo-convex masses, about ten inches in diameter and three inches thick, which derive their form from the vessels into which they have been sublimed. It is white, translucent, crystallises in octahedra, and has a bitter, pungent, cooling taste, and a strong, peculiar, aromatic odour. It floats on water, its specific gravity, varying with the temperature, is about .996. Exposed to the air, it slowly evaporates; heated, it takes fire, and burns with a bright but sooty flame. It is tough and difficult to powder, unless with the addition of one-fourth of its weight of spirit or a little volatile oil or sugar. It dissolves readily in ethers, acids, and oils, in about its own weight of rectified spirit, in eight times its weight of milk, and in 1000 times its weight of water. Camphor ($C_{10}H_{16}O$) is an oxide of terepene ($C_{10}H_{16}$)—the chief constituent of oils of turpentine, chamomile, cardamoms, cloves, hops, juniper, savin, and valerian. Associated with the terepene in these oils is an oxidised product or stearoptine corresponding with the colophony of turpentine. Continuously heated with nitric acid, camphor oxidises, and is converted into camphoric acid ($C_{10}H_{16}O_4$).

Sumatra or Borneo camphor ($C_{10}H_{18}O$) is found in minute prisms in cavities in the wood of the *Dryobalanops aromatica*, and is distinguished from laurel camphor by its softness, friability, and opacity, its higher density, and its somewhat alliaceous odour. From Borneo, Formosa, and other parts of China, **fluid camphor oils** are obtained from several different trees. **Artificial camphor** ($C_{10}H_{16}HCl$) is got by the action of hydrochloric acid on oil of turpentine. **Camphora monobromata** ($C_{10}H_{18}BrO$) resembles bromine rather than camphor in its actions, is sometimes used instead of the bromides, but is not so efficient.

ACTIONS AND USES.—The camphors in large doses are irritant and narcotic. Medicinal doses are antiseptic, stimulant, antispasmodic, anodyne, anaphrodisiac, and diaphoretic. Ex-

ternally, they are used as antiseptics, parasiticides, counter-irritants, and to relieve itching in various skin diseases.

GENERAL AND TOXIC EFFECTS.—The camphors, physiologically as well as chemically, are **volatile oils**. Like other bodies of the group (p. 243), they are **topical irritants**, and large doses stimulate and subsequently **narcotise the central nervous system**. They frequently produce convulsions. Those which contain the most hydrogen, as the Borneo, the monobromata, as well as menthol ($C_{10}H_{20}O$), are least convulsant. In fine powder or solution they are quickly absorbed; are oxidised in great part into camphoric acid; **stimulate** the brain, spinal cord, heart, and respiratory functions; and are excreted by the skin and bronchial membrane, and in less amount by the kidneys (Bartholow). Moiroud records that two ounces produced in horses convulsive movements and acceleration of the pulse, unaccompanied, however, by fatal results. Hertwig mentions that two to four ounces given to horses and cattle, two to four drachms to sheep, or one to three drachms to dogs, accelerate respiration and pulsation, communicate a camphoraceous odour to the breath, heighten sensibility, and occasionally induce convulsions. Dogs, besides, exhibit imperfect power of controlling the movements of their limbs, and when the doses amount to three or four drachms insensibility and death ensue. The vapour of camphor destroys fleas, bugs, moths, and spiders, exciting, enfeebling, and stupefying them. It has considerable **antiseptic** power. Koch found that one part to 2500 of water hindered development of anthrax bacilli.

MEDICINAL USES.—Camphor is a **nervine stimulant**, and hence usefully controls reflex excitability in gastro-intestinal, respiratory, urino-genital, and cutaneous irritability. It is used, especially in young animals, as a **gastric stimulant** and antiseptic. In diarrhœa it is given with aromatics and a few drops of hydrochloric acid, or with ether and laudanum. Professor Robertson prescribed it with opium in enteritis in horses. Many veterinarians give it freely in catarrhal cases presenting increased secretion and dyspnœa, conjoining it with salines, ammonia salts, or belladonna. In chronic bronchitis in horses, Professor Robertson prescribed it with squills, and in conval-

escence from catarrhal complaints used a bolus consisting of a drachm each of camphor, gentian, ginger, and myrrh. For influenza and other exhausting diseases, whether in horses or cattle, a **stimulating draught** is often made with two drachms each of camphor and ammonium carbonate, and an ounce of ether, given in ale or cold gruel. **Sore-throat** and irritable, spasmodic cough are relieved by placing on the tongue, at intervals of two or three hours, or as required, an electuary made with equal parts of camphor, borax, and belladonna extract, reduced to a paste with ammonia acetate solution, and mixed with eight or ten parts of honey or treacle. Small doses prescribed with belladonna **lessen urino-genital irritability**, resulting from cantharides or other causes. Its anaphrodisiac effects are not very notable in veterinary patients. It does not, as has been popularly believed, diminish the lacteal secretion.

For dogs, grs. v. each of camphor and belladonna extract, with fʒj. of ammonia acetate solution, in a few ounces of water, is prescribed to **relieve cough** and **bronchial irritation**. Professor Williams recommends camphor and sweet spirit of nitre for allaying the restlessness and convulsions of **chorea**.

Externally, it is applied either in oily or weak spirituous solution to **allay itching** in chronic eczema and urticaria. Dissolved in oil or other media, it is used to destroy skin parasites, and to prevent attacks of flies. It is a constituent of soap, opium, belladonna, chloroform, turpentine, and other liniments.

Doses, &c.—For horses, ʒj. to ʒij. ; for cattle, ʒij. to ʒiv. ; for sheep and pigs, grs. xx. to grs. xl. ; and for dogs, grs. v. to grs. x. When used for anodyne purposes, it is conveniently made into an emulsion with eggs, or dissolved in milk or oil. For external use, it is dissolved in six or eight parts of proof spirit, in diluted acetic acid, linseed oil, or oil of turpentine.

CANNABIS INDICA.

INDIAN HEMP. The dried, flowering, or fruiting tops of the female plants of *Cannabis sativa* grown in India, and from which the resin has not been removed. It is known in India as gunjah or ganga. (B.P.) *Nat. Ord.*—Urticaceæ.
Sub. Ord.—Cannabineæ.

The *Cannabis sativa* is grown in India, and also in the Southern States of America. Its properties depend upon an aromatic bitter resin, **cannabin**, and the plant also yields a **volatile oil**. It is used in several different forms. Bhang consists of the small bright-green leaves, with a few flowering or fruiting tops and the adhering resin; and I am informed by Mr Richard Rutherford that it is the first season's growth. Gunjah consists of the leaf-stalks, with adhering brown leaves, dried, flowering, and fruiting tops, and resinous exudate, and is reported to be the growth of subsequent years. An Arabian preparation is known as haschish.

ACTIONS AND USES.—Indian hemp is a **deliriant-narcotic anodyne** and **antispasmodic**. Bhang is widely used in India by all classes of people as a pick-me-up, and in larger amount to induce pleasing, dreamy narcosis. Similar effects are exerted on horses; the flagging appetite is improved, capacity for exertion increased, exhaustion and restlessness overcome. Gunjah is more active, anodyne, and narcotic. It has long been used in India to dull sensibility during surgical operations both on man and animals. Sir Robert Christison stated that "for energy, certainty, and convenience, Indian hemp is the next anodyne to opium, and often equals it" (*Dispensatory*). Mr Richard Rutherford, Edinburgh, for several years used gunjah largely in India in the treatment of **colic in horses**, and informs me that it relieves spasm and pain as quickly as opium, but more permanently, and without arresting the action of the bowels, or leaving headache or delirium, as opium occasionally does. American practitioners sometimes prescribe it in diarrhœa, occasionally conjoining it with spirit of chloroform and aromatic spirit of ammonia. Mr Richard Rutherford recommends it in **tetanus**, remarking that it relieves irritability,

spasm, and pain, without impairing the appetite, interfering with the action of the bowels, or producing delirium. More than half the cases he has treated with cannabis have recovered. It proves equally useful in tranquillising the involuntary spasms of **chorea in dogs**. In the form of injection or suppository it is sometimes substituted for opium in the treatment of irritable or painful conditions of the lower bowel or urogenital organs.

DOSES, &c.—The extract is the preparation generally used. Horses and cattle take ℥ss. to ℥j.; dogs, gr. $\frac{1}{4}$ to gr. j. The tincture is given in about the same doses as that of opium. The drug has not been very favourably thought of in this country, owing to the difficulty of getting either the extract or tincture pure or of full strength.

CANTHARIDES.

LYTTA VESICATORIA. Blistering or Spanish Fly. The dried beetle—*Cantharis vesicatoria*. *Class*—Insecta. *Order*—Coleoptera.

Cantharides flies are found in most parts of Southern Europe, Germany, and Russia, and occasionally along the south coast of England. They settle on such trees and shrubs as the olive, lilac, privet, ash, elder, honeysuckle, and rose. During May and June, after nightfall or before dawn, the collectors, with their faces protected by masks and their hands by gloves, shake or beat the insects from the trees on which they feed, kill them by exposure to the fumes of oil of turpentine, or by immersion in boiling water or vinegar, and quickly dry them in the sun or by artificial heat. The flies used in this country were formerly brought from Spain (and hence their vernacular name of Spanish flies), but are now chiefly imported from Hungary, St Petersburg, and Messina, usually packed in barrels or cases containing from 100 to 200 lbs.

PROPERTIES.—The insect is of a copper-green colour, measures six to ten lines in length, and two to three lines in breadth, and weighs about a grain and a half. A little furrow, running along the head, neck, and body, divides it into two symmetrical halves; investing the fine, gauze-like, membranous wings is a

pair of shining elytræ, or wing coverings, of a copper-green colour, and so indestructible that they have been recognised in the human stomach nine months after interment. The body, especially along its under surface, is covered with grey-white hairs; the head is large; the antennæ or horns are black and thread-like. The insect, which lives eight to ten days, deposits its larvæ in the earth, leaving them to be hatched by the heat of the sun. It has a resinous, acrid taste, and a disagreeable, penetrating, fœtid odour. Powdered cantharides is freely soluble in boiling water, alcohol, ether, acetic acid, and fixed and volatile oils. The active principle being volatile, no cantharidine preparation should be heated beyond 200° Fahr. Its distinguishing tests are its vesicant action, and the brilliant green appearance of the wing-covers.

Cantharides, besides animal matters, acetic and uric acids, contains a bland oil, a fœtid, acrid, volatile oil, and about two per cent. of **cantharidin** ($C_{10}H_{12}O_4$), which is confined to the soft parts of the body, and is present particularly in the female sexual organs. It also occurs in the *mylabris cichorii*, common in India, and in most vesicant insects. It is slowly deposited, when an alcoholic solution of cantharides is concentrated. When pure, it crystallises in colourless scales or prisms, melts at 482° Fahr., is insoluble in water, but soluble in alcohol, acetic acid, ether, chloroform, and oils; $\frac{1}{100}$ of a grain suffices to blister.

IMPURITIES.—As the powdered cantharides sold in the shops sometimes contains euphorbium and various cheap irritants, it is advised that the flies be purchased entire. Other insects are sometimes mixed with them. The species of *mylabris* sold as Chinese blistering flies have two orange-coloured bands and spots on the wing-covers. Activity is sometimes impaired by damp, long-keeping, and attacks of mites, moths, and beetles—parasitic attacks which are prevented by keeping the fresh flies in closely-stoppered bottles, with a few drops of acetic acid, or a few grains of camphor or ammonium carbonate.

ACTIONS AND USES.—Cantharides is an irritant, and produces its effects on any part with which the free cantharidin is brought into contact. Applied externally, it stimulates and vesicates, and is used as a counter-irritant. When swallowed

it irritates the digestive mucous membrane; large doses produce gastro-enteritis. The active cantharidin is absorbed, and in the blood forms a non-irritant albuminoid, but in the kidneys is again liberated, developing its characteristic irritation—small doses stimulating the urino-genital tract, causing diuresis, and in some animals aphrodisias; full doses inducing inflammation, strangury, and hæmaturia.

GENERAL ACTIONS.—According to the strength of the preparation, or the period during which it is applied, cantharides produces **redness, vesication, or sloughing** of the skin or mucous surfaces. An ordinary vesicant dressing causes congestion, elevation of local temperature, and, usually within three to twelve hours, formation of blisters, which, after a variable but generally short time, burst, and discharge a yellow, serous fluid, which dries into scurfy cicatrices. When freely or continuously used, the deeper-seated skin tissues are inflamed, and suppuration, ulceration, and sloughing ensue. When the true skin has thus been seriously inflamed, the hair bulbs are injured; the hair is removed, and permanent baldness and blemishing may result. As a vesicant it is most powerful on horses and dogs, less powerful on cattle, still less so on swine and poultry, and is said to have no action on hedgehogs.

TOXIC EFFECTS.—Orfila found that “three drachms of the tincture, with eight grains of powder suspended in it, caused the death of a dog in twenty-four hours, if retained in the stomach by a ligature on the gullet, insensibility being the chief symptom; and that forty grains of the powder killed another dog in four hours and a half, although he was allowed to vomit. When administered by the stomach, that organ was found much inflamed after death; and if given in the form of powder, fragments of the poison were generally discernible. When applied to a wound, the powder excites surrounding inflammation; and a drachm will, in this way, prove fatal in thirty-two hours, without any constitutional symptom except languor” (Christison *On Poisons*). An ounce of powdered cantharides administered to a horse caused death in eighteen hours; and fatal effects are reported to have occurred where only one drachm was given (Morton).

The treatment of the gastro-intestinal or urinary irritation

consists in the free use of mucilaginous drinks with opiates. Oils and fats are inadmissible on account of their favouring solution of any unabsorbed poison. When constitutional irritation has resulted from absorption of the cantharidin from a blistered surface, this should be dressed with soothing remedies.

MEDICINAL USES.—Small, repeated doses are occasionally prescribed in **chronic catarrh**. In such cases Professor Robertson gave it with copaiba. It is sometimes serviceable in **chronic cystitis**; while giving tone to the sphincter vesicæ, small doses prevent involuntary escape of urine. In some parts of Germany it is given to cows which are tardy in coming to service; but its aphrodisiac effects on either sex are uncertain, and seldom produced except by dangerously large doses. When administered for some time, small vesicles sometimes appear on the skin, depending on the excretion of cantharidin cutaneously.

EXTERNAL APPLICATIONS.—Cantharides, in small amount and diluted, stimulates the capillaries and trophic nerves of the part to which it is applied, and thus **increases the blood supply and functional activity of the skin and hair bulbs**. It hence induces a healthier condition of the dermis in some chronic scaly diseases, and promotes growth of hair; ulcers and tardily-healing wounds are stimulated, and their repair encouraged; while slowly-developing abscesses, as those of irregular strangles, are brought to a head. **Inflammatory products are liquefied and absorbed**—an effect familiarly illustrated by the action of a blister on the swelling remaining around a kick or other bruise, or on the fulness and thickening resulting from a strain. The beneficial effects of a cantharides blister in **arresting inflammation and removing effusion** were often exhibited when blood-letting was more common than it now is, and phlebitis of the jugular vein of the horse was not infrequent. The blistering ointment, well rubbed in along the course of the vessel, seldom failed to remove the tense, corded, inflammatory swelling.

To produce inflammatory exudate, cantharides is usefully applied in open joints or bursæ, where the breach of continuity is small, as from perforation by a stable fork; exudate and

swelling are thus produced sufficient to prevent escape of synovia. It is also applied in umbilical hernia in foals and calves; and while it mechanically prevents the descent of the intestine, it gradually obliterates the opening in the abdominal walls. Similar effects are sometimes obtained by moistening the adjacent skin with sulphuric acid.

Cantharides is much used as a **counter-irritant**. The external irritation reflexly **relieves tension, inflammation, and pain** of adjacent or deeper-seated parts (p. 44). Blisters applied experimentally to the chest or loins of dogs and rabbits, while producing external congestion, cause anæmia of the pleura and lungs, or of the deeper-seated muscles of the back. Professor Robertson has recorded that in pleuritic and other cases a blister so notably modifies morbid action, and relieves painful tension, that temperature is reduced 2° to 3° Fahr., and the pulse ten beats per minute. He preferred cantharides mustard, believing it to cause less irritation and pain, and to produce more permanent curative effects. Professor Williams, however, maintains that cantharides and other blisters unnecessarily irritate most horses, and, in acute diseases of the respiratory organs, are neither so certain nor so satisfactory as hot fomentations (p. 49).

In many cases of catarrh and sore-throat, heat and moisture are certainly more effectual than blisters; but tedious, irritable conditions of the larynx, inducing coughing, are often relieved by a cantharides dressing. In the outset of **roaring**, counter-irritation is often useful. In **acute attacks of bronchitis**, when mainly affecting the larger tubes, it is serviceable, in conjunction with inhalation of steam, and after stuping the parts with hot water. But Professor Robertson also speaks favourably of fly blisters in cases where considerable exudation blocks the smaller tubes. Their efficacy is seldom so obvious in pneumonia, especially when involving a considerable area. In **pleurodynia** and most stages of **pleurisy**, cantharides is specially useful; in the earlier stages it moderates acute inflammation, while later it checks and removes effusion. It is the counter-irritant usually applied in inflammation of the heart and pericardium. Although occasionally used, it is seldom of much value, either in colic or enteritis. In peri-

tonitis it is seldom so effectual as in pleurisy, but was advised by Professor Robertson in chronic cases. Where acute inflammation extends over a considerable area of the peritoneum, it is desirable that the blister be applied some little distance to the side of and not directly over the closely underlying inflamed spot. Professor Williams and other good authorities recommend cantharides blisters in encephalitis and spinitis, as well as in chronic paralysis. Those cases of paralysis among cows depending upon **puerperal apoplexy** are usually benefited by moderate counter-irritation, maintained for a week or ten days. In **rheumatism**, in all patients, advantage frequently results from a good fly blister, the effects of which are kept up for several days.

Irritation and inflammation of joints, bursæ, ligaments, tendons, and bones are combated and effused products removed by blisters properly used. When external surfaces or comparatively superficial textures are to be directly stimulated, the cantharides application must be mild, and not too long applied. When deeper-seated parts are to be acted on, more powerful preparations are needful, and their effects may be maintained by repetition. It is seldom admissible to apply cantharides directly to any part which is hot, tender, or inflamed. In applying blisters to inflamed joints or bursæ, it is judicious to place them, not immediately upon, but somewhat above or below, the affected spot. Where continued effects are desired, mercury biniodide dressings are alternated with the cantharides, or substituted for it, or setons or the hot iron are used instead of blisters.

Owing to its liability to become absorbed and irritate the kidneys, it is **an unsuitable counter-irritant** in inflammation of the urinary organs. In common with all other causes of irritation, it must be avoided in tetanus. Unless on a very limited surface, and freely diluted, cantharides must not be used in typhoid complaints, or in weakly, exhausted subjects. It should not be applied to any portion of the skin in a highly vascular or sensitive condition, or where there is tendency to erysipelas. In blistering dogs, special caution is required, as they are apt to rub the irritated parts, and cause sloughing. Cantharides sometimes acts with unexpected violence on the

thin skins of well-bred horses, and for such subjects strong blisters are not advisable, and their application over considerable surfaces should be avoided. No horse should have all four legs blistered at once. In some excitable subjects even a moderate blister causes irritative fever.

Doses, &c.—For horses, grs. iv. to grs. xx.; for cattle, grs. x. to grs. xx.; for sheep and swine, grs. ij. to grs. viij.; for dogs, grs. ss. to grs. ij., repeated once or twice a day, usually given with aromatics and bitters, in the form of bolus or tincture; administration suspended if strangury or any untoward effects occur.

Cantharides is used externally in the form of powder, tincture, vinegar, ointment, liniment, and plaster.

Powdered cantharides is principally used for keeping up discharges, and for scattering over mustard poultices and other stimulant applications to increase their activity.

Tinctures of cantharides, vulgarly termed sweating blisters, are made of varying strength. Those used in human medicine are too weak for most veterinary purposes. One ounce of coarsely-powdered flies, macerated for seven days with fifteen or twenty ounces of proof spirit, forms a useful tincture of medium strength. The activity is augmented by addition of liquor ammoniæ, or oil of turpentine. The tinctures in common use act speedily, but their effects are less powerful and permanent than those of the ointments. Though producing considerable irritation, they seldom cause blistering, unless applied repeatedly at short intervals. In using them, it is not essential that the hair be removed, nor even that the animal be kept idle. They may be applied repeatedly to the same spot without fear of blemishing.

Vinegar of cantharides (acetum cantharidis)—a solution of one part of powdered flies in about ten of acetic acid—forms a prompt counter-irritant.

Ointments of cantharides (unguenta cantharidis) are much used. Their oleaginous constituents ensure solution of the cantharidin, and render them easy of application. Many contain a number of ingredients, but the simplest are usually the best. A useful ointment of medium strength consists of one part of powdered cantharides to six of hog's lard, palm oil,

resinous ointment, or vaselin. Such an ointment, when well made and applied with smart friction, acts effectually, and is little apt to blemish. Another excellent ointment is made with one part each of powdered cantharides, Venice turpentine, and resin, with four parts of vaselin, palm oil, or lard. The powdered flies are digested with the oily matters in a covered vessel, over a slow fire or in a water-bath, for twelve hours, and the vessel placed in boiling water for fifteen minutes; any wax or resinous matters used to give consistence are then melted and stirred in, any volatile flavouring oil added, and the mixture, if required, strained through muslin. Euphorbium, sulphuric acid, peppers, and occasionally corrosive sublimate and arsenic, are added; but are apt to cause unnecessary pain, sloughing, and blemishing.

French and German practitioners frequently, however, add other irritants to their cantharides blisters. M. Degive, of the Veterinary College at Cureghem, states that numerous experiments convince him that the best vesicant is made of 10 to 15 parts each of cantharides and corrosive sublimate dissolved in 100 parts of vaselin. The part is prepared by clipping the hair, and washing with soap and water. The ointment is rubbed in for ten minutes, and, if needful, six hours later the surface may be simply anointed. Swelling and vesicles appear usually within a few hours; the vesicles are as large as pigeons' eggs; but by the second day inflammation subsides, and blemishing, it is said, does not occur. Even the strongest of these ointments are stated to be in daily use at the Brussels Veterinary College (*Journal of Comparative Pathology and Therapeutics* for March 1890).

In **cattle practice**, counter-irritation is generally produced with mustard and hot water, but some powder or strong ointment of cantharides, mixed with the mustard, greatly increases its effects. **For dogs**, a convenient ointment is made with an ounce each of powdered cantharides and oil of turpentine, and 12 to 20 ounces of lard.

To ensure full vesication, the hair, where rough or long, should be clipped or shaved off; the skin, especially if dirty, washed with soap and water; and the ointment then spread over the part, and well rubbed in. The extent of surface to

be covered must obviously depend upon the nature, seat, and extent of the malady. To prevent the ointment, when liberally applied, from spreading beyond the desired limits, the blistered spot may be surrounded with an edging of resinous ointment. The blister, while rising, often causes considerable irritation, and the animal, if permitted, will rub or bite the blistered part. In the horse this should be prevented by securing the head to the rack, putting on a cradle, or, when required, tying up the tail; in the dog, by the use of the muzzle. On the next, second, or third day, the blistered part should be fomented with warm water, and dressed with oil, lard, vaselin, or Carron oil. If sufficient effect has not been produced, a little more of the blister may then be applied.

Liniments of cantharides are merely liquefied ointments, and, in respect of activity, usually occupy a mediate place between ointments and tinctures. They generally consist of one part of cantharides and six to ten parts of rape or linseed oil. Oil of turpentine is sometimes added. Some practitioners use a liniment of one part of cantharides and four or five of tar—a combination not very commendable, and not easily rubbed in.

Plasters of cantharides are made in the same manner as ointments, but rendered more strongly adhesive by the addition of resin or pitch. To prevent their being displaced by the powerfully corrugating action of the panniculus carnosus, they are usually applied in the melted state, immediately covered by a little tow or teased lint, and enveloped in a suitable bandage.

CARBOLIC ACID.

ACIDUM CARBOLICUM. Phenic Alcohol. Phenol. Phenic Acid. Phenol Hydrate. C_6H_5HO .

Carbolic acid is an occasional constituent of the urine of most animals, may be extracted from some plants, and is one of the many products of coal-tar. Cannel coal is its most prolific source; but it also occurs in other coals, as well as in bitumen and petroleum. It is **extracted from the heavier coal-tar oils**, which distil at from 300° to 400° Fahr. They

are treated with caustic soda ; on standing, two layers separate ; the upper consists of the higher homologues of benzene (p. 295), the lower of sodium phenylate. This latter, diluted with water, is neutralised with sulphuric acid and purified by fractional distillation.

Thus purified, carbolic acid occurs in pulverulent crystals, and in masses of acicular crystals. It is colourless, or faintly red or brown, absorbs moisture, melts at 91.5° Fahr., boils at 371° Fahr., has a specific gravity of 1060 to 1066, and a peculiar pungent taste and odour. It is devoid of acid reaction, is liquefied at 60° Fahr. by five to ten parts of water, and dissolved by fifteen parts of cold water. It is freely soluble in glycerine, most volatile oils, alcohol, ether, alkaline solutions, and acetic acid. It coagulates albumin. It destroys the particulate cells which produce the several fermentations. With an equivalent of sulphuric acid, it forms sulpho-carbolic acid, which produces a series of definite stable, soluble, crystallisable salts—the sulpho-carbolates, which have no action of carbolic acid (p. 345). With nitric acid, it forms explosive compounds and picric acid ($C_6H_2(NO_2)_3OH$), an antiseptic, and much used as a yellow dye. When carbonic anhydride is passed through dry powdered phenol-sodium, salicylic acid is produced.

Carbolic acid is **distinguished** by its odour. Bromine water forms, even in very dilute aqueous solutions, pale-yellow crystalline needles of tribromo-phenol. Concentrated sulphuric acid, containing a little potassium nitrite, gives a brown colour, changing to green when gently heated with phenol. An aqueous solution, even if containing $\frac{1}{1000}$ part, when treated with a drop or two of ferric chloride solution, produces a mauve colour. Wood-tar oils and crude creosote, apt to be mistaken for impure carbolic acid, are distinguished by their being less soluble in water, by boiling and drying about 212° Fahr. instead of at 370° , and by not solidifying about 40° Fahr.

The B.P. acidum carbolicum liquifactum, containing 10 per cent. of water, is a colourless or slightly red liquid, with the taste, odour, and properties of the pure acid. The empyreumatic red-brown liquid **commercial acid** contains the uncrystallisable, acrid methyl-phenol or cresol ($C_6H_4(OH).CH_3$).

Calvert's carbolic powders consist of 20 to 30 per cent. of carbolic acid, incorporated with refuse from the alum-works. **MDougall's disinfecting powders** contain about 33 per cent. of calcium carbolate and 59 per cent. of magnesium sulphite. A mixture of carbolic acid and bleaching powder has been patented. **Blast furnace residual oils**, now produced largely in Scotland, consist of 20 to 35 per cent. of phenoloids, soluble in caustic soda, resemble wood-tar products, and are used for preserving timber.

ACTIONS AND USES.—Carbolic acid belongs to the benzol or aromatic series of carbon compounds, which are notable for their antiseptic and antipyretic properties (p. 293). It closely resembles creosote and creolin. Large doses are irritant and narcotic poisons. It is used as an antiseptic, antiparasitic, and occasionally as a local anæsthetic, stimulant, rubefacient, and caustic. It is administered in various contagious and zymotic diseases, with a view to prevent or arrest the development of particulate micro-organisms. It is employed as a disinfectant.

GENERAL ACTIONS.—It coagulates albumin and destroys micro-organisms. It is not nearly so active as corrosive sublimate, chlorine, iodine, or sulphurous acid in arresting the action of ptyalin, pepsin, diastase, and other organic ferments, or in killing or preventing the development of bacteria; but Koch's experiments show that about one part to 500 prevents the growth of anthrax and other bacilli. Oats, barley, beans, and lentils, soaked in a one per cent. solution, do not germinate. Milk is maintained unchanged by $\frac{1}{54}$ th part of acid. Healthy pus is kept aseptic by $\frac{1}{100}$ th part. Two per cent. is, however, needful effectually to secure the antiseptic state of vaccine lymph, glanderous pus, and other virulent fluids. As carbolic acid gradually volatilises, not only may fresh infection occur, but spores and organisms, the development of which has been arrested, may regain activity.

A strong solution applied to the skin, or to a mucous surface, coagulates albumin, acts as a topical irritant and caustic; anæsthesises not only the skin, but the underlying structures; causes a stain at first white, but shortly becoming brown; and leaves a dry, roughened surface, from which the

shrivelled epidermal scales subsequently peel off. "It is a powerful poison to all tissues, paralysing both muscle and nerve when applied directly to them, and without previously stimulating them" (Brunton).

Full doses when swallowed, besides producing these local effects, cause **increased salivation**, and in carnivora usually **vomiting**, with **gastro-enteritis** and **collapse**, which may end fatally. It is absorbed, and, like other members of the alcohol series, it first **stimulates and subsequently paralyzes the medulla and spinal cord**, and involves also the cerebral centres. The respiratory and vaso-motor centres are first stimulated, quickening respiration, raising blood-pressure, and accelerating the pulse; but as paralysis is developed, respiration is slowed, and blood-pressure falls. Stimulation of the sweat-centre increases perspiration. Implication of the cerebral centres gives rise to restlessness, irregular movements, convulsions, and anæsthesia. Moderate doses **kill by paralysis of respiration**, but larger doses besides cause **cardiac paralysis**. It is **excreted** in part by the lungs and skin, mainly **by the kidneys**, and chiefly in the form of sulpho-carbolates, detectable, two or three hours after administration, by bromine water or ferric-chloride. The urine has an olive-brown hue, and for a considerable time resists putrefaction; but, if it stands long, it becomes amber-brown, depending upon hydro-quinone and other phenol products undergoing further oxidation. Excretion is tolerably rapid; carbolic acid can seldom be found in any notable amount in the urine either of men or animals twenty-four hours after the exhibition of the last dose.

Toxic Effects.—Two drachms prove immediately fatal to **dogs**, and kill full-grown cats in two minutes (Dr Sansom). Dr Cullen, of Calcutta, found that one drachm given to small dogs caused excitement, dilated pupils, shallow, stertorous breathing, convulsions, and death in ten minutes. (*Veterinarian* for September and November 1872). Friedberger found that fifteen grains killed dogs in a few hours. Three or four drops placed under the wings of sparrows caused excitement, restlessness, and death in half an hour; toads, earthworms, beetles, ants, and fleas were promptly poisoned (Lamaire). Two drachms

repeatedly given by the late Mr Romanes, of Leith, to a **donkey** had no very notable effect. Half-ounce doses are dangerous for **horses**; ounce doses are fatal (Kaufmann). Poisonous doses immediately cause dogs, rabbits, and other animals to reel, move in jumps, and fall as when intoxicated by alcohol; they tremble and show muscular weakness, cough, and froth at mouth; the pulse is small, quick, irregular, and intermittent; temperature is lowered; albuminuria and hæmaturia are occasionally present; shallow, gasping, difficult breathing, collapse, paralysis, more or less anæsthesia, and occasionally convulsions, precede death.

By whatever channel it is introduced into the body, its characteristic effects are produced. Dressings used in human surgery sometimes cause nausea, vomiting, giddiness, high-coloured urine, and occasionally collapse, and even death. **Scabby sheep too freely dressed** occasionally suffer from congested and inflamed lungs, linger for weeks, and even then die. **Dogs and cats are particularly susceptible**; even a single dressing, incautiously applied over a large surface, produces dulness, trembling, and disinclination for food, which may continue for several days. Stronger dressings within a few minutes cause excitement, blowing, unsteady gait, and occasionally fatal collapse. A considerable skin surface, freely wetted, is recorded by Professor Williams to have produced "gradual failure of the heart's action;" whilst in other cases the dog has fallen into a state of marasmus, with sunken eyes, fætor of the breath, formation of sordes on the teeth, "tarry" fæces, total loss of appetite, and death in six to twelve days (*The Principles and Practice of Veterinary Surgery*).

THE POST-MORTEM APPEARANCES are—brown discoloration and corrugation of the membrane of the mouth and fauces, and sometimes of the stomach; strong solutions leave patches of redness and inflammation in the stomach and small intestines. The blood is dark-coloured and feebly coagulated, but the corpuscles are unchanged (*The Antiseptic System*, by Dr A. E. Sansom, 1871). Where death has occurred within a day after the poison has been taken, a smoky phenol odour pervades the body, and the poison has been discovered in most of the internal organs; but where life has been prolonged beyond twenty-four hours, the

volatile drug may not be discoverable. Dr Cullen records that the vessels of the brain are full of fluid blood; while serous effusion is generally observable on the surface of the brain and within the ventricles. The lungs, in cases that have survived several days, are frequently ecchymosed.

ANTIDOTES.—Where the poison has been swallowed, any unabsorbed portion should be removed by the stomach-pump. Pharyngeal and gastric irritation are allayed by inhalation of steam, medicated by a little laudanum, and by demulcent drinks and saccharated lime. Neutralisation of the poison, by conversion into phenol-sulphuric acid, and excretion by the kidneys, are hastened by administration of sulphates, conveniently given in the form of sodium sulphates.

FOR SURGICAL PURPOSES carbolic acid is the antiseptic most frequently and generally used in this country. In preparation for any considerable operation, the parts are washed and kept wetted with a one to twenty or one to forty solution. The hands of the operator and his assistants are washed in the weaker of these solutions, in which are also placed instruments, tow, sponges, sutures, and other appliances. Extensive wounds, likely to be irritated by continuous contact of considerable amounts of carbolic acid, are sometimes first covered by a protective of oiled silk varnished with copal and coated with dextrin, which allows the silk to be uniformly wetted with the antiseptic solution. Over this protective—or, in ordinary cases, directly upon the wound—are laid six or eight folds of freshly-prepared carbolic lint, made of coarse unbleached gauze or muslin, which has been impregnated by prolonged soaking with a mixture of one part of crystallised carbolic acid, four of resin, and four of paraffin. Through these dressings, the air, before reaching the abraded surface, is filtered and deprived of micro-organisms. To retard undue evaporation of the volatile antiseptic, and prevent discharges soaking through the dressing, a piece of mackintosh cloth, wetted with the carbolic solution, is applied with the indiarubber coating next the wound. Over this, and underneath the appropriate strappings, are placed, as required, folds of carbolised lint, tow, or oakum. With such antiseptic precautions, human surgeons have reduced the mortality of capital operations by more than

one-half, and equally favourable results are obtained by veterinarians.

To prevent and arrest attacks of micro-organisms, carbolic acid is applied, in all classes of patients, to most descriptions of **wounds**. Incised or lacerated wounds are washed, according to their condition, with a one to forty or one to twenty solution, before and after being secured with stitches or sutures. Broken knees and open joints are cleansed, and at intervals irrigated with carbolic lotions. When wounds for several days have been treated with the stronger carbolic solutions, an aseptic condition may be maintained, and healing usually hastened by milder dressings of boric, salicylic, or sulphurous acids. Added to Carron oil, it allays pain, and prevents or limits suppuration of **burns and scalds**. Over-reaches and other serious bruises, after being drenched with a watery solution, are covered with a few folds of carbolised lint or oakum, and, when painful, enveloped in a large bran poultice. Similar treatment is serviceable in carbuncle of the coronary band, occurring in hard-worked horses in wet, cold weather. A saturated watery solution is used in **foot-rot among sheep**; but in chronic cases, and where reparative power is deficient, it is usefully alternated with turpentine and oil, and, where granulations are superabundant, with copper sulphate. **Farcy buds and ulcers** are stimulated, and their healing promoted, by thorough soaking with strong carbolic. **Fistulæ** of the poll, withers, or lateral cartilages, cleansed of micro-organisms by strong acid, and provided with a dependent opening, frequently heal if protected by carbolic gauze from fresh incursions of organisms.

Injuries of the uterus or vagina, resulting from parturition, leucorrhœal and other discharges, and metritis in all animals, are treated with the glyceride and other carbolic solutions, with the effect of abating irritation, noisome discharges, and straining. No treatment is so effectual in **metritis in ewes**, the prevalence of which might be materially abated if shepherds would observe greater cleanliness, and wash their hands with an antiseptic fluid before rendering assistance to ewes lambing. Such precautions are specially needful where post-mortem examinations have been engaged in, where dead

lambs, which have lain about for some days, have been skinned, or where cases of metritis have been handled. No one who has been in contact with such a contagious complaint can enter the lambing pens without much risk of distributing the specific organism. After washing with corrosive sublimate solution, a strong carbolic solution painted over the umbilical cord of foals and calves at birth, and repeated daily for a week, effectually prevents **inflammation of the navel**, and the ensuing pyæmic infection of joints and other parts (M. Gmelin, *Journal of Comparative Pathology and Therapeutics*, March 1892).

Carbolic acid is seldom used as a caustic. Concentrated solutions applied to **boils** frequently cause their abortion, and prevent their spreading, and are sometimes injected into lymphatic glands swollen from pyæmia, and into tuberculous, cancerous, and melanotic tumours. Injected into the swellings on cattle or horses, caused by the œstrus bovis, it kills the larvæ. Painted over the skin, strong solutions cause superficial **local anaesthesia**, sufficient for the opening of abscesses, but insufficient for the painless insertion of setons, or for moderately deep firing. Eight or ten per cent. solutions are occasionally applied as **topical stimulants**, and rubefacients for sore-throat and rheumatic joints.

FOR MEDICINAL USES carbolic acid is not so effectual as for surgical purposes. It has been prescribed, however, in most **diseases produced by micro-organisms**. In **cattle-plague** it appears to lower advancing temperature, and prolong even where it does not save life. Mr William Crookes injected 105 grains in six ounces of water into the jugular of a cow suffering from cattle-plague, with little apparent injury beyond what might have been expected from the injection of any simple fluid, and the patient gradually recovered. M. Bouley reports that cattle inoculated with **malignant pustule** invariably died; but when these inoculated subjects were promptly dosed with two or three drachms daily of carbolic acid, four out of five recovered. Similar results followed the use of the acid in horses and sheep inoculated with pustule. In **Texas cattle fever** an approved remedy has been twelve ounces each of carbolic acid and sodium bicarbonate, mixed with four fluid

ounces of glycerine, two tablespoonfuls of the mixture being given thrice daily in a quart of water. In black-quarter and other **anthrax** cases, Professor Robertson advised half a drachm in a pint of water three or four times daily, conjoined with morphine when there was abdominal pain. He also used subcutaneously carbolic acid ℥ ij., morphine hydrochloras solution ℥ xxx. and water ℥ xxx. Mr Priestman and other practitioners used carbolic acid with some benefit in the treatment of contagious pleuro-pneumonia in cattle. It has been administered in **foot-and-mouth** complaint, in which the glyceride and other solutions are also applied locally with zinc and lead lotions. The severity of **catarrhal influenza** amongst horses is materially abated, while its spread is checked by administration of antiseptics and by spraying the nostrils and throat with a one per cent. carbolic solution. In such cases, and also in chronic bronchitis and pharyngitis, such solutions are mixed with air or steam, and used as inhalations. In tedious malignant cases of strangles and in purpura it is prescribed with iodine or iron, or both, and is also applied externally.

Stomatitis and **ulcerations** about the mouth and throat are treated with the acid conjoined, sometimes with iodine, or with tannin and glycerine. **Actinomycosis**, after the diseased surface has been scraped, is directed by Professor Walley to be dressed with four parts of carbolic acid and one of iodine, dissolved in six or eight parts of glycerine. Added to the ordinary prescriptions used in dyspepsia, diarrhoea, and dysentery, carbolic acid or creolin **checks fermentative changes** and lessens acidity and fœtor of the excreta. With oil of turpentine and opium tincture, it is used for **intratracheal injections** in calves suffering from stronguli. Carbolic solutions relieve the itching and swelling occasioned by stings of bees, wasps, mosquitoes, and ants, and, promptly used, prevent mischief from dissection wounds.

Carbolic acid checks the parasitic growth of the tinea form of ringworm, but is not so effectual as iodine or ferric-chloride dressings. Alternated with other remedies, it is often serviceable in that form of eczema popularly known as **grease**. In these and other cases where there are foul discharges, it proves a useful addition to lead, zinc, or other appropriate dressings.

In **eczema in dogs**, attended with profuse discharge, the acid is sometimes applied mixed with starch powder or fuller's earth. For most eczema cases the wood-tar oils are, however, more suitable than those derived from coal-tar. Diluted solutions are used for **destroying ticks, keds, lice**, and the **acari** of scab and mange. The preparation known as M'Dougall's sheep-dipping composition was favourably reported on by the Australian Government Commissioner appointed to inquire into the spread and cure of scab in that colony. **Mange in dogs** is frequently treated by shaving the hair when it is thick or matted, scrubbing thoroughly with soap and water, and painting with a solution of one part of acid to twenty of oil; but to avoid dangerous absorption, too large a surface must not be dressed at a time.

Carbolic acid is used for the **disinfection** of stables, kennels, cow-houses, piggeries, and poultry pens; of railway horse-boxes, cattle-trucks, and loading-places, and of cattle vessels and landing-stages. M'Dougall's or Calvert's disinfecting powders are conveniently sprinkled daily throughout the stables of many omnibus, cab, and carrying establishments of London, Liverpool, and other large towns, at an annual cost of about 5s. for each horse. Thus employed, carbolic acid is not injurious or distasteful either to the animals or their attendants. It drives away flies and fleas; arresting decomposition, it prevents unpleasant smells; fixing ammonia, it increases the value of manure with which it has been mixed. To ensure purification of infected premises, the antiseptic must be freely and frequently used in the condition of powder, fluid, spray, or vapour, or in several of these forms. Solutions of less than one per cent. are not to be relied on. The vapour is readily evolved by sprinkling the acid on live coals or on a hot metal plate. Besides smearing the walls and woodwork with the crude brown acid, during the prevalence of infectious and zymotic diseases, sheets wetted with it should be suspended here and there to catch floating germs. Along with carbolic acid, sulphurous acid or sulphites may be fittingly used. To destroy these germs or limit their distribution, animals infected with contagious disorders should have antiseptics given internally, and should be lightly sponged daily with a one per cent. solution.

Contagious germs may thus be prevented spreading to healthy subjects, which, by daily administration of antiseptics, may, moreover, be rendered less liable to suffer from toxic micro-organisms which reach them.

Doses, &c.—Horses and cattle take ℥ xv. to ℥ xl.; sheep and large pigs, ℥ v. to ℥ x.; dogs, ℥ i. to ℥ ii. The crystallised acid is best for internal use. It may be made into bolus with meal, but is more readily absorbed, more regular in its effects, and less likely to develop local irritation, when given either in water or in glycerine and water. One part by weight of acid rubbed in a mortar with four of glycerine forms a convenient compound, readily miscible with water or other solvents. Brown decoloration of the urine need not prevent the continued use of the drug. Such decoloration results more frequently from external applications which favour rapid oxidation. An **ointment** is made by rubbing in a mortar about one part of acid with twenty of lard. The **liniment** usually contains one part of acid shaken up with twenty to forty of rapeseed oil, which is preferable to the drying linseed oil. It is occasionally mixed with soap. For dusting irritable surfaces it is mixed with starch, lycopodium, and occasionally with charcoal and plaster of Paris. Watery solutions are, however, most convenient and penetrating, and are best fitted for antiseptic purposes.

Sulpho-carbolic or **sulpho-phenic acid** ($\text{H}_6\text{C}_6\text{H}_4\text{O.HSO}_3$) is prepared by mixing, at a high temperature, one part of carbolic and two of sulphuric acid. When slowly crystallised, it forms colourless, deliquescent needles; it has less odour than carbolic acid; at 400° Fahr. it becomes red; at 540° Fahr. it boils. It is soluble in water, alcohol, and ether. When the acid in solution is saturated with the oxides or carbonates of the alkalis, earths, or metals, there are obtained crystalline, soluble, almost odourless, usually colourless, stable **sulpho-carbolates**, which do not give any evidence of the actions of carbolic acid. The sodium salt is not now trusted either as a surgical or medical antiseptic. The iron, zinc, and copper salts exhibit the actions of their bases. These sulpho-carbolates are excreted by the kidneys in great part unaltered, they probably do not readily give up their carbolic acid in the body,

and certainly have not fulfilled the expectations formed of them when they were introduced twenty years ago as anti-septics.

CASCARILLA BARK.

CASCARILLÆ CORTEX. The dried bark of *Croton Eleuteria*.
(B.P.) *Nat. Ord.*—Euphorbiaceæ.

Cascarilla bark is principally imported from the Bahama Islands in quills about the size of a drawing pencil, and varying from two to four inches in length. Its outer surface is fissured, and usually covered with a light-coloured lichen; its inner surface is smooth and light-brown. It has a strong, pungent, rather nauseous taste; its aromatic odour is increased by heat, and recommends it as a constituent of fumigatory pastilles. It contains the neutral crystalline bitter cascarillin ($C_{12}H_{18}O_4$), 15 per cent. of two resins, and 1·5 of a pungent volatile oil, one portion of which is isomeric with oil of turpentine.

ACTIONS AND USES.—Cascarilla is an aromatic and bitter tonic and stimulant, allied to chiretta and resembling cinchona, but less active, and occasionally used in indigestion, diarrhœa, and convalescence from exhausting diseases.

DOSES, &c.—For horses, ℥ij. to ℥iv.; for cattle, ℥i.; for sheep and swine, ℥i. to ℥ij.; and for dogs, grs. x. to grs. xl., given in bolus, infusion, or tincture.

CASTOR OIL.

OLEUM RICINI. The oil expressed from the seeds of *Ricinus communis*. (B.P.) *Nat. Ord.*—Euphorbiaceæ.

The castor oil plant, or Palma Christi, is generally considered to be Jonah's gourd. Cultivated in the colder parts of Europe, it is an annual shrub, four or five feet high; in Spain and Sicily it reaches a height of twenty feet; in the southern latitudes of India, in Central Africa, and various parts of North and South America, it becomes a large tree. The natural order Euphorbiaceæ, besides the castor oil and croton, includes a tall

Brazilian tree, the coco-purgatif, which yields the oil of Danda, or assu juice, resembling castor oil, but greatly more active.

The officinal part are **the seeds**, three of which are contained in each capsule. Two varieties are met with—one the size of beans; the other, and commoner, somewhat smaller. Both have the shining yellow-white epidermis, mottled with red-brown streaks and spots. The seeds comprise upwards of 25 per cent. of ligneous husk, 8 per cent. of moisture, and nearly 70 per cent. of kernel, which contains about 50 per cent. of **the castor oil**. Besides the ordinary glycerides present in fats, this oil contains ricinolein, and when saponified, as it is by the alkaline secretions of the bowels, there is produced about one-thirtieth part of an unformed ferment, termed **ricin**, an active irritant, of which the lethal dose in man is said to be 0·18 grain (*Year Book of Pharmacy*, 1890).

Castor oil is manufactured in London, largely imported from the East Indies and America, and in smaller quantities from Italy, the West Indies, and Australia. Various modes of **extraction and purification** are adopted. In London the carefully shelled seeds are crushed in a screw or hydraulic press, the oil purified by rest, filtration, and bleaching. In the East Indies mucilage and albumin are got rid of by heating the expressed oil with boiling water, and straining it through flannel. In America, the seeds, deprived of husk, are exposed to gentle heat, in order that the oil may be more readily expressed; the crude oil is freed from mucilage and albumin by boiling with water until perfectly transparent when cool; 25 per cent. of best oil is thus got. In Jamaica the bruised seeds are boiled with water, and the oil skimmed off as it rises to the surface—a process which yields, however, an inferior and dark-coloured specimen. The Continental plan of extracting the oil by alcohol or carbon bisulphide is expensive and inconvenient.

PROPERTIES.—Oil obtained by these various methods differs slightly in activity, but considerably in colour, flavour, solubility, and keeping properties. The English castor oil, prepared by expression alone, is usually rather dark; the East Indian, principally imported from Calcutta, is of superior quality and moderate price; the American or United States oil is very free of taste, but at low temperatures deposits margarin; the Italian

usually commands the highest price (Pereira). Cold-drawn castor oils, prepared by expression alone, or with only a very slight degree of heat, are generally preferred. A high temperature is believed to destroy the ricin.

Castor oil, when fresh and well prepared, is viscid, almost colourless, and of a faint oily odour and taste. Although lighter than water, it is one of the heaviest of the fixed oils, its specific gravity at 60° Fahr. being .964. Exposed in a thin layer it thickens, gets rancid, and after a time entirely dries into a varnish-like film. Castor oil and alcohol are mutual solvents; the oil is soluble in one volume of absolute alcohol and four of rectified spirit and in ether; is easily miscible with other oils; saponifies with alkalis, yielding glycerine, palmitic and other fatty acids, and the special ricinoleic acid ($\text{H.C}_{18}\text{H}_{33}\text{O}_3$). Such saponification caused by the alkaline secretions of the bowels is believed to develop, as in the case of croton oil, the active principle.

IMPURITIES.—Castor oil is adulterated with croton oil to increase its activity, with lard and bland oils to reduce its cost. Pure oil is distinguished by entirely dissolving in its own weight of absolute alcohol and in four of rectified spirit (B.P.) Inferior sorts are dark-coloured, but become translucent by exposure to sunlight and filtration through animal charcoal; while the disagreeable acrid taste and odour may in great part be removed by repeated agitation with water containing calcined magnesia and coarse animal charcoal.

ACTIONS AND USES.—Castor oil **seeds** are irritant and purgative, have caused fatal gastro-enteritis in human patients, and, containing a larger proportion of the ricin, are more irritant than the oil extracted from them. When crushed, they form an Indian cure for mange. A decoction of **the leaves** is applied by the women of South Africa to their breasts to increase the lacteal secretion. **The oil** is a mild purgative, closely resembling linseed and the other fixed oils.

MEDICINAL USES.—The oil, emulsionised mainly by the alkaline bile, is in part absorbed; but the greater amount, little changed, passes through the bowels, increases both secretion and peristalsis, rarely causes griping, and imparts to the dejections a glazed appearance.

For horses it is a mild cathartic, prescribed in diarrhœa, dysentery, enteritis, and peritonitis; in hernia, advanced pregnancy, affections of the kidneys and bladder; in purpura and bilious influenza, when more drastic purgatives might unduly irritate, or where reiterated doses require to be given. It has no cholagogue action, nor is it a vermicide; its occasional effect as a vermifuge depends upon its purgative action. Foals and calves, for several days after birth, sometimes have no movement of the bowels, and the removal of obstructive masses of meconium, and the natural actions of the intestine, are best secured by administration of castor oil and enemata.

In cattle practice it is useful in diarrhœa and inflammation of the digestive organs, and, united with Epsom salt, in doses of half or three-quarters of a pound of each, produces prompt and certain effects. For young calves it is the best of purgatives.

In the **dog** it is more active than in man, and for delicate subjects a mixture of equal quantities of castor and olive oils is often used. Its occasionally causing emesis in dogs results from its nauseous oleaginous taste, not from any specific emetic action, and is obviated by giving the oil free of rancidity and beat up with an egg, with mucilage, a little spirit, or ether. It proves a safe and easy **purge for pigs**, and also for poultry.

The bruised seeds are much used by native Indian farriers for the **cure of mange**; and the late Thomas Pritchard, of Madras, informed me that two or three dressings usually suffice to remove the disease. For enemata it is generally superseded by rape or linseed oil. As an external demulcent it is unsuitable on account of its tendency to become rancid. A drop placed in the conjunctival sac lessens irritation after removal of a chaff or other foreign body from the eye.

Doses, &c.—Castor oil seeds are occasionally given to the dog or pig to the number of six or eight, triturated with linseed meal, made into bolus, or rolled in a piece of meat. The dose of oil for the larger quadrupeds is about a pint; for sheep and pigs, fʒij. to fʒiv.; for dogs, fʒi. or fʒij.; for cats, about fʒi.; for poultry, fʒss. to fʒj. It may be given alone or mixed with linseed oil, with gruel, milk, or aromatics; to increase its activity, it is combined with small quantities of oil of turpentine or of

croton ; to control undue irritation, as in diarrhœa and dysentery, it is prescribed with laudanum, spirit of chloroform, or warm starch gruel. For delicate or pampered dogs, a palatable laxative emulsion is made by shaking together an ounce each of castor oil and syrup of buckthorn, with twenty minims of spirit of nitrous ether.

C A T E C H U.

GREY CATECHU. *Catechu palidum*. Gambier. An extract of the leaves and young shoots of *Uncaria Gambier*. (B.P.)
Nat. Ord.—Cinchonaceæ.

BLACK OR BROWN CATECHU. *Catechu nigrum*. Cutch or Terra-Japonica. The aqueous extract of the wood of *Acacia Catechu*, of *Acacia Suma*, of other Leguminosæ, and of plants of other natural orders.

The *Uncaria Gambier*, producing the **pale catechus** (*cate*, a tree ; *chu*, juice), is a stout climbing shrub, inhabiting the islands of the Indian Archipelago, and cultivated for its astringent juice. A decoction made of the leaves and young roots is evaporated, worked into red-brown earthy-looking masses or cubes, with surfaces about an inch square.

The **black or brown catechus**, chiefly brought from Bengal and Burmah, are derived from several trees, largely from the *Acacia Catechu*, a native of India and Africa. The *Acacia Suma*, a large tree growing in Bengal, Burmah, and Southern India, has a white bark used for tanning, and red heart-wood, from which catechu is also made. The wood of these and of other trees is cut into chips and boiled with water, the decoction concentrated either by fire or the heat of the sun, and the extract cut or moulded into square cakes or masses.

The pale and brown catechus are very similar in **composition** and **properties** ; are porous and opaque ; brittle, breaking with a granular fracture ; under the microscope exhibit minute, needle-like crystals ; are without odour, but have a sweet astringent taste. They are soluble in alcohol and ether, partially soluble in cold water, almost entirely dissolved by boiling water, with which they form red-brown solutions. They consist

of about 40 per cent. of **catechu-tannic acid**, which is soluble in cold water; and of **catechin or catechuic acid** ($C_{13}H_{12}O_6$), which is also a modification of tannic acid, deposits in acicular crystals from boiling watery solutions of catechu, and is soluble in alcohol and ether. They further contain the yellow colouring matter quercitin.

ACTIONS AND USES.—Catechu is **astrigent**, acting by contact only. It forms insoluble compounds with albumin and gelatin, and, like other tannin-containing substances, is used in making leather. It is less astrigent than oak bark or galls, but more astrigent than kino, the inspissated juice obtained from incisions made in the trunk of *Pterocarpus Marsupium*; than rhatany, the dried root of *Krameria Triandria*; than logwood, the sliced heart-wood of *Hæmatoxylon Campechianum*; or than bearberry or uva-ursi leaves (p. 306).

Catechu is administered to the several domestic animals for the arrest of chronic mucous discharges and hæmorrhage, especially from the throat and alimentary canal. The insoluble catechin beneficially exerts its astringency on the relaxed, over-secreting surfaces alike of the small and large intestines. In persistent **diarrhœa** and in **dysentery** it is conjoined with aromatics to allay flatulence; with opium to relieve irritability and spasm; with alkalis, magnesia, or chalk, to counteract acidity. A convenient prescription for such cases consists of three ounces each of catechu, prepared chalk, and ginger, and six drachms of opium, made, as is most suitable, either into mass or draught. This will make eight doses for a horse, six for a cow, and eight or ten for a calf or sheep. For the horse the dose is given in bolus; for the ruminants, suspended in starch gruel. Catechu is occasionally applied to sluggish wounds and ulcers, to excoriations on the udder of cattle, and for the several purposes of a vegetable astrigent.

DOSES, &c.—For horses, ℥i. to ℥ij.; for cattle, ℥ij. to ℥vi.; for sheep and swine, ℥i. to ℥ij.; and for dogs, grs. iv. to grs. xx. These doses are administered three or four times a day, with sufficiency of mucilage or gruel to cover their astrigent taste. An **infusion** is readily prepared for veterinary purposes by pouring boiling water over coarsely-powdered catechu, digesting by the fire for an hour, and straining. Flavouring ingredients

may be added as required. The B.P. orders the **tincture** to be made with catechu, in coarse powder, two ounces and a half; cinnamon bark bruised, one ounce; proof spirit, one pint; macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add proof spirit to make one pint. For external purposes the powder infusion and an ointment are used.

CHAMOMILE FLOWERS.

ANTHEMIDIS FLORES. The dried single and double flower-heads or capitula of the *Anthemis nobilis*. From cultivated plants. (B.P.) *Nat. Ord.*—Compositæ.

Chamomile flowers are extensively cultivated in the warmer parts of England, are gathered during dry weather, exposed for a short time on trays in the shade, and carefully stored and kept very dry. Both varieties, but especially the single, have a hot, bitter taste, and a strong aromatic odour. They contain bitter extractive matter, soluble both in water and alcohol; a small quantity of tannin; traces of the bitter anthemic acid; a crystallisable, soluble base, anthemine; and 0.60 to 0.80 per cent. of **volatile oil**, usually got by distillation of the whole plant, of a pale-blue or green colour, gradually becoming yellow-brown, and consisting of a mixture of ethers, chiefly of the angelates and valerianates of butyl.

ACTIONS AND USES.—Chamomile flowers are mildly stimulant, aromatic, stomachic, and tonic; full doses produce emesis in dogs. The infusion is sometimes given in atonic dyspepsia and diarrhœa. Horses and cattle take one to two ounces; calves, sheep, and swine, a drachm. The flowers are occasionally used for fomentations and poultices. Like other **volatile oils**, that of chamomile **lowers reflex irritability**, and hence is useful in dyspepsia, diarrhœa, and spasmodic cough.

CHARCOAL.

Two varieties of charcoal, or carbon (C), are used in medicine and pharmacy—**wood charcoal**, or carbo ligni, and **animal charcoal**, or carbo animalis. The former is prepared

by piling billets of hard wood into heaps, covering them with turf and sand, and leaving a few apertures for admission of air. The pile is ignited; after the flame has risen through the whole mass, the openings are closed, and combustion proceeds slowly, without access of air. The high temperature dissipates moisture, breaks up the complex vegetable matters into simpler forms, producing empyreumatic gases and tarry fluids (pp. 190, 203), and leaving a charred residue of about one-fifth the weight of the original wood, and consisting of chemically pure carbon and ash, with oxygen, hydrogen, and traces of nitrogen retained in the porous mass. Oils or resins, when burned in a deficiency of air, produce **lamp black**—a finely-divided, amorphous carbon.

Animal charcoal, also known as bone or ivory black, is chiefly prepared from bones, which are boiled to separate fatty matters, and heated in close vessels until the ammoniacal gases cease to be disengaged. The fixed residue contains about 10 per cent. of carbon, 88 per cent. of calcium phosphate and carbonate, and 2 per cent. of iron carbide and silicide—mineral matters which separate the carbon particles and enhance their absorbent properties.

Both vegetable and animal charcoal are remarkable for their porosity, are brown-black, insoluble and inodorous, readily absorb moisture, gases, and most vegetable colouring matters. Animal charcoal is distinguished by its greater density, its incombustibility, its bitter taste, its large proportion of phosphates, and also by its greater absorbing power.

ACTIONS AND USES.—Charcoal is a **desiccant, antiseptic, disinfectant, and deodorant**, and is used as a **decoloriser** in pharmacy, sugar-refining, and other arts. One volume of good boxwood charcoal absorbs into its pores 100 volumes of ammonia gas, 50 of hydrogen sulphide, and 10 of oxygen. The oxygen thus retained decomposes and deodorises noxious gases which come into contact with the charcoal. Air laden with sewer gases is purified by passing it over charcoal. Brown sugar in solution filtered through animal charcoal is deprived of colouring matter; crude spirit is robbed of its fusel oil; foul water is cleansed of organic impurities. Urine heated with it parts with colouring matters, urea, and uric acid, but

not with any sugar it may contain. Vegetable acids, alkaloids, and their salts are sometimes purified by charcoal; but for these pharmaceutic purposes it has the disadvantage of retaining, not only colouring particles, but portions of the drugs—a property, however, which renders it serviceable as an antidote in poisoning with arsenic, aconite, strychnine, and even prussic acid. The charcoal mechanically envelops and holds the poisonous particles; half an ounce, swallowed immediately after a grain of morphine or strychnine, is stated to prevent absorption.

Sprinkled over meat or game, or placed in barrels of water intended for long keeping, it attracts and retains septic matters, and hence **retards putrefaction**. Unlike chlorides of mercury or zinc, or other powerful antiseptics, it does not, however, attack or destroy organised germs. Whilst passing through the alimentary canal, it checks fermentative changes, lessens acrimony and fœtor of the fæces; probably also removes mucus, and exerts some amount of healthy stimulation. As an **absorbent** and **deodoriser**, it is occasionally sprinkled over suppurating or foul wounds, or scattered on the poultices applied to them. Equal parts of charcoal, gum-arabic, and colophony constitute a useful **hæmostatic**.

Doses, &c.—For the horse, ℥iv. to ℥i.; for cattle, ℥i.; for sheep and pigs, ℥i. to ℥iij.; and for dogs, grs. x. to grs. lx. It is usually given suspended in gruel or other mucilaginous fluid. It must be kept dry and clean, for when its pores are filled with water, or, indeed, anything else, their power of further absorption is destroyed. **Raised to a low red-heat** shortly before it is used, gases and organic matters are burned out of its pores, and its efficacy is much increased. The charcoal fouled in sugar-refining and other processes is thus cleansed for repeated use.

CHLORAL—CHLORAL HYDRATE.

Chloral is **prepared** by passing dried chlorine gas into absolute alcohol for twelve or fourteen days, or so long as the spirit will absorb it. The oily-looking pungent liquid chloral or tri-chloraldehyd (CH_3COH) is **purified** by distillation with

sulphuric acid, subsequently with a small quantity of lime, and, when mixed with water, evolves much heat, and becomes the solid hydrate ($\text{CCl}_3 \cdot \text{COH} \cdot \text{H}_2\text{O}$).

Chloral hydrate occurs in colourless crystals; is neutral, aromatic, bitter, pungent, and permanent in air. It melts at about 133° Fahr., and boils at 205° Fahr. It is soluble in less than its own weight of water, alcohol, and ether, and in four parts of chloroform. The caustic alkalis, and, in less degree, the alkaline carbonates, decompose it into chloroform and an alkaline formiate. A hundred grains dissolved in an ounce of distilled water, and mixed with 30 grains of slaked lime submitted to careful distillation, should yield not less than 70 grains of pure chloroform. Inferior specimens, besides being of imperfect strength, are apt to contain chlorinated organic impurities, which render them yellow and cloudy, acrid and irritating, imperfectly soluble in water, on which they float as oily drops, while, instead of hypnosis, they produce nervous excitement.

ACTIONS AND USES.—Like other members of the alcohol group, chloral hydrate is an antiseptic and topical irritant. When absorbed it has a primary stimulant and secondary sedative action on the circulation and central nervous system. Toxic doses, after slight and temporary stimulation, notably depress and paralyse the cerebro-spinal centres. Medicinal doses are hypnotic, analgesic, and feebly anæsthetic. It is used topically as a stimulant, anodyne, and antiseptic.

GENERAL ACTIONS.—It destroys micro-organisms; one part in 1000 hinders development of anthrax bacilli; it has about the same antiseptic strength as carbolic acid. Personne exhibited at the Academy of Sciences, Paris, the body of a dog perfectly preserved in chloral hydrate for fifty-five days. Solutions exceeding 20 per cent. are **topical irritants**, and hence when swallowed cause a burning sensation in the throat, and sometimes vomiting and purging. Diluted solutions are **readily absorbed**. The drug acts apparently without undergoing decomposition into chloroform, which is not discovered in the blood tissues or expired air of animals receiving chloral, and only appears in the urine when that fluid contains sufficient free alkali to decompose the chloral. Small doses increase

heart action, pulse rate, blood tension, and temperature. Fuller and repeated doses slow circulation and respiration, and **produce sleep**, usually natural, deep, and from which the animal awakes without discomfort. **Anodyne and antispasmodic** actions are likewise produced. Anæsthesia cannot safely be produced by giving the drug by the mouth, but is caused by intravenous and rectal injections. Larger doses impair reflex irritability and sensibility, and lower temperature, sometimes to the extent of 6° or 8° Fahr. By moderate doses, and during safe anæsthesia, the pupil is contracted; but it is dilated when the doses are dangerously large, or the anæsthesia deep or long continued. Death results from **cardiac and respiratory paralysis**. The heart is arrested in diastole, with the right cavities distended. There is no paralysis of muscles or motor nerves. The drug is **eliminated** by the lungs, skin, and kidneys.

Toxic Effects.—Dr B. W. Richardson, in an extended series of experiments, found that fish and pigeons were narcotised by $1\frac{1}{2}$ to 2 grains; mice by one-third of a grain; rabbits, weighing 85 ounces, by 30 grains (*Medical Times and Gazette*, vol. xi, 1869). 180 grains produce fatal effects in man, but dangerous symptoms have occasionally been developed by one-fourth of that amount. Mr T. A. Dollar, of New Bond Street, gave a **horse** suffering from spasmodic colic two ounces in water; the spasms were speedily removed, but for twelve hours the patient remained very dull and sleepy. Mr F. J. Mavor, of Mayfair, gave a horse four ounces of chloral hydrate in water; in five minutes he fell down insensible, perspired freely, his muscles relaxed, his pupils dilated; his pulse, at first accelerated, gradually became normal, respirations were quickened, until in an hour they numbered 36. The temperature, from 100° Fahr., fell in two hours to 95 $\frac{2}{5}$, but two hours later rose to 97 $\frac{1}{5}$. In half an hour he was in a quiet sleep, lasting one and a half hours, when he attempted but failed to rise, and shortly again slept, the breathing being slow and heavy, the skin cold, the sphincters relaxed. Four hours after receiving the draught he was restless, shivering, but disposed to feed, continued in this state for several hours, and suffered next day from bronchitis, from which he gradually recovered. Mr Mavor gave a healthy horse four ounces in ten ounces of water; in

half an hour he was restless but drowsy, passing fæces frequently; his pupils dilated. He continued in this state for fully three hours, when he was slightly delirious, but gradually became more quiet. Eight hours later the effects had passed away (Mavor and Burness, *Actions of Medicines*).

Fröhner records that horses receiving, *per orem* or rectum, three to four ounces, or intravenously six to ten drachms, became intoxicated, staggered, fell, and lay for several hours with the muscles relaxed and unconscious. Sleep may be maintained by repeated doses, he states, for several days, or even weeks. Nocard kept a horse affected by tetanus under its influence for thirty days, administering daily one and a half to two ounces. The lethal dose is four to six ounces when given by the mouth or rectum, but one-third these quantities is fatal when introduced intravenously. Cattle are affected in much the same manner, and by similar doses. The lethal dose for dogs is two to six drachms. In them the preliminary excitement is more marked than in horses or cattle.

The treatment of poisoning consists in maintaining the temperature by warm clothing, hot applications, stimulants, and hot coffee. Dr Lauder Brunton and Professor Stricker found that animals which received lethal doses recovered if wrapped in cotton wool and kept in a warm atmosphere. Although chloral is an antidote to strychnine, the antagonism of strychnine to chloral is not so marked.

MEDICINAL ACTIONS.—Chloral hydrate **quiets irritability and causes sleep.** Conjoined with morphine, it is prescribed to relieve gastro-intestinal irritation and spasm, but as it is a topical irritant it must not be used where there is congestion or inflammation. Small doses are serviceable in some attacks of **canine asthma**, and in violent **paroxysmal coughing**, both in dogs and horses. It quiets the excitability and spasms of **chorea, epilepsy, and hysteria**, and temporarily relieves those of tetanus and rabies. Professor Robertson used it successfully in **tetanus** in horses. It **antagonises** the tetanic convulsions of **strychnine**. Administered to rabbits along with lethal doses of strychnine, sleep is produced, and the creature recovers. Chloral is also antagonistic to physostygmine and picrotoxine, but to act as an effectual antidote the slower-

acting chloral must be given before, at the same time, or within two minutes after these quickly-acting convulsants (*Report of the Edinburgh Commission of the British Association on the Antagonism of Medicines*). Mr Robert Littler, of Long Clawson, gives it with benefit in the outset of those cases of **parturient apoplexy** in cows in which there is intense nervous excitement, and violent cramp of the muscles of the hind extremities. Conjoined with bromides, it is indicated in cases of **phrenitis**. A like combination abates the irritable cough and sleeplessness frequently occurring in **canine distemper**. Injections and suppositories, in which opium is frequently also used, allay irritability and straining of the lower intestines and urino-genital organs.

French veterinarians use it as an anæsthetic. M. Kaufmann declares that it yields to no other anæsthetic when injected intravenously (*Traité de Thérapeutique*). But intravenous injection is troublesome, and attended with considerable danger. M. Cagny anæsthesises horses by injecting hypodermically 15 to 25 grains of morphine with 5 grains atropine, and shortly giving an enema containing 6 to 8 drachms of chloral hydrate (*Précis de Thérapeutique Vétérinaire*). But the anæsthesia produced by chloral, however administered, is neither so complete, lasting, or safe as that obtained by inhalation of chloroform or ether. Equal parts of chloral and camphor, mixed with 6 or 8 parts of vaselin or simple ointment, form an analgesic dressing which relieves the pain of neuralgia and the itching of various skin complaints. A diluted solution is sometimes applied as an antiseptic stimulant to foul wounds. It should not be prescribed where there is weak, irregular action of the heart or congested lungs.

Chloral hydrate **resembles** various other drugs. As a hypnotic, it is allied to sulphonal paraldehyde, and also to morphine. Like bromides, it quiets excited cerebral centres. Its anodyne and antispasmodic effects are limited compared with those of opium, but for the relief of pain and spasm it is usefully conjoined both with morphine and atropine. Although allied in composition to chloroform, it is not so effective as a local anæsthetic, and as it cannot be inhaled, general anæsthesia is produced only when full doses are swallowed or injected into

the rectum or veins. In relieving spasm and lowering arterial pressure it bears some resemblance to amyl-nitrite.

Doses, &c.—For horses and cattle, $\mathfrak{z}\text{i}$ to $\mathfrak{z}\text{ij}$; for sheep and pigs, $\mathfrak{z}\text{ss}$. to $\mathfrak{z}\text{ij}$; for dogs, grs. v. to grs. xx., repeated every two or three hours, administered in mucilage or syrup. For enemata about half the dose, given by the mouth, usually suffices, and should first be tried. On account of its irritating in-contact effects, it cannot be used hypodermically or intratracheally. Continued use of the drug does not establish tolerance, as in the case of alcohol or opium. For relief of general irritability it is prescribed with bromides, opium, or belladonna; for relief of pain, with opium, belladonna, or camphor.

BUTYL-CHLORAL HYDRATE, formerly called croton-chloralhydrate, is prepared by passing a stream of dry chlorine for twenty-four hours through acetic aldehyd, separating the butyl-chloral by fractional distillation, and, by addition of water, converting it into the hydrate ($\text{C}_4\text{H}_5\text{Cl}_3\text{O}\cdot\text{H}_2\text{O}$). It forms pearly crystalline scales, which are pungent, acid, and disagreeable to the taste. It resembles chloral, but is less powerful, has less depressant cardiac action, paralyses specially the fifth nerve and parts supplied by it, and has been prescribed in human medicine in facial neuralgia, migraine, and as a hypnotic instead of chloral in weak heart (Brunton).

BROMAL HYDRATE ($\text{C}_2\text{Br}_3\cdot\text{OH}$), partaking of the character of its bromine constituent, is more irritant than chloral hydrate. It increases the salivary, nasal, and bronchial secretions, and induces more preliminary excitement and more marked cardiac paralysis. It poisons in smaller doses; 4 grains suffice to kill a rabbit weighing 4 lbs., with symptoms of cyanosis, dyspnoea, and convulsions.

CHLORALAMIDE has recently been obtained by the action of formamide on chloral. It occurs in colourless crystals, slightly bitter, soluble in 10 parts of hot water, and in less of spirit. When administered it appears to be converted into chloral, which it resembles. It is a topical irritant, causing diarrhoea when full doses are swallowed. Dogs receiving 7 to 10 grains per kilogramme of body-weight in five minutes become restless, moan, and lose the power of movement. These symptoms continue about an hour, and are followed by drowsiness, and

sometimes by sleep (Kaufmann). Neither as a hypnotic nor as an analgesic is it as effectual as chloral. Fröhner states that it is frequently substituted for chloral, but that it is milder, and does not act so notably on digestion or circulation. He prescribes it in cramps and excitement in dogs, and especially in distemper. The doses, which are frequently repeated, are one and a half times those of chloral.

CHLORINE.

Chlorine is **prepared** by heating common salt and manganese black oxide with sulphuric acid. It is a chemical element (Cl), a yellow-green gas, with a peculiar suffocating odour and an astringent taste. It is two and a half times as heavy as air, and soluble in less than half its volume of water at 60° Fahr. Under a pressure of four atmospheres it forms a bright yellow liquid. For nearly a century moist chlorine has been used for bleaching. Water charged with two volumes of chlorine gas constitutes the **liquor chlori**—a yellow-green, chlorine-smelling liquid, readily decomposed by air and sunshine, the B.P. solution containing at least 0.6 per cent., the U.S.P. 0.4 per cent. of chlorine.

ACTIONS AND USES.—Chlorine, whether as gas or in solution, is irritant, stimulant, antiseptic, deodorant, disinfectant, and parasiticide.

One part in 8540 of a watery solution arrests the action of ptyalin on starch paste; one 7411 part arrests the action of diastase; one 27.167 part arrests the action of pepsin. Although not so active as corrosive sublimate, one 22.768 part kills developed bacteria; but one 1431 part is required to prevent their reproduction, and 1008 to prevent reproduction of spores. One part to 1500 prevents development of anthrax bacilli. The **bleaching, antiseptic**, and other actions of chlorine result from the breaking up of complex organic substances by the **chlorine seizing their hydrogen**, while the **nascent oxygen** thus liberated exerts active oxidation.

Applied to the skin or mucous surfaces, it causes irritation, relieved by lime-water, white of egg, soap, or diluents. Irritation of the air-passages, induced by the insufficiently diluted

gas, is counteracted by inhalation of ether, weak ammonia, or the vapour of warm water or of alcohol.

MEDICINAL USES.—Diluted chlorine gas is inhaled, or the freshly-prepared solution applied in spray, to increase bronchial secretion, to stimulate and disinfect ulcerated or diphtheritic **sore-throat** in horses, and **abate** the **discharge** and **fœtor** from diseases of the facial and frontal sinuses. Both gas and solution are used for the **destruction of stronguli** infesting the air-passages of calves and lambs, and the liquor chlori, as well as the equally effectual but less irritant sulphurous acid solution, is now frequently employed intratracheally, while stock-owners also continue to use turpentine drenches. It is recommended as an antidote in poisoning by hydrocyanic acid and strychnine, forming with the alkaloid an insoluble compound. The liquor chlori is used as a **stimulant, antiseptic, and deodorant** for the same purposes as chlorinated lime and soda. It relieves the itching of various skin diseases.

For **disinfecting** or **deodorising**, the materials for evolving chlorine should be placed in earthenware vessels in the upper parts of the boxes or sheds, in order to facilitate diffusion of the heavy vapour. One part each of common salt and manganese black oxide, intimately mixed, are treated with two measures of oil of vitriol, diluted with two measures of water. For more gradual production of the gas, bleaching powder is mixed with potash alum. Where chlorine is used for thorough disinfection, the buildings must be cleared of animals; large volumes of gas liberated; sunlight admitted to intensify the action; the walls and woodwork washed with a strong watery solution. It may be fittingly used in conjunction with the tar acids, but is incompatible with sulphurous acid.

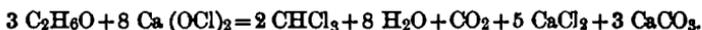
CHLOROFORM.

CHLOROFORMUM. Trichloromethane. CHCl_3 .

Chloroform was discovered in 1832, about the same time, by Soubeiran and Liebig; its effects on the lower animals were described by Dr Glover in 1842; while its valuable anæsthetic properties were first discovered and applied by the

late Sir James Y. Simpson in November 1847. Since then it has been largely and successfully used for the alleviation of human suffering during surgical operations, parturition, and various diseases, and has also been applied to similar purposes in veterinary practice.

Chloroform, by direction of the B.P., is **prepared** by distilling together ethyl-alcohol, chlorinated lime, slaked lime, and water. The reactions which occur are not thoroughly understood, but the final result is probably as follows:—



Purification is effected by (1) repeated agitation with water, which washes away saline acid and some organic impurities; (2) shaking with sulphuric acid (scrupulously free from nitric acid), which chars and removes the last traces of organic oils; (3) admixture with slaked lime and calcium chloride, which gets rid of acid and water; and (4) careful distillation; while better keeping is secured by addition of one per cent. by weight of ethyl-alcohol.

A perfectly pure chloroform may be prepared by decomposing chloral hydrate by an alkali. Chemically, it is a substitution derivative from marsh gas (CH_4), three of the H atoms being replaced by three of Cl.

PROPERTIES.—Chloroform is a limpid, colourless, neutral fluid, with a density of 1.49, a sweet taste, and a fragrant, ethereal, and apple-like odour. At ordinary temperatures it volatilises entirely. It is slowly decomposed by sunlight, and hence must be kept in the dark. **Its vapour is four times heavier than air.** It boils at 140° Fahr. Though not spontaneously inflammable, it can be burned around a wick saturated with alcohol, forms a green, sooty flame, and evolves hydrochloric acid. Alcohol, ethers, oil of turpentine, and carbon bisulphide dissolve it readily, but water takes up only about $\frac{1}{200}$ th part. It readily dissolves iodine, bromine, volatile oils, wax, resin, and many organic active principles.

IMPURITIES.—Chloroform carelessly prepared or imperfectly purified contains **volatile organic oils**, which, if inhaled, induce nausea and headache. Such specimens have an unpleasant, pungent odour when evaporated from the back of the hand, and

are blackened by agitation with sulphuric acid. Samples containing more than the one per cent. of alcohol authorised to check decomposition have their specific gravity proportionally lowered, lose bulk, notably when shaken with water, and moreover become cloudy at temperatures approaching 32° Fahr. Traces of sulphuric acid are discovered by the usual barium test; chlorine and hydrochloric acid by silver nitrate. **The purity** of chloroform is also judged by its odour when evaporated, its behaviour when agitated with sulphuric acid, its reaction on litmus, and its specific gravity, which is lowered by the ordinary adulterations.

ACTIONS AND USES.—Chloroform precipitates albumin, and is a topical irritant. It is antiseptic, and destroys the lower forms both of plants and animals, and hence is parasiticide. Small to moderate doses, swallowed or otherwise absorbed, produce slight and temporary stimulation, and hence are carminative, antispasmodic, and analgesic. Full doses quickly and powerfully paralyse the cerebro-spinal nervous system, causing muscular relaxation, insensibility to pain, and unconsciousness. It kills by respiratory and cardiac arrest. The paralyzant and anæsthetic effects are most rapidly induced when the drug is inhaled. Chloroform is the anæsthetic most used in this country, alike for human and veterinary patients. Applied topically, it is rubefacient, refrigerant, anodyne, and a local anæsthetic.

GENERAL ACTIONS.—Chloroform is allied chemically and physiologically to alcohol, ether, and other bodies of the alcohol series. It precipitates albumin, dissolves protagon, the essential constituent of nerve-centres, nerves, and red blood corpuscles, and retards oxidation of blood (Brunton). Applied to the skin, it evaporates, causing a sensation of cold; but if evaporation be prevented, it irritates. Hence, when swallowed, it stimulates the flow of saliva, excites gastric secretion and movements, in men and dogs occasionally causing emesis, and develops carminative and antispasmodic actions. By whatever channel it is absorbed, it acts on the nerve-centres somewhat in the same manner as alcohol, but its stimulant action is slight and brief. When the vapour is inhaled **anæsthesia is quickly produced.** Its effects are divisible into four stages

—1. Stimulant; 2. Narcotic; 3. Anæsthetic; 4. Paralytic (p. 65).

The vapour inhaled **first stimulates** and **subsequently paralyzes** the parts with which it comes into contact. Acting on the nasal and laryngeal mucous membrane, it first slows the breathing, and also reflexly the pulse. As it passes down, it stimulates those branches of the vagus distributed to the lungs and heart, quickening respiration, and usually also circulation. As paresis of the vagus takes place, the respiratory movements are sustained steadily, as in the third stage of anæsthesia. Still fuller effects paralyse the medullary centres, respiration becomes slower and feebler, and stops, while pulsation and blood-pressure are lowered. "The nervous system," Dr Lauder Brunton states, "is paralysed in the following order—first, the cerebral hemispheres; next, the grey matter of the cord; next, the white matter; next, the reflex power of the medulla oblongata; next, the automatic power of the respiratory centre; and, lastly, the cardiac ganglia" (*Pharmacology*).

Scottish medical men and veterinarians concur in the belief that chloroform is **the most convenient and effectual anæsthetic**, and these conclusions have recently been fully justified by two series of investigations undertaken at Hyderabad in 1888 and 1889, under the auspices of Surgeon-Major Lawrie and Dr Lauder Brunton, and comprising upwards of 700 experiments, chiefly on dogs and monkeys, but also on horses, goats, and rabbits. Chloroform was the anæsthetic chiefly used, but ether and mixtures of chloroform and ether were also given. Careful records of every experiment were made, and tracings of the pulse and blood-pressure, registered by a manometer, have been reproduced by photography. The experiments were undertaken to make clear the manner in which chloroform acts, and especially to determine how overdoses kill. With these objects, the chloroform was administered in many different ways, and under very various conditions. Some of the animals were fasted for twenty-four hours; others were recently fed with flesh or farinacea; some had coffee, wine, or other stimulants shortly before inhalation; most were healthy, a few had cardiac disease, and some had fatty degeneration of the heart, purposely produced by administration of phosphorus.

Morphine, strychnine, and atropine, singly and in combination, were administered subcutaneously to various subjects before the chloroform was inhaled. The drug was given with and without inhaler, and in every conceivable way.

Notwithstanding these different conditions, **the train of effects followed in regular order.** Preliminary excitement, with more or less struggling, occupied from one to two minutes, but gradually gave place to increasing insensibility, unconsciousness, and muscular relaxation. Fuller anæsthesia, suitable for the performance of operations, was reached in two to three minutes from the beginning of inhalation, breathing became quiet and regular, blood-pressure was increased, and reflex actions were impaired and abolished. When the effects were further pushed, respiration ceased in six to seven minutes from the commencement of the experiment. About one and a third minutes later, the pulse, after being greatly quickened, ceased; while two to three minutes later the heart itself stopped. **In no case did the heart stop before the breathing.** Even when poisonous doses were used, two to six minutes elapsed between the time that respiration ceased and the heart stopped. A somewhat shorter interval occurred, however—in two cases, in which the inhalation was very slow and prolonged; in four cases, complicated with asphyxia; and in ten cases, in which morphine, atropine, or strychnine had been previously injected subcutaneously; but even in these sixteen cases the heart continued to beat for one minute after respiration ceased. Even in those animals debilitated by twenty-four hours' fasting, by blood-letting, or by fatty degeneration of the heart caused by phosphorus, the pulse and heart continued to beat after respiration ceased. Neither serious surgical operations nor bruising of delicate parts during full anæsthesia, or even while the animal was partially conscious, produced syncope or notable direct action on the heart.

These experiments testify that chloroform may be administered to animals with **perfect safety, provided there is no interference with breathing.** They further indicate that the large proportion, if not all, the fatalities from chloroform result from asphyxia, depending upon some fault in its administration. As Dr Lauder Brunton has aptly observed, suffocation and

anæsthesia are a deadly combination. Dangerous restriction of air may result from the inhaling appliances or apparatus unduly closing the nostrils. Ingress of air may be arrested by pressure on the neck or chest, by the animal being placed in an awkward position, by the tongue dropping on to the larynx, or by vomited food entering the windpipe. In forcibly restraining the early struggling, breathing is sometimes interfered with, and the deep inspirations which usually subsequently occur will convey into the lungs and distribute to the nerve-centres unduly large quantities of the anæsthetic vapour. The experienced practitioner is always specially watchful of cases in which there is much struggling; he pushes the administration rapidly, in order quickly to produce perfect anæsthesia, but so soon as this is effected he allows several full draughts of air. At this stage the napkin, nose-bag, or inhaler may be removed, for so soon as full anæsthesia is produced, the insensibility is readily maintained by small quantities of the drug, given occasionally.

The further precautions mainly consist in the chloroformist bestowing undivided attention on two points:—(1) He must watch the breathing, in order that the patient's safety shall be maintained by fresh air constantly entering and being removed from the lungs, thus preventing any dangerous accumulation of the drug, and the arrest of natural respiration; (2) he must maintain throughout the operation the requisite amount of anæsthesia, and accordingly, from time to time, he will touch the cornea, and, if returning reflex activity is noted, further chloroform will be given. With these precautions, anæsthesia may be safely continued for an hour or more. Dogs, without harm, have been kept under chloroform for two hours, and chloroformed deeply on consecutive days. Fröhner mentions that sheep will stand two hours' anæsthesia, repeated daily for eight days, about an ounce of the drug being used each day.

Whenever respiration is impaired, unduly slow, shallow, or gasping, the administration of the drug must cease, fresh air be freely allowed, the tongue drawn forward, and the head placed on a lower level than the rest of the body. But if natural respiration ceases, not a moment must be lost in adopting **artificial respiration**. The Hyderabad experiments show that

every animal was revived, in which artificial respiration was used, within thirty seconds after natural respiration ceased, in some cases in which it was used after fifty seconds, but in none in which the treatment was delayed for sixty seconds after respiration stopped. When the pulse and heart had ceased to beat, neither artificial respiration nor other remedies, however promptly used, were effectual in restoring life. In such emergencies, faradaic stimulation of the phrenic nerve and inhalation of amyl-nitrite may aid in restoring respiratory movements.

Compared with ether, chloroform has several advantages as an anæsthetic: it is more agreeable to the taste, is less irritant, about one-fourth of the quantity suffices, it produces less preliminary excitement, the effects continue longer after inhalation ceases, and it is less inflammable. Many practitioners, however, prefer ether, as it does not so readily paralyse either the heart or the vaso-motor centre. In protracted and serious operations, especially in dogs or cats, it is accordingly desirable either to use ether or a mixture of chloroform and ether. In some parts of the Continent the A.C.E. mixture is preferred (p. 64).

MEDICINAL USES.—Chloroform is used to anæsthesise horses and other animals during castration, deep firing, and other painful operations (p. 68). Parturition in the lower animals is usually performed so easily, and with so little apparent pain, that chloroform, in the majority of cases, is unnecessary. Where **false presentations** have to be rectified in the mare, it is sometimes, however, impossible, without anæsthesia, to keep the animal quiet, or to abate violent uterine throes; while in bitches it is also sometimes requisite when the pups have to be reduced before they can be extracted. Amongst cows and ewes, labour pains sometimes continue for hours, and other preparations for parturition appear to be complete; but the neck of the uterus remains firmly closed, sometimes in spite of medicines and manipulation. Chloroform inhaled in amount insufficient to produce complete anæsthesia usually relaxes the rigid muscle. Partial anæsthesia generally controls labour pains occurring prematurely, moderates irregular, tumultuous pains, such as are sometimes met with in first parturitions,

and abates **after-pains**, the chloroform inhalation in some of these cases being advantageously aided by hypodermic injection of morphine.

Inhalation of chloroform has been advised for relaxing intestinal spasm, and hence aiding **reduction of intestinal hernia** and strangulation; but in horses the results have not been encouraging. It has been recommended in **tetanus** in horses, and relief is usually obtained so long as anæsthesia continues; but the temporary benefit is more than counter-balanced by the disturbed and excited state caused by the administration of the drug and by the excitement which succeeds the anæsthesia. Professor Robertson made repeated trials with chloroform in tetanus, and has recorded that, although spasms and muscular rigidity were abated while anæsthesia continued, they afterwards returned with increased severity (*Equine Medicine*). The shoeing of irritable and vicious horses is greatly facilitated if chloroform be given so as to produce partial anæsthesia. Inhaled or swallowed, it is occasionally prescribed to check the fits of **chorea** and **epilepsy** in dogs.

When **swallowed, it relieves gastric irritation, spasm, and pain**, and also exerts antiseptic effects on the contents of the canal. Chronic irritability of the bowels in weakly foals and calves, after removal of the irritant by castor oil, is usually benefited by a dose of chloroform or of spirit of chloroform and laudanum, repeated two or three times daily. Similar treatment is sometimes useful in removing worms. Horses are subject to a form of **epizootic sore-throat** and violent **spasmodic cough** which is notably relieved by chloroform, conjoined with belladonna extract or laudanum, dissolved freely in cold linseed gruel, and swallowed slowly, so as to ensure more prolonged anodyne effect on the irritable nerve-endings.

As a **local anæsthetic** it has not such direct paralysing effects on sensory nerves as ether, cocaine, iodoform, or even as cold or carbolic acid. It is sometimes, however, applied to allay the pain of neuralgia, rheumatism, and occasionally of local inflammation. Its conjunction of anodyne and antiseptic properties have suggested its use, with carbolic acid and vaselin, in thrush and actinomycosis. Mixed with a little

spirit, it is a cleanly means of destroying lice or fleas infesting dogs, cats, or fowls. As a liniment it is sometimes useful in mammitis in cows. It is occasionally added to anodyne enemata for the relief of irritation of the lower bowels and urino-genital organs. Its high diffusive power, which it retains when mixed with spirit, renders it a useful vehicle for the subcutaneous injection of morphine, atropine, and other alkaloids. It is a solvent for guttapercha, and the solution is occasionally employed as a substitute for collodion.

DOSES, &c.—To produce anæsthesia in horses and cattle, fʒi. to fʒij. are required; fʒiv. to fʒj. for sheep and pigs; fʒj. to fʒiv. for dogs. The fitting stage of anæsthesia is readily kept up by repeated small doses. The chloroform vapour is given **diluted with about ten volumes of air.**

Administration is best effected in small animals by saturating blotting-paper or a sponge, and holding it near the nostrils; and in the larger animals by placing the saturated sponge in a towel held over the nostrils, or in a nose-bag attached to the head (p. 68). The horse to be anæsthisèd should always have his knees protected with stout caps. **Messrs Carlisle & Bell**, of Carlisle, have recently patented a convenient leather muzzle, in the bottom of which is a tin box with a perforated lid, in which the saturated sponge is placed. The bag is nicely padded, and straps allow of its adjustment to fit any horse. Waste of the volatile liquid is accordingly so minimised that one ounce quickly anæsthisès most horses. Indeed, Messrs Carlisle & Bell inform me that since they have used this muzzle they have anæsthisèd many horses with four drachms of chloroform, and, except in protracted operations, rarely use more than an ounce. If the operation to be undertaken necessitates the animal being cast, he is brought on to the bed prepared for him, and usually within three minutes may be carefully pulled over and secured. The chloroform vapour being inhaled in tolerably concentrated form, the initial stage of excitement is shortened; the reduced quantity required diminishes risk of respiratory and cardiac paralysis; while the irritation and nausea apt to ensue from the use of larger doses are avoided. The subcutaneous injection of morphine, or, better still, of a mixture of atropine and morphine, fifteen

minutes before anæsthisng, diminishes preliminary excitement and intensifies the anæsthesia.

Administered by the mouth as a stimulant, antispasmodic, and analgesic, the dose for horses or cattle is $\text{f}\mathfrak{z}\text{i}$. to $\text{f}\mathfrak{z}\text{ij}$; for sheep and swine, $\text{℥}\text{xx}$. to $\text{℥}\text{xl}$.; and for dogs, $\text{℥}\text{v}$. to $\text{℥}\text{x}$. These doses are given with syrup, mucilage, whisked egg, or weak spirit, and repeated at intervals of two or three hours. Being an in-contact irritant, it is unsuitable for intratracheal or hypodermic use, and, except in small doses and freely diluted, it should not be given by the rectum.

AQUA-CHLOROFORMI, consisting of 1 part chloroform to 200 of water, is used as a carminative, antiseptic, and stimulant, and as a convenient medium for giving unpalatable drugs.

SPIRIT OF CHLOROFORM, also called chloric ether, is made by dissolving one fluid part of chloroform in nineteen fluid parts of rectified spirit. It has the specific gravity $\cdot 871$, and a warm ethereal odour and taste. It is an effectual **stimulant, antispasmodic, and anodyne**, resembling ether and sweet spirit of nitre. Diluted with water, or any bland cold fluid, it is prescribed for horses in doses of $\text{f}\mathfrak{z}\text{i}$.; for cattle, $\text{f}\mathfrak{z}\text{ij}$.; for sheep and pigs, $\text{f}\mathfrak{z}\text{ij}$. to $\text{f}\mathfrak{z}\text{vi}$.; and for dogs, $\text{f}\mathfrak{z}\text{i}$. to $\text{f}\mathfrak{z}\text{ij}$.

CHLORODYNE, so popular an anodyne in human medicine, is made from different formulæ; Dr Collis Browne's is stated to contain ten parts each of chloroform, ether, Indian hemp, and morphine, two parts capsicum tincture and prussic acid, three parts aconite and hyoscyamus tinctures, one part of oil of peppermint, five parts hydrochloric acid, and fifty of simple syrup (*New Remedies*, October 1877). It is an effectual anodyne and antispasmodic, frequently prescribed to relieve especially gastro-intestinal and bronchial irritation.

CHRYSAROBIN.

CHRYSAROBINUM. Araroba or Goa Powder. The diseased pith of the stem and branches of *Andira araroba*, dried and powdered, and imported from Brazil.

It occurs in a crystalline, brownish-yellow powder, which is insoluble in water, but soluble in chloroform. By oxidation it

yields chrysophanic acid, which is a constituent of rhubarb, stains yellow, and is less irritant than chrysarobin.

Both chrysarobin and chrysophanic acid are irritant and parasiticide, are seldom given internally, but are applied, usually in the form of a two to five per cent. ointment, in the second squamous stages of eczema and in psoriasis.

CINCHONA.

Bark of different species of Cinchona. *Nat. Ord.*—Cinchonacæ (Rubiaceæ).

QUININE SULPHATE. Quininæ Sulphas. The sulphate of an alkaloid prepared from the powder of various kinds of Cinchona and Remijia bark. (B.P.)

CINCHONINE SULPHATE. The sulphate of an alkaloid obtained from the bark of various species of Cinchona and Remijia. (B.P.)

The evergreen trees or tall shrubs which yield the medicinal barks were originally grown on the slopes and in the valleys of the Andes, but are now cultivated in British India, Ceylon, Java, and Jamaica. The bark, in 1639, was brought from Peru to Madrid, distributed by the Jesuits, and hence received the names of Peruvian and Jesuits' bark. Of thirty-six known species, there are many varieties, yielding barks distinguished as pale, yellow, and red.

The pale cinchonas, some of which are got from the stem and branches of the *Cinchona officinalis* and *C. condaminea*, are usually in single and double rolls, and yield more cinchonine than quinine.

The yellow barks yielded by the *C. calisaya* and other species are commonly met with in flat pieces, eight to fifteen inches long, two to three wide, and two to four lines thick. They consist mostly of liber, are furrowed and brownish-yellow externally, fibrous and yellow-orange within. The transverse fracture shows numerous short fibres; the powder is cinnamon-brown; the odour aromatic; the taste bitter, without astringency. Good specimens yield five to six per cent. of quinine.

The red barks are frequently the produce of the *C. succirubra*; are sometimes in quills, but usually in flat, in-curved pieces, six to fifteen inches long, one to three inches wide, two to three lines thick, and made up chiefly of liber. They are red, rough, wrinkled, and coated with epiderm externally; finely fibrous, with granular fracture, and brick-red or deep red-brown internally; agreeable in odour, and of a bitter, rather astringent taste. They yield five to six per cent. of alkaloids.

The cuprea barks from the *Remijia*—a genus nearly allied to cinchona and cascarilla—are now largely imported; are dense, with a thin, longitudinally striated epidermis, and a smooth pale-red inner surface; and besides quinine and quinidine, contain a special alkaloid, cinchonamine, but no cinchonidine (Phillips).

PROPERTIES.—The cinchona barks occur in quills, stripped from the smaller branches, and curled into single or double rolls, and in flat pieces from the larger branches or trunk. They are dried in the sun, or on hurdles over fires. Their colour varies from deep-yellow to red-brown, and is deepened by moisture. They have an aromatic odour, and a bitter, usually astringent taste. They are soluble in cold and hot water, and in alcohol; their best solvents are proof spirit and diluted acids. When solutions are exposed to high or prolonged heat, the colouring matter unites with the alkaloids, forming insoluble compounds, and on this account decoctions and extracts are ineligible. The alkaloids, their salts, and any bark containing them, when heated in a test-tube, produce a very characteristic purple tar. The tests of quality and value are the general appearance, fracture, colour, odour, taste, and percentage of the alkaloids, which are the active principles.

COMPOSITION.—Besides ordinary plant constituents—lignin, starch, gum, resin, mineral matters, with traces of a volatile oil—cinchona bark contains (1) a series of active alkaloids ranging from three to five per cent.; (2) kinic and kinovic acids, with which the alkaloids are naturally united, but which have no very marked physiological actions; (3) tannins, recognised as a kinno-tannic acid and kinovi-tannic acid, constituting two to four per cent. of the bark, and conferring its astringency;

(4) a resinous amorphous neutral body, kinovin ; (5) a colouring matter, cinchona red.

QUININE ($C_{20}H_{24}N_2O_2$) is present in all the Cinchona and Remijia barks, and is prepared by boiling the bruised bark with diluted hydrochloric acid, and mixing the filtered solution with lime until it is alkaline, when a precipitate falls, containing the several alkaloids and colouring matters, is collected and boiled with alcohol, which dissolves both the quinine and cinchonine. The solution is neutralised with sulphuric acid, boiled with animal charcoal, and filtered, when, on standing, the quinine sulphate crystallises out, leaving the cinchonine sulphate in solution. It is in the form of sulphate that quinine is generally prescribed in this country. From a watery solution of the sulphate the alkaloid may be precipitated by ammonia. It occurs in delicate silky prisms containing three molecules of water. It has an intensely bitter taste. It requires for solution 900 parts of cold water, but is readily soluble in alcohol, ether, chloroform, and diluted acids. It forms colourless, bitter, crystallisable, rather insoluble salts, remarkable, like the alkaloid, for tonic and febrifuge properties. Quinine and its salts turn a ray of polarised light to the left. Aqueous solutions, acidulated with sulphuric acid, even when extremely diluted, exhibit blue fluorescence. Treated with chlorine or bromine solutions, and then with a drop of liquor ammoniæ, a green coloration is produced.

QUINOIDINE, or amorphous quinine, is obtained from the brown mother-liquor from which the quinine sulphate is crystallised, and usually contains quinidine, and also cinchonine and cinchonidine. It is isomeric with quinine, is believed to be nearly as active, is considerably cheaper, and deserves the attention of veterinarians.

QUINIDINE, or conquinine, is isomeric with quinine, but contains two instead of three molecules of water, crystallises in larger prisms, is dextro-rotatory, and its salts are more soluble and of nearly the same activity. It is got from quinoidine, and also from some of the inferior cinchona barks.

CINCHONINE ($C_{20}H_{24}N_2O$) is present in the bark of various species of Cinchona and Remijia. It is obtained from the mother-liquors, after crystallisation of sulphate of quinine, by

precipitating the alkaloid with caustic soda, freeing it from the other alkaloids by washing with spirit, dissolving in sulphuric acid, purifying with animal charcoal, and crystallising. Like the quinine, it is used in the form of sulphate, which occurs in hard, colourless prisms, having a feebly bitter taste. It is anhydrous, dextro-rotatory; soluble in alcohol, ether, and thirty parts of water; its acidulated watery solution exhibits no fluorescence. Chlorine and ammonia solutions, instead of the emerald green produced with quinine, give a yellow-brown. It is the least active of the cinchona alkaloids, requiring to be given in double the dose of quinine.

CINCHONIDINE, an alkaloid isomeric with cinchonine, is obtained from the mother-liquors of the crystallisation of sulphate of quinine, is purified by crystallisation from alcohol, and finally from hot water. Like the other alkaloids, it is used as a sulphate, and is considerably more active than cinchonine.

Quinine and cinchonine, when heated with excess of a mineral acid, are converted into amorphous isomeric alkaloids, termed respectively quinicine and cinchonicine.

ACTIONS AND USES.—Cinchona bark is astringent from the presence of tannin, and antiseptic, tonic, and antipyretic owing to its alkaloids. These alkaloids have in concentrated form the several actions of the crude drug, but not its astringency. They differ only in the degree of their action. Quinine is the most powerful and most generally used. Small doses stimulate, large doses depress the functions of the organs with which they are brought into contact.

GENERAL ACTIONS.—Quinine and its salts combine with albumin, and have **antiseptic** properties nearly as marked as those of carbolic, benzoic, and salicylic acids, camphor, eucalyptol, or chloral hydrate. One part to 830 hinders, 1 part to 625 prevents, development of anthrax bacilli (Koch). It diminishes fermentation, especially when depending upon such organised ferments as the alcoholic, lactic, or butyric. It checks oxidation, and lessens protoplasmic and amœboid movements. Similar antiseptic effects doubtless occur when quinine is administered, and afford explanation of most of its curative effects.

Quinine in the mouth, from its bitterness, reflexly increases the flow of saliva. Small or moderate doses **stimulate the stomach and increase appetite**; but large doses impair appetite, and may induce nausea and vomiting. Its effects on intestinal secretion and movements are unknown; but it does not increase secretion of bile. It is absorbed from mucous, serous, and cellular surfaces, especially when in perfect solution, and its effects are notable fifteen to twenty minutes later. **Small doses stimulate, large doses depress.** Small to moderate doses reduce the calibre of the blood-vessels, and increase the strength of the circulation, but large doses weaken cardiac action and diminish blood-pressure. Moderate doses quicken respiration, large doses slow and eventually paralyse it. Death results from respiratory failure. The brain functions are stimulated by small, but depressed by large doses. Sensory and motor nerves are affected only when the drug is locally applied.

Tissue change is diminished. Experiments on dogs have shown that less oxygen is taken up, while less carbonic acid and albuminoid waste materials are excreted. **Temperature**, notably in febrile cases, **is lowered.** These effects may depend upon the antiseptic action of quinine, and may be connected with its property of increasing the size of the red globules while diminishing their capacity to give up oxygen, and on its diminishing the number, contractility, and movements of the white blood globules. It diminishes all secretions except the urinary, which is increased. Repeated full doses contract the spleen and also the uterus, sometimes exciting abortion. This may result from large quantities causing gastro-intestinal irritation. That the drug has no specific ebolic action appears to be proved by Dr H. C. Wood's experiments on healthy pregnant cats (*Practitioner*, 1879 and 1881). The headache, impaired sight and hearing, and other symptoms of **cinchonism** produced in man by large or repeated doses, have not been distinctly recognised in the lower animals.

Cinchona bark as a bitter tonic **resembles** cascarilla bark (p. 346), calumba root, and hydrastis, the rhizome and rootlets of *Hydrastis canadensis*, or golden seal, which yields the alkaloids berberine and hydrastine. The antiseptic and febrifuge pro-

perties of quinine ally it to various substances of the aromatic carbon series, while the anti-malarial actions resemble those of arsenic.

MEDICINAL USES.—The bark and its alkaloids are prescribed for all classes of patients as **bitter stomachics** and **tonics**. They improve appetite, check abnormal gastro-intestinal fermentation, and counteract relaxed conditions of the intestine and accumulations of mucus, which prove favourable to the development of worms. In troublesome cases of **atonic indigestion** in horses, where alkaline treatment has failed, Professor Robertson frequently gave 20 to 30 grains of quinine sulphate, with half a drachm to a drachm of nitric or hydrochloric acid. Weakly foals and calves affected by **relaxed bowels**, after a dose of oil, are often much benefited by a few doses of cinchona bark, hydrochloric acid, and spirit. Few tonics are so effectual as bark or quinine in improving appetite and muscular strength, and **hastening convalescence** from debilitating disease. In **anæmia** they are advantageously joined with iron salts. They are serviceable in the earlier stages of tuberculosis, in septicæmia, and pyæmia in all animals; in influenza, protracted cases of strangles, purpura, and other typhoid attacks in horses, in puerperal metritis in cows and ewes, and in bad cases of distemper in dogs—their beneficial effects in these and other cases probably depending on their **attacking** and **destroying pernicious micro-organisms**. Drachm doses, conjoined with iron salts, repeated night and morning, are certainly the most effectual treatment for **purpura**.

In **malarial diseases**, which in various regions attack the lower animals as well as man, no remedies prove so effectual. Not only do they mitigate the febrile symptoms and cut short the fever attack, but full doses, given one or two hours before a periodical seizure, frequently prevent it. The antiseptic properties of the drug explain this remarkable power. Mr R. W. Burke, of the A.V.D., has successfully used drachm doses of quinine in malarial and other fevers affecting horses and cattle in India, and, where febrile symptoms run high, reports that the medicine, within an hour after administration, reduces the temperature 1° to 3° , and when persisted with prevents its

subsequent rise (*Veterinarian*, October 1887). It is often useful in **rheumatism**, being given either by the mouth or hypodermically, frequently conjoined with salicylic acid or potassium iodide. Mr T. A. Dollar, New Bond Street, London, has successfully treated **rheumatism** and **sciatica** cases in horses, which have resisted other remedies, by hypodermic injection into the affected muscles of half a drachm of quinine sulphate in solution, and has not found undue irritation or abscess follow the operation. Like other bitters, when administered with cathartics, it generally increases their activity. Alternated with cod-liver oil and iron, quinine is the **best tonic for weakly dogs** and those suffering from chorea.

Both bark and alkaloids are occasionally used as antiseptics for wounds, and as a spray and gargle for relaxed and diphtheritic throats.

Doses, &c.—Cinchona bark is prescribed in the following doses:—For horses, ℥ij. to ℥iv.; for cattle, ℥i. to ℥ij.; for sheep and pigs, ℥i. to ℥iv.; for dogs, grs. xx. to ℥i., repeated twice or thrice daily for several days. If nausea or vomiting supervene, as occasionally happens in dogs, the dose should be considerably reduced or intermitted for a day or two. It is administered in bolus, pill, or solution, and is often conjoined with camphor, gentian, ginger, spirit, or ether. The **infusion** is made by digesting for one hour, in a covered vessel, one part red bark in No. 40 powder with one-fourth part aromatic sulphuric acid and twenty parts water, and straining. The **tincture** is made by maceration and percolation of four ounces red bark No. 40 powder in one pint of proof spirit.

The alkaloid being insoluble, some of its soluble salts are preferred. **Quinine sulphate** or disulphate— $(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 15Aq.$ —is generally used in Great Britain. Although requiring 700 to 800 parts of water for solution, it is very readily dissolved in water acidulated by sulphuric acid. **Quinine bisulphate**, commonly used in America, is soluble in ten parts of water. **The hydrochlorate**, much used in Germany, is also soluble, and less liable to be spoilt by the fungus which injures other quinine solutions.

These salts of quinine, as also the sulphate of quinoidine (p. 373), and sulphate of cinchonidine (p. 374), as already stated,

do not differ materially in activity, and are prescribed in the following doses :—Horses and cattle, grs. xx. to $\mathfrak{z}\text{i}$.; sheep and pigs, grs. v. to grs. xx.; dogs and cats, gr. j. to grs. viij. Cinchonine sulphate is given in double these quantities. These doses, in bolus, pill, or solution, are administered two or three times daily. Given in the fluid form, their solubility is increased and their bitterness diminished by prescribing them in an acidulated solution. They are also conveniently exhibited in milk. Any tendency to nausea or vomiting is abated by combination with hydrobromic acid. For hypodermic use a convenient solution of the sulphate is made with tartaric acid. The alkaloids might economically be sold, as in India, as they crystallise from the solution of the bark, and without the troublesome and costly process of separation. The cinchona alkaloids form comparatively insoluble compounds with bile, and hence before their administration any excess of bile should be cleared away by a laxative. They are often conjoined with other bitter tonics, and with capsicum, camphor, valerian, or salts of iron. The citrate of iron and quinine is sometimes used in canine practice, but as it is apt to be adulterated, it is better to prescribe a reliable quinine salt with a salt of iron.

CINNAMON.

CINNAMOMI CORTEX. Cinnamon Bark. The dried inner bark of shoots from the truncated stocks or stools of the cultivated cinnamon tree (*Cinnamomum zeylanicum*). Imported from Ceylon, and distinguished in commerce as Ceylon cinnamon. (B.P.) *Nat. Ord.*—Lauraceæ.

CINNAMOMUM OLEUM. The oil distilled from cinnamon bark. (B.P.)

The bark occurs in rolled quills, is thin and brittle, yellow-brown externally, darker brown on its inner surface, with a fragrant odour, and a warm, sweet, aromatic taste. Besides mannite, resin, and other vegetable constituents, the bark contains tannic and cinnamic acids, but its aroma and medicinal properties depend upon the presence of about one per cent. of a **volatile oil** ($\text{C}_9\text{H}_7\text{OH}$), which, when fresh, is bright-yellow,

but becomes cherry-red when kept. An inferior oil is extracted from the leaves.

ACTIONS AND USES.—Cinnamon bark is aromatic, carminative, and astringent, and is used for flavouring.

The oil resembles that of anise, caraway, coriander, peppermint, and other Umbelliferæ and Labiatae (p. 243). It is carminative, stimulant, and antispasmodic, and useful in all animals in indigestion, flatulence, and diarrhoea. Mr Richard W. Burke, A.V.D., thus testifies to its merits: "After a long trial I have found there is no more efficacious remedy in the treatment of diarrhoea in the dog, especially in that form of the disease which is noticed during the rains in India. It will check diarrhoea when opium, chlorodyne, and other remedies usually employed have been found to produce no effect in allaying the symptoms. I have also employed the tincture of cinnamon (which is prepared by dissolving the bark in rectified spirits and straining), in doses of one to two drachms for smaller animals. It is nearly, if not equally, as rapid in its effects as the oil of cinnamon bark" (*Veterinarian*, February 1888).

Doses, &c.—Of the bark, horses take ℥iv. to ℥i; dogs, ℥ss. to ℥i. Of the oil, horses take ℥xx. to ℥zi; dogs, ℥i. to ℥iv., administered on sugar, or in syrup, mucilage, or spirit and water.

COCAINE.

COCAINE HYDROCHLORAS. The hydrochlorate of an alkaloid obtained from the dried leaves of the *Erythroxylon Coca*, a shrubby plant indigenous to the mountains of Peru and Bolivia. $C_{17}H_{21}NO_4 \cdot HCl$. *Nat. Ord.*—Linaceæ.

The alkaloid, of which the leaves yield 26 per cent., is prepared by agitating an acidulated alcoholic extract with ether. It occurs in colourless prisms, requiring for solution 704 parts of water. The hydrochlorate, in almost colourless acicular crystals, or crystalline powder, is readily soluble in water and alcohol. Its watery solution has a bitter taste, producing on the tongue a sensation of tingling, followed by numbness. It gives a yellow precipitate with gold chloride, and a white pre-

cipitate with ammonium carbonate, soluble in excess of the re-agent. Cocaine is associated in the plant with cocatannic acid, and with other two alkaloids—ecgonine and hygrina—and a volatile constituent which gives aromatic fragrance to the fresh leaves.

ACTIONS AND USES.—Cocaine paralyses the sensory nerves with which it comes in contact, and is thus a local anæsthetic. It is also antiseptic. Small to moderate doses are stimulant and tonic, and diminish metabolism. The South American Indians, on long marches, not only chew the leaves, but give them to their horses, with the effect of diminishing thirst, hunger, and sense of fatigue. Although **topically anæsthetic and anodyne**, large doses, swallowed or injected subcutaneously, **paralyse the central nerve-centres**, impair co-ordination, causing aimless gyrating movements, muscular spasms, and death from respiratory failure.

GENERAL ACTIONS.—Solutions of 4 to 10 per cent. applied to a mucous surface within one minute cause pallor and contraction, and two or three minutes later local anæsthesia lasting ten minutes. A few drops of a 5 per cent. solution placed within the eyelids paralyse the conjunctiva and iris, and dilate the pupil. This dilatation is more notable in men and dogs than in horses and cattle (Fröhner). When swallowed, it slightly stimulates the stomach. It diminishes the sensations of hunger and thirst. Fuller or repeated doses quicken circulation, increase blood-pressure, breathing, and temperature, and heighten reflex irritability. Still larger doses cause trembling and timidity, impair co-ordination and equilibrium; animals cannot walk straight, have muscular trembling and rotatory convulsions, and die from paralysis of respiration. It is excreted by the kidneys; does not appear, however, to alter the proportion of the urinary constituents, but exerts antiseptic effects on the urine and other secretions.

Horses receiving 60 to 80 grains injected subcutaneously, or about .005 grammes per kilogramme of body-weight, are reported by Fröhner to be restless, paw with the fore feet, neigh, and exhibit timidity and excitement, the pulse rises to 90–96, temperature is increased, salivation occurs, the bowels are frequently moved, and the pupil dilated. After fifty minutes

the animal is in a state of frenzied excitement, with greatly augmented reflex activity. Two hours elapse before these effects disappear. **In cows** like effects were produced by hypodermic injection of similar doses. One drachm is stated to have produced excitement bordering on madness, and continuing for four hours, but gradually passing off, and leaving no injurious effects.

In dogs, doses consisting of .015 to .02 grammes per kilogramme of live-weight produce psychical excitement, muscular spasms, rhythmical contractions of the skeletal muscles, tetanic and clonic spasms, epileptic fits, rolling, loss of co-ordination, and dyspnoea. The spasms and more prominent symptoms do not, however, occur when potassium bromide, ether, or amyl-nitrite have previously been given. Large doses paralyse the central nervous system, implicating first the brain, then the corpora quadrigemina, the spinal cord, and lastly, the medulla.

MEDICINAL USES.—Cocaine hydrochlorate is a convenient and effectual local anæsthetic, and its cost alone prevents its more extensive use. Its effects are confined to the skin or mucous surfaces moistened with it, are more easily regulated than those of ether spray, are unaccompanied by pain, and may be kept up for considerable periods without injuriously affecting the nutrition of the parts. Anæsthesia may be produced within five minutes, and when insensibility is secured, it usually continues from twenty to thirty minutes. Twenty minims of a 4 or 5 per cent. solution **dropped into the eye** within ten minutes diminish sensibility, so that a thorough examination can be made of the organ; the irritability and pain of conjunctivitis, iritis, and ulcerations of the cornea are abated; chaff or other foreign bodies embedded in the cornea can be removed without provoking pain or reflex movements; warts can be excised, torn lids stitched, or other injuries of the eye painlessly treated. Indeed, after several applications of the cocaine solution, the eyeball of the horse has been removed, apparently without suffering, and without the necessity of casting the patient. In examinations and operations **in connection with the larynx**, cocaine is equally serviceable, and for such cases a 10 to 20 per cent. solution is generally used. Applied to the skin, along the course of the plantar

nerves, and still more effectually when injected subcutaneously, it abolishes sensibility sufficiently for the painless performance of **neurotomy** on most horses without casting them. Mr Richard Rutherford, Edinburgh, after closely clipping or shaving the hair, finds that half an ounce of a twenty per cent. solution in fifteen or twenty minutes anæsthesises the limbs even of irritable horses sufficiently for the performance of firing without casting, and for the painless insertion of setons in lameness of the back-tendons and hock. It is serviceable in the opening of abscesses, the removal of tumours, and in operations on the uterus, vagina, and rectum. Subcutaneously injected, it has been used to allay rheumatic and other irritative pain. In order to preserve cocaine hydrochlorate solutions, which, when long kept, are liable to spoil, 1-200th part of boric acid should be added to them when freshly made.

COD-LIVER OIL.

OLEUM MORRHUÆ. The oil extracted from the fresh liver of *Gadus morrhua*, by the application of a heat not exceeding 180° Fahr. (B.P.)

The fresh, carefully-cleaned livers of cod, and occasionally of other fish, are placed in a boiler and exposed to steam heat not exceeding 180° Fahr.; twenty-eight pounds of liver yield ten pounds of oil, which floats to the top, is collected and filtered, cooled to 50° Fahr., and again filtered. The chief supplies come from Newfoundland. An oil called candle-oil, prized by the Indians as a tonic, and used along the Pacific Coasts, is obtained from the *oslachan* or *boulican*, which inhabits the waters of British Columbia and Vancouver's Island. Good samples of cod-liver oil have a pale yellow colour, and an oily, fishy taste, which becomes, however, less obvious to those accustomed to take it. The dark colour and nauseous flavour of indifferent specimens result from exposure to high temperatures, or from the oil being extracted from stale, putrid livers. Its specific gravity is about .928; ether dissolves it readily; cold alcohol dissolves two to three per cent.; hot alcohol, three to seven per cent. It consists of varying proportions of **palmitin and stearin**; seven per cent.

triolin ; traces of four volatile and two fixed alkaloids, morrhucic acid, with biliary and other organic bodies containing phosphorus, iodine, bromine, and chlorine. A drop of sulphuric acid, added to a few drops of cod-liver oil in a porcelain cup, develops a violet colour, which passes to yellow or brown-red, depends upon the presence of biliary matters, and indicates the source, but not the purity or goodness of the oil.

ACTIONS AND USES.—Cod-liver oil is nutrient, tonic, and alterative. Like other fixed oils, large doses cause derangement of the bowels and purgation. For lubricant purposes, vegetable and mineral oils are more convenient and less liable to rancidity.

Dr Pollock published in the *Lancet* (5th November 1853) some **experiments** on cod-liver oil, made by an Essex agriculturist, on **pigs, sheep, and cattle**. Twenty pigs, separated from a lot of three hundred, averaging from five to fifteen stones, received two ounces of oil daily, with as much meal as they cleared up. The rest of the lot were treated in exactly the same manner, but got no oil. Those receiving the oil are stated to have consumed less food, and when killed “weighed the heaviest, and made the most money in the London market, the fat being firm and white. When the daily allowance of oil was increased to four ounces per day, the fat became yellow, and the flesh acquired a fishy taste.” For small pigs, an ounce daily was found the most economical quantity. An ounce given daily to sheep improved the quality both of the fat and flesh; while cattle receiving about half a pint daily are stated to have eaten less food, and paid better, than when treated in the usual way. The oil, it is mentioned, cost from 2s. 8d. to 3s. per gallon, and in some comparative experiments is said to have proved superior to sperm oil. These experiments confirm the recognised fact that oleaginous materials are essential to speedy and economical fattening; they do not, however, establish the individual superiority of cod-liver oil. In healthy animals equally satisfactory results would probably be obtained from the use of linseed, lard, rape, or other mild fixed oils.

MEDICINAL USES.—The biliary constituents of cod-liver oil facilitate its emulsion and digestion. Experiments show that

admixture of a little bile hastens absorption of any bland oil included in a loop of intestine. Cod-liver oil is also very readily oxidised. This **ready absorption and assimilation** render it specially useful not only for children, but for other young animals, in cases of **malnutrition** and convalescence from exhausting disease. Although it has no specific action on any particular organ, it improves general nutrition. Two-ounce doses, given twice daily, I have found benefit delicate **horses, thriving badly** after strangles and influenza. "In chronic **catarrh and bronchitis**, it appears to furnish suitable material for the formation of mucous cells and the repair of the inflamed mucous membrane" (Brunton). Like other oils, it materially relieves horses suffering from **broken wind**. It helps recovery of **cattle** reduced by diarrhoea, anæmia, or rheumatism, but for many such cases in horses, cattle, and sheep, linseed or linseed cakes are preferred. For **dogs and cats** it is useful in protracted cases of distemper, eczema, and other inveterate skin diseases; in epilepsy, chorea, rickets, and in chronic rheumatism, especially that variety known as kennel lameness, and depending upon damp, bad feeding, and faulty nutrition.

Doses, &c.—Horses take f̄ij. ; cattle, f̄ij. to f̄iv. ; sheep, about f̄ij. ; pigs, f̄iv. to f̄i. ; dogs, f̄i. to f̄iv. ; cats, about f̄i. The doses may be repeated twice daily, and persevered with, if required, for weeks; but if diarrhoea results, they must be reduced or intermitted for a day or two. To remove disagreeable flavour, and prevent nausea or vomiting, it is given in milk, mucilage, or gruel, beat up with an egg, conjoined with some aromatic, or with ether, and is best digested along with or immediately after other food.

COLCHICUM.

AUTUMN CROCUS. Meadow Saffron. The fresh corm of *Colchicum autumnale*. Collected about the end of June or beginning of July; stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150° Fahr. (B.P.) *Nat. Ord.*—Colchicaceæ or Melanthaceæ.

The autumn crocus grows wild throughout Middle and Southern Europe, and on English lawns and coarse, wet pastures,

in mild, moist localities, and is cultivated in many gardens. It has an annual stem; lilac or purple flowers, numerous round, red-brown, bitter, acrid seeds, about the size of millet; and a bulbous root, which, when about a year old, reaches the size of a walnut, and matures in July.

The corms are used both fresh and dried. They are sold in slices, which are kidney-shaped, about one and a half inches long, and an inch wide, are greyish-white, dry, firm, and starchy, with a bitter acrid taste. They yield their active principles to spirits and vinegar. They contain about 70 per cent. of water, and 18 of starch and gum, with $\frac{1}{10}$ of 1 per cent. of a bitter, crystallisable, poisonous alkaloid, **colchicine** ($C_{17}H_{19}NO_5$). It is conjoined with gallic acid, is present in other parts of the plant, and is nearly 100 times more active than the fresh bulb. Sulphuric acid colours it yellow-brown, nitric acid dyes it violet, passing through various hues to yellow. The corms also contain traces of the allied alkaloid veratrine.

ACTIONS AND USES.—Colchicum irritates most textures with which it comes into contact. Large doses are gastro-intestinal irritants and cardiac depressants. Medicinal doses are emetic, cathartic, and cholagogue. Its diuretic and diaphoretic actions are uncertain. It resembles the other Melanthaceæ—Veratrum album, V. viride and cevadilla.

TOXIC EFFECTS.—The corm, whether used green or dry, the seed, any active preparation, and still more notably the colchicine, are **in-contact irritants**. Owing to the active principle being slightly soluble they have little action on the sound skin. When swallowed, a sense of acidity is produced in the mouth and throat, and the flow of saliva is increased. Passing into the stomach and bowels they cause colic, tenesmus, and diarrhoea, and in carnivora nausea and vomiting. Absorption, however, is slow. The gastro-intestinal irritation is succeeded by cardiac depression, resembling that caused by veratrine and aconite, while full or frequently repeated doses induce collapse. The brain, motor nerves, and muscles are unaffected; the spinal cord and sensory nerves are paralysed.

Mr Broad, of Bath, in the *Veterinarian*, April 1856, records two cases of **horses dying** from eating in their hay the stalks, leaves, and seeds of colchicum. Colic, tympanitis, and great

dulness supervened, with death in twenty-four hours, and on post-mortem examination "inflammation and patches of erosion" were found on the mucous membrane of the stomach. Mr Broad also mentions the poisoning of eight two-year-old in-calf heifers, which suffered from tympanitis, purging, feeble pulse, and coma. Three died in about twenty hours, and the mucous membrane of the stomachs exhibited patches of inflammation and erosion.

M. Barry, in the *Recueil de Médecine Vétérinaire*, December 1862, records the case of a cow and heifer in Aisne, which ate some cut grass containing a considerable amount of meadow saffron. In a few hours they had violent colic, profuse and bloody diarrhœa, tenderness of the abdomen, coldness of the surface, and prostration. The cow recovered; the heifer died from irritation and exhaustion in three days. A number of cows ate small quantities of colchicum, suffered from colic and diarrhœa, but recovered when treated with emollient drenches and mild saline mixtures. Three cattle having eaten colchicum are reported (*Veterinarian*, August 1864) to have suffered from dulness, stupor, grinding of the teeth, dilated pupils, imperceptible pulse, relaxed bowels, cold extremities, and thirst, but no griping pains, nor quickened breathing. They were successfully treated by laxatives and stimulants.

Dogs and cats, like man, are more susceptible than horses or ruminants. Two drachms of the dried bulb caused in dogs vomiting, bloody evacuations, diuresis, tremors of the limbs, depression of the heart action, and death in five hours. A tenth of a grain of colchicine given to a cat occasioned salivation, vomiting, purging, staggering, extreme languor, colic, and death in twelve hours. Rabbits, as well as frogs and other cold-blooded animals, are stated to be less susceptible to the drug.

As antidotes the stomach must be emptied; full doses of tannin form an insoluble compound with the colchicine; white of egg and other demulcents are freely given, and stimulants if there be collapse.

MEDICINAL USES.—Large doses of the fresh corm given by Professor Rutherford to fasting dogs, and their expulsion by vomiting prevented, increased secretion of bile, and also purged

powerfully. But action on the liver and gastro-intestinal membrane is more safely effected by other medicines. Small doses, conjoined with alkalies or salines, are occasionally given to horses in **rheumatism and rheumatic influenza**, especially in subacute cases in which inflammation flies from joint to joint. Foreign authorities prescribe it in constitutional ophthalmia. Professor Williams has used it, conjoined with potassium iodide, in **pleurisy**, in rheumatic forms of pericarditis, and sometimes in pneumonia when the kidneys were torpid. It is excreted in great part by the kidneys, and when not quickly removed by the bowels it increases, alike in health and disease, both the organic and inorganic constituents of the urine.

DOSES, &c.—The powdered corm or seed for horses, ℥ss. to ℥j.; for cattle, ℥j. to ℥ij.; for sheep, grs. x. to grs. xxv.; for dogs and pigs, grs. ij. to grs. viij., given with salines. A convenient solution is made with one part of colchicum, six or eight of vinegar, and a little spirit. Colchicine is given by the mouth or hypodermically in doses of grs. j. to grs. v.; to dogs grs. $\frac{1}{10}$ to grs. $\frac{1}{8}$.

COPPER AND ITS MEDICINAL SALTS.

Copper (Cu) is a brilliant red metal, found native near Lake Superior in North America, crystallised in octahedrons or cubes. It has a specific gravity of 8.95, a nauseous styptic taste, and unpleasant odour, especially when rubbed. It is malleable and ductile, constitutes 95 per cent. of the material of our bronze coinage, which contains besides about four of tin and one of zinc. Brass consists of about two-thirds of copper and one-third of zinc. The principal copper ores are pyrites, which is a double sulphide of copper and iron, and the carbonate or malachite. Its chief officinal salts are the sulphate, nitrate, iodide, and acetate. Copper forms two series of salts, the cuprous and cupric, the latter the more stable, and, when hydrated, having a green or blue colour.

Cupric salts are recognised by the following **tests**. Addition of hydrochloric acid gives no precipitate. In the acidulated solution hydrogen sulphide and ammonium hydrosulphide give

black precipitates of copper sulphide (CuS); solutions of potassium or sodium hydrate, a greenish-blue precipitate of cupric hydrate ($\text{CuO}\cdot\text{H}_2\text{O}$), insoluble in excess, but blackened by heat; ammonia, a similar precipitate, which redissolves on further addition of the precipitant, forming a deep-blue liquid, yielding $\text{CuSO}_4\cdot 4\text{NH}_3\cdot\text{H}_2\text{O}$; and potassium ferrocyanide, a maroon-red precipitate of copper ferrocyanide ($\text{Cu}_2\text{Fcy.}$) A piece of polished iron or steel placed in a solution of a copper salt quickly becomes coated with a red deposit of metallic copper.

ACTIONS AND USES.—Salts of copper, like those of other heavy metals, form sparingly soluble albuminates. In virtue of their combining with the albumin of the tissues, they are antiseptic, astringent, irritant, and caustic. When they are absorbed, these topical effects are more widely extended, and more general astringent, antiseptic, tonic, or irritant effects are produced.

Copper salts are allied to those of **zinc** and **silver**, and some of their actions also resemble those of iron, lead, and mercury. Like zinc and lead, they are muscle poisons, and hence weaken heart action. Acute copper poisoning inflames the spinal cord, but not in so marked a degree as lead and mercury. The sulphate, nitrate, and other soluble salts have slight action on the unbroken skin, but **combine with albumin**, and hence constrict and irritate the abraded skin and mucous surfaces. When swallowed they **irritate the stomach**, in many animals producing emesis, which, when the drug is absorbed, is also excited by irritation of the vomiting centre. After exerting, according to dose or state of concentration, astringent or irritant effects on the alimentary mucous membrane, they are slowly **absorbed as albuminates**, and as the still more soluble peptonates. They appear to remain in the plasma of the blood, but do not combine with the corpuscles, or only to a limited extent. They probably unite with various tissues, and **modify their nutritive and functional activity**. Like many other metallic salts, they are **excreted** tolerably quickly by the bile, by the mucous membranes of the stomach and bowels, to a slight extent by the skin, but mainly by the kidneys, and exert their special effects on the channels by which they are excreted.

Copper in the metallic state is devoid of poisonous action.

Drouard gave ounce doses finely divided to dogs of different sizes and ages, but none experienced any inconvenience (Pereira). Two drachms of oxide caused in dogs vomiting and diarrhoea. The more **soluble salts** are more **active irritants**. Dogs tolerate for a week or two daily doses of 10 to 15 grains of the sulphate or acetate, but 40 to 60 grains induce loathing of food, diarrhoea, and in some instances death by collapse. **Chronic poisoning** occasionally occurs among animals depastured in the neighbourhood of copper-smelting works, but such effects are apt in part to depend upon the arsenic present in these ores (p. 265). Cuprous poisoning also results in cows, pigs, and dogs, from the use of food or drink boiled in copper vessels, and allowed to remain in them while cooling. Acid and fatty matters are most apt thus to be contaminated, especially if long in contact with copper, and exposed at the same time to air and moisture. The prominent **symptoms** are impaired appetite, constipation, alternated with diarrhoea, colic, imperfect nutrition, muscular weakness and trembling, and occasionally hæmoglobinuria or hæmaturia. **The antidotes** consist of white of egg, washing out the stomach, administering demulcents, and allaying irritation and pain, if need be, by morphine.

COPPER SULPHATE. Cupri Sulphas. Cupric Sulphate. Blue Vitriol. Blue Stone. Vitriol of Copper. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

Copper sulphate is got by dissolving the black oxide in sulphuric acid, by boiling metallic copper with sulphuric acid, and on the large scale by roasting copper pyrites (CuFeS_2), when both the copper and iron are oxidised into sulphates; at the red-heat used the iron sulphate is decomposed, and the copper sulphate crystallised from a hot watery solution. Blue vitriol made from pyrites always contains iron, which does not, however, interfere with its medicinal uses. It occurs in large blue double oblique rhombic prisms, has a specific gravity of 2.2, and a styptic metallic taste. Exposed to the air, it effloresces and becomes covered with a greenish-white powder of carbonate. It is insoluble in alcohol, but soluble in about two parts of boiling and four of temperate water. The ordinary

blue vitriol, exposed to a temperature of 400° Fahr., loses water of crystallisation, becomes a yellow-white powder (CuSO_4), and is used for testing alcohol and other liquids for water, which it seizes, regaining its blue colour.

ACTIONS AND USES.—It combines with the albumin of the tissues with which it comes into contact, and in moderate doses or weak solutions is antiseptic, astringent, and tonic. Even small doses induce emesis in dogs and other carnivora. Large doses and concentrated solutions are irritant and caustic. Externally, it is used as a stimulant, astringent, and caustic. Like many other metallic salts, it arrests the action of enzymes and of organised ferments.

TOXIC EFFECTS.—Hertwig records that large doses (above twelve drachms for horses and cattle, one drachm for sheep or swine, and half a drachm for dogs) cause indigestion and impaired appetite; in carnivora, vomiting and diarrhoea; the evacuations are tinged green or blue, and mixed with blood; and fatal inflammation of the stomach and intestines usually follow. Drouard found that sixty grains retained in the stomach of a dog killed it in half an hour, but left little appearance of inflammation. Mitscherlich found that two drachms speedily killed dogs, leaving "blueness of the villous coat of the stomach, mingled with brownness, the apparent effect of chemical action." A drachm applied to a wound caused in dogs rapid prostration, and death in four hours. Injected into the jugular vein, it speedily reduces and arrests the action of the heart, fifteen grains proving fatal in twelve seconds (Christison *On Poisons*). In poisoning by copper salts, the appropriate remedies are white of egg or milk, which form insoluble innocuous albuminates; iron filings, which attract and fix the copper; or potassium ferrocyanide, which produces a comparatively insoluble and harmless salt.

MEDICINAL USES.—Copper sulphate is given to dogs and cats as a promptly-acting **effectual emetic**, useful in narcotic poisoning. With phosphorus it forms a stable, inert compound. It acts both on the stomach and the vomiting centre (p. 93). It is prescribed for all animals in **atony and excessive mucous discharges**, especially from the alimentary canal. In chronic diarrhoea and dysentery it is prescribed with opium. In nasal

gleet it is sometimes conjoined with cantharides. In glanders, farcy, purpura, and other typhoid complaints, it improves appetite and diminishes abnormal secretion. In grease it is used both internally and locally. Given in bolus, administered fasting, and repeated daily for a week, it is a useful general **vermifuge** for the horse, and the repeated doses are followed by a dose of physic. As a **nerve tonic** it is prescribed especially for weakly dogs affected by epilepsy and chorea, but in the latter it is not so effectual as arsenic.

Externally, it is applied as a stimulant and astringent. In ophthalmia, as an antiseptic stimulant; as a spray and gargle for ulcerated sore-throat; as an antiseptic stimulant and caustic for sluggish wounds, discharging and parasitic skin diseases, exuberant granulations, warts, farcy-buds, fistulæ, and foot-rot in sheep, and as a styptic for arresting hæmorrhage from superficial vessels.

Doses, &c.—As a tonic and astringent, horses take \mathfrak{z} i. to \mathfrak{z} ij.; cattle, \mathfrak{z} i. to \mathfrak{z} iv.; sheep, grs. xx. to grs. xxx.; pigs, grs. v. to grs. x.; and dogs, gr. $\frac{1}{4}$ to grs. ij. These doses, repeated twice daily, are administered either in bolus or dissolved in some mucilaginous solution; and as tonics are best given along with food, or immediately after eating. Unless in very small doses, it cannot in horses or dogs be persisted with, like an iron salt, as it is apt to interfere with appetite, and even cause nausea. As a prompt emetic for the dog, grains vi. to grains x. are given dissolved in water, and about double that amount for pigs of 100 lbs. weight. **Externally**, the powder or a watery solution is applied, and the crystals are used as an escharotic. Shepherds make an ointment for foot-rot with equal weights of powdered blue vitriol, gunpowder, and hog's lard. A more convenient and adhesive application is prepared by carefully mixing over a slow fire one part of powdered blue vitriol with one of lard and two of tar.

The ammonio-cupric sulphate ($\text{CuSO}_4 \cdot 4\text{NH}_3 \cdot \text{H}_2\text{O}$) is used in a hydrated state as a test for arsenic (p. 261), and is occasionally substituted for the sulphate as a tonic.

COPPER IODIDE. Cupri Iodidum. Cuprous Iodide. Cu_2I_2 .

Although not recognised by the B.P., cuprous iodide is noticed in Morton's *Veterinary Pharmacy* and in Tuson's *Veterinary Pharmacopœia*. It is the by-product in one of the processes for iodine, and is also obtained by mixing solutions of cuprous sulphate and potassium iodide. It is a fawn-coloured salt, has a disagreeable, styptic, coppery taste, and evolves an odour of iodine. It was introduced in the belief that it conjoined the actions of its two constituents; but large doses, in which its characteristic actions should be most obvious, produce the effects of other soluble copper salts. It has been recommended as a stimulating tonic in glanders, farcy, and chronic œdema of the legs, and as an astringent in ill-conditioned ulcers and inveterate grease (Morton's *Pharmacy*).

COPPER ACETATES. Verdigris. Blue Verdigris. *Ærugo*.

Chemists describe five acetates of copper. Of the cuprous or sub-acetate two varieties are made—one in this country, distinguished by its green colour; the other abroad, especially in the south of France, of an azure-blue colour. It is usually prepared by placing plates of copper in layers, alternated either with woollen cloths saturated with acetic acid, or, according to the foreign method, with the moistened husks of the grape and the refuse of the wine process. Exposed for about a month to the conjoined action of air and acid, a paste of verdigris forms on the copper plates, and chiefly consists of $(\text{CH}_3\text{CO}_2)_2\text{Cu.CuO.6H}_2\text{O}$. It occurs either in amorphous masses or powder, is blue or green, according to the mode of preparation, and has the taste and odour of a copper salt. It remains unchanged in air; when heated, it gives off water, acetic acid, and acetone, leaving a residue of oxide and metal.

ACTIONS AND USES.—The acetates, like other copper salts, are irritant poisons, emetic, antiseptic, astringent, and tonic, but are rarely prescribed internally. They are used externally as caustics, stimulants, astringents, and antiseptics.

Drouard exhibited twelve grains of the subacetate to a strong dog fasting, and observed aversion to food, efforts to

vomit, diarrhœa, listlessness, and death in twenty-two hours. Paralysis of the hind extremities was also observable in some cases, but in none was the stomach much inflamed. The normal cupric acetate $(\text{CH}_3\text{CO}_2)_2\text{CuH}_2\text{O}$, is still more active. Orfila found that twelve to fifteen grains given to dogs, besides gastric irritation, produced convulsions, tetanus, sometimes insensibility, and death within an hour (*Christison On Poisons*). Hertwig records that one ounce administered to a horse caused colic, with acceleration of the pulse; and that two ounces, given some hours after, aggravated these symptoms, causing first acceleration and then depression of the pulse, debility, and, after six hours, convulsions and death. Prescribed internally, **the doses** of the acetates are the same as those of the sulphates. The external uses are also the same. They are applied in the form of powder, solution, and ointment, the latter made with one part of the salt to eight or ten of lard or of resinous ointment. A useful dressing for foot-rot in sheep is made with one part of acetate to three or four parts of lard, oil, or tar.

CREOSOTE.

CREASOTUM. Creosote. A product of the distillation of wood-tar. (B.P.)

Tar obtained from hard woods yields twenty to twenty-five per cent. of creosote. The process of extraction is tedious and complex, requiring repeated distillations and the removal of the lighter paraffin oils. It consists of a series of phenol oils, of which the most important are phenol, cresol, phlorol, guaiacol, and creosol (Bloxam). It yields creosotic acid, which in its properties and uses closely resembles salicylic acid.

Creosote is a mobile, oily, neutral fluid, with the specific gravity 1.071; colourless and transparent when first prepared, but, unless very pure, soon becoming brown. It has a strong, persistent, smoky odour, and a pungent, acrid taste, with a sweet after-taste. It requires for solution eighty parts of water, but readily dissolves in alcohol, ether, acetic acid, and volatile oils. Dropped on white filtering paper, and exposed to a heat of 212° Fahr., it leaves no translucent stain (B.P.)

Impure carbolic acid and other coal-tar oils, frequently mixed with or substituted for the more expensive wood creosote, are **distinguished** from it by their greater solubility in water; by their solidifying in acicular crystals at low temperatures (p. 336); by their not affecting a ray of polarised light, which creosote turns to the right; by their producing a clear jelly when shaken with collodion, which does not affect wood creosote; while their watery solution gives a blue colour, with a neutral iron perchloride solution, which gradually browns the watery solution of wood creosote.

ACTIONS AND USES.—Creosote belongs to the aromatic series of carbon compounds (p. 294). Containing so many phenols and glucol, it has a complex action, but it resembles carbolic acid. It is occasionally administered to arrest gastro-intestinal fermentation, and diminish factor of the discharges. It is used as an antiseptic and analgesic, and for the destruction of skin parasites and bacteria. In large doses it is an irritant poison and cardiac paralytant.

GENERAL ACTIONS.—When undiluted, it coagulates albumin and destroys the epithelium of mucous membranes, and even of the skin, producing corrugation and a white stain or scar. Diluted solutions act as antiseptics, irritate slightly, and then cause analgesia and feeble anæsthesia. Although in saturated solution it has little effect on enzymes, 1 part in 500 of water arrests the action of yeast, while 1 to 1000 kills bacteria (Bucholtz). It is **absorbed**, and communicates its odour to the various tissues. Large doses, given internally, cause nausea; in carnivora, vomiting, colicky pains, and diarrhoea, with muscular paralysis, especially involving the heart, and depressing the central nervous system. It is **excreted** by various channels, chiefly by the kidneys.

TOXIC EFFECTS.—Three drachms given to horses caused slight and temporary feverishness, and imparted to the breath a creosote odour (Hertwig). Thirty drops given to dogs by Sir J. R. Cormack caused uneasiness, copious salivation, vertigo, muscular twitching, enfeebled and fluttering action of the heart, laboured breathing, diminished sensibility, dulness, and stupor. The symptoms came on within a few minutes, and continued for two or three hours. For a day or two, however, irritability

of the stomach, occasional vomiting, and dulness were still observable. Two dogs got two drachms each, and died within three hours, evincing, besides the symptoms above mentioned, violent convulsions and complete coma. A rabbit was thrown into convulsions, and died within a minute, from the effects of thirty drops (*Treatise on Creosote, Harveian Prize Dissertation*, 1836). From the prominence of the convulsions in these cases, it is probable that the creosote was largely mixed with carbolic acid. The **antidotes** have been enumerated (p. 138).

MEDICINAL USES.—It is prescribed in some forms of indigestion, to arrest undue **fermentation**, and is given to dogs in chronic vomiting (p. 94). With chalk and catechu mixture, or a little laudanum and an aromatic, it helps to check **diarrhoea and dysentery**. A few drops inhaled with steam benefit chronic **bronchitis and lung complaints**, when accompanied by excessive and fetid discharges. Parasites lodged in the air-passages are destroyed by creosote, administered either by the mouth, or, more effectually, by inhalation or intratracheally. In **contagious pleuro-pneumonia** in cattle creosote was some years ago used at the Royal (Dick's) Veterinary College with some advantage in relieving distressed breathing and irritable bowels. It has been tried in glanders in horses, but without any very striking results. **Farcy and nasal gleet**, with enlarged glands and fetid discharge, are sometimes, however, benefited by a daily drachm of creosote, given with thirty minims sulphuric acid, and made into bolus with linseed meal. In that form of diabetes insipidus common in horses it usually does harm rather than good.

For external purposes, carbolic acid has superseded creosote as an **antiseptic** for wounds, as well as a **stimulant** and **escharotic** in caries, scrofulous tumours, fistula, canker, thrush, and foot-rot. Diluted with glycerine and water, or with vinegar, it is still occasionally used to relieve itching and remove scurf in chronic eczema, prurigo, and psoriasis. It **destroys parasites infesting the skin**. For mange and scab, Gerlach advises an ounce of creosote, dissolved in fifteen ounces of spirit and forty of water. For intractable follicular mange, after washing the dog with soap and water, or, better still,

shaving him, Mr Hunting advises inunction of a mixture of one part of creosote and fourteen of olive-oil, the penetrating power being increased by the addition of two parts of caustic potash solution. Human patients suffering from toothache depending on caries are often relieved by a drop of creosote cautiously placed in the hollow of the tooth, where it unites with albuminoid matters, protecting the irritable nerve pulp from air and irritants, and further exerting its anodyne action.

DOSES, &c.—For horses, ℥ x. to ℥ xxx.; for cattle, fʒss. to fʒj.; sheep, ℥ v. to ℥ xv.; pigs, ℥ ij. to ℥ x.; dogs, ℥ i. to ℥ ij. It is given in bolus with syrup; in solution, with mucilage, acetic acid, volatile oils, or alcohol; or conveniently shaken up with milk. As a stimulant or escharotic, it is applied with a camel's hair brush; is used in solution in spirit or acetic acid, or as an ointment, made with one part to eight of lard or simple ointment. For skin diseases, equal parts of creosote and sulphur may be made into an ointment with lard, or a liniment with oil. A few drops are sometimes added to turpentine, hartshorn, or other embrocations.

CREOLIN.

A coal-tar product of complex composition, containing naphthalin, several creosols, and other phenoloids.

Creolin is one of the most useful of the benzol or aromatic carbon series (p. 294). It is a dark-brown oily liquid, of tarry odour and taste, soluble in ether and chloroform, nearly soluble in strong alcohol, and forming an emulsion when mixed with forty parts of water.

ACTIONS AND USES.—It is antiseptic, disinfectant, deodorant, parasiticide, and astringent.

Bacteriological tests prove it to be more prompt and effective than carbolic acid in the **destruction of the microbes** of anthrax, fowl cholera, glanders, &c. A one per cent. solution is stated by Esmarck and Fröhner to kill cholera bacteria in ten minutes, and arrest development of typhus bacilli in one hour; while a one per cent. solution of carbolic acid requires four days to kill cholera bacilli, and had no effect on typhus

bacilli in twenty-one days. Kaufmann states that as a bactericide it is ten times as powerful as carbolic acid. It coagulates albumin, but, unlike carbolic acid and creosote, ten per cent. solutions do not irritate the skin, even when abraded, or the mucous membranes. It is quickly absorbed, but large doses are given without causing intoxication or injury. It quickly impregnates with its empyreumatic phenol odour the sweat, milk, and urine, by which it is excreted, partly as naphthalin, partly as sulphuric acid. It usually colours the urine brown.

Horses have received in emulsion from one and a half to three fluid drachms without effect, and cattle still larger doses. A medium-sized dog had a drachm and a half, and another thirty minims daily for four weeks without injury. Sheep and goats have taken with impunity two to six fluid drachms. The in-rubbing even of concentrated solutions is readily borne. Fröhner records that at the Berlin Veterinary College upwards of a thousand mangy dogs have been treated with creolin lotions without a mishap. A thousand horses suffering from mange have been anointed with a ten per cent. solution; sheep suffering from scab have been dipped in a two and a half per cent. solution; while 20,000 sheep are stated to have been washed with creolin dips in Prussia in 1888. Further testimony of its non-irritant and innocuous character is adduced by Professor Späth and two of his colleagues, who took daily from thirty minims to two fluid drachms without loss of appetite, nausea, or disturbance of circulation or secretion. The larger doses diminished the amount of intestinal gas, the fæces lost their distinctive smell, and the urine contained less indican, and, although kept for several days in a warm room, did not decompose.

MEDICINAL USES.—At the several Continental veterinary schools creolin is much used, and is characterised as the cheapest and best **antiseptic and disinfectant**. It is not often prescribed internally, but, as already indicated, in gastrointestinal derangements it is effectual in checking undue fermentation, and lessening the fœtor and acidity of the excretions. As a surgical antiseptic, it has the merit of being non-irritant and non-poisonous. It does not dry or harden the operator's hands, or spoil the steel instruments, as carbolic acid

does. Its chief disadvantage is its dirty appearance. With glycerine and water it is a serviceable gargle in aphthous ulcerated conditions of the mouth and throat. It is inhaled in ozæna, strangles, bronchitis, gangrenous pneumonia, and purpura. In the form of injection it is useful in retention of the placenta, metritis, and purulent cystitis. **It destroys skin parasites**, whether animal or vegetable, in all animals, and is recommended in chronic eczema. It is used for the several purposes of a disinfectant.

Doses, &c.—For horses and cattle, fʒij. to fʒvi.; for dogs, ℥v. to ℥xx. For external purposes, one to five parts are mixed with a hundred of water, solution being facilitated by addition of a little glycerine or soft soap. As a dry dressing it is used with boric acid, zinc oxide, or kaolin. Creolin solutions lose their efficacy when they stand long, and hence should be made up fresh every week. For mange or scab Fröhner advises the dressing of the worst parts with a lotion of one part each of creolin and methylated spirit and eight parts of soap, and subsequently placing the patient for two or three minutes in a bath of two or two and a half per cent. of creolin, and, if necessary, repeating the treatment in a week.

CROTON SEEDS AND OIL.

CROTON SEEDS. *Semina Crotonis.* The seeds of *Croton Tiglium*.

CROTON OIL. *Oleum Crotonis.* Oil expressed in Britain from the seeds of *Croton Tiglium*. (B.P.) *Nat. Ord.*—*Euphorbiaceæ*.

The *Croton Tiglium* is a tree fifteen or twenty feet high growing on the Indian Continent, in Ceylon, and in many islands of the Indian Archipelago. Its oval-shaped fruit or nut is somewhat larger than a hazel, and contains three seeds about the size of French beans, resembling the castor-oil seeds, brown, but free of mottling, and when shelled weighing on an average three grains each. They are odourless, with a taste at first mild and mucilaginous, but soon becoming hot and acrid. When heated they yield irritating fumes. The thin brittle external shell constitutes fully one-third of the weight of the seed. Mr Morton found by experiment that the plumæ and

testæ are less active than the cotyledons (*Veterinary Record*, 1846). The seed kernel contains 50 to 60 per cent. of fixed oil.

The oil is obtained either by crushing the seeds or bruising and digesting them with light petroleum spirit. The properties differ somewhat with the method of preparation, and subsequent straining. It is viscid, of a brownish-yellow colour, with a peculiar nauseous odour and a persistent acrid taste. It is freely soluble in ether, light petroleum spirit, and oils, fixed and volatile. It consists of croton-oleic acid, and a neutral glucoside, which, when the oil comes into contact with the alkaline intestinal secretions and the bile, is saponified, producing a drastic resinoid. The residual cake left after expression of the oil, owing to the variable amount of oil it contains, is dangerously uncertain, and accordingly should not be used.

ACTIONS AND USES.—Croton irritates the living textures with which it comes into contact. The oil, undiluted, and in various degrees of dilution, is occasionally used as a counter-irritant, and when rubbed into the skin produces vesicles and pustules. It is a drastic hydragogue cathartic. Full doses cause gastro-enteritis and much prostration.

GENERAL ACTIONS.—Croton oil, undiluted and freely used, seriously and deeply inflames the skin, leaving sometimes permanent blemishing, and causing besides pyrexia, and sometimes purgation. It resembles tartar emetic in its producing pustules. Used with an alkali, the irritant resin is more readily developed, and its effects intensified. The men who shell the seeds frequently suffer from inflammation of the face and other parts exposed to the croton dust.

Purgation is produced when the oil is freely applied to the skin, or enters the body by any other channel. When full doses are given, the active resin is excreted not only by the bowels, but by the kidneys, inducing diuresis, and sometimes strangury. **As a drastic and hydragogue cathartic** croton resembles gamboge and elaterium—a sediment from the juice of the fruit of the squirting cucumber. It operates more speedily than aloes, and produces more frequent, full, and fluid dejections. **For horses**, croton is, however, too violent and

irritating for safe or general use. **For cattle** it is sometimes valuable, operating with certainty when most other purgatives are ineffectual, and, if carefully used, is rarely attended with evil consequences. **For sheep** it is too irritating and depressing to be generally available. **For dogs and pigs** it is a prompt and effectual drastic purge, requiring, however, as in other patients, to be used with much caution. Professors Rutherford and Vignal have shown that, although causing great dilatation of the vessels of the intestinal mucous membrane, it has no special cholagogue action.

Toxic Effects.—Forty seeds destroyed a horse in seven hours, with acute gastro-enteritis; half that quantity usually produced fatal inflammation (Hertwig). Morton administered twenty bruised seeds to two horses and observed super-purgation, accelerated pulse and respiration, injected mucous membranes, collapse, and death in eighteen and twenty-four hours. Medicinal doses sometimes cause, alike in horses and dogs, unexpected and serious irritation. In India the seeds are occasionally used to poison horses. Orfila gave a dog three drachms, which killed him in three hours; one drachm was also fatal; while Hertwig found that ten or twelve grains induced violent purgation, gastro-enteritis, and death in four to seven hours, if vomiting was prevented by tying the œsophagus. About the same quantity of the bruised seed or oil, which proves fatal when given internally, has the like effect when placed in the areolar tissues, or applied to a wound. Hertwig states that eight drops injected into the jugular vein killed a horse, while two drops killed a dog. Moiroud records that twelve drops injected into the veins of a horse produced in a few minutes alvine evacuations, while thirty drops were quickly fatal. Fifty drops in alcoholic solution, applied to the belly of a small horse, caused next day alvine evacuations of normal consistence, but three or four times more abundant than natural, and continuing so for two days. Thirty drops had similar effects on sheep, fifteen to twenty on dogs (Hertwig).

Post-mortem discovers inflammation of the small and large intestines. In horses poisoned the cæcum and colon are especially affected, usually exhibiting much extravasation of

blood, and occasionally patches of erosion; sometimes the lungs are congested, and occasionally they are inflamed (Hertwig, and Professor John Gamgee's *Veterinarian's Vade Mecum*).

MEDICINAL USES.—Croton is used as an **active hydragogue cathartic for cattle** suffering from fardel-bound and other forms of constipation, and from torpidity of the bowels associated with phrenitis or other disordered states of the nervous system. It is serviceable where bulky medicines are inadmissible, where animals are unmanageable, or have difficulty in swallowing, where it is requisite promptly to produce copious fluid evacuations and extensive counter-irritation. It is contra-indicated in young and delicate subjects, in all debilitating complaints, and wherever any portion of the alimentary canal is in an irritable or vascular state. The evil effects of **overdoses are abated** by demulcents and opium, given by the mouth and rectum, by hot cloths to the abdomen, and, if need be, by stimulants to counteract depression.

As a counter-irritant its effects may be regulated by diluting it. When undiluted it is too irritant either for horses or dogs; but is less apt either to purge or blemish cattle, to which it is occasionally applied in laryngitis, chronic glandular enlargements, and chronic articular rheumatism.

DOSES, &c.—Ten or twelve seeds, which, allowing three grains for each, weigh from thirty to thirty-six grains, is the dose if it be given to the horse, fifteen to twenty seeds for cattle, three or four for sheep, two or three for pigs, and one or two for dogs. The dose of croton oil for the horse is ℥ xv. to ℥ xxv.; for cattle, fʒss. to fʒj.; for sheep and swine, ℥ v. to ℥ x.; and for the dog, ℥ ii. to ℥ iij. The dose of the so-called croton cake is stated to be double that of the fresh croton bean; but, as already indicated, it is an uncertain preparation. The bruised seeds and the oil are administered made into bolus with linseed meal, or dissolved in castor or linseed oil or mucilage. They are less irritating and more certain and regular when conjoined with other purgatives. In obstinate constipation or torpidity of the bowels among cattle, half doses are given, with twenty or thirty grains of calomel, a pound of salts, or a pint of linseed oil; and few purgative mixtures are more effectual. The oil is sometimes dropped on

the tongue, but, unless freely diluted, is apt to irritate both tongue and fauces. For **external** purposes it is dissolved in six or eight parts of bland oil or soap liniment. Small quantities added to blistering ointments promote their activity, but in horses also increase their tendency to blemish.

CURARE.

CURARA. Woorara. Woorali. Urari. A South American arrow poison. An extract from one or more species of *Strychnos*, mixed with some mucilaginous juice, and owing its activity to an alkaloid, curarina ($C_{10}H_{15}N_3$).

Curare is a black-brown substance, with a very bitter taste, and imperfectly soluble in water. It appears to vary somewhat in composition, and two varieties have been described.

The drug, and its twenty-times more active alkaloid curarina, by whatever channel they enter the body, **paralyse the peripheral endings of motor nerves.** The nerves of the voluntary muscles of the limbs are first affected, then those of the trunk and head; but later, and with large doses, they involve the endings of sensory nerves, and also of the vagus, enfeebling, and, it may be, arresting respiration. Intelligence and consciousness remain unimpaired. Horses are poisoned by 15 to 30 grains of curare, dogs by about one-tenth of these doses. Nikelski and Dogiel's recent investigations demonstrate that the poison affects the protoplasm both of nerves and muscles; that paralysis is removed when the drug is washed out of the muscle; that it acts less powerfully on the vasomotor system of rabbits and cats than of dogs; applied to the conjunctiva it dilates the pupil of birds, but not of mammals; while the reverse obtains in the case of atropine (*Transactions of Chemical Society*, 1891). Although the blood becomes charged with carbonic acid, the motor nerves are so paralysed that convulsions do not occur. The heart continues to beat after the breathing ceases, but the poison is quickly eliminated by the kidneys, and artificial respiration persisted with accordingly prevents death, even when lethal doses have been given. The rapid excretion of the poison unchanged by the kidneys is strikingly illustrated by the fact that the urine of a frog,

poisoned by curare, injected subcutaneously into a second frog, paralyses it, and its urine will even paralyse a third (Brunton).

It is allied to hemlock and coniine, and to methyl-strychnine, methyl-brucine, and methyl-thebaine. Some of its effects are antagonised by strychnine. It has been given in chorea, epilepsy, tetanus, and hydrophobia; but in none of these has its efficacy been established.

The doses for horses and cattle are from gr. ss. to gr. j.; for dogs, gr. $\frac{1}{20}$ to gr. $\frac{1}{2}$. It acts much more powerfully when injected intravenously, hypodermically, or intratracheally than when swallowed. Any considerable amount of food in the stomach retards and minimises its effects when given *per orem*.

DIGITALIS.

FOXGLOVE. The leaves of *Digitalis purpurea*. Collected from wild British plants of the second year's growth when about two-thirds of the flowers are expanded, and carefully dried. (B.P.) *Nat. Ord.*—Scrophulariaceæ.

Digitalis grows wild in this country and in many parts of the Continent, on gravelly, sandy soils, in young plantations, on hedge sides, and hill pastures. Other species have probably the same properties as the *D. purpurea*, recognised by the B.P. It is herbaceous, biennial or perennial, with numerous drooping, purple-spotted, occasionally white flowers, an erect stem one to five feet high, and large alternate ovate-lanceolate, crenate, rugose leaves, downy, especially on their paler lower surfaces, and tapering into winged foot-stalks. The leaves, the officinal part of the plant, are gathered late in June or in July, before the small round grey-brown seeds begin to ripen, and when about two-thirds of the flowers are expanded. The leaves of the second year's growth are generally more active than those of the first. They are dried in baskets, in darkness, over stoves, and are then of a dull-green colour, with little smell, but a nauseous, bitter, slightly astringent taste. They should be used when fresh; twelve months' keeping greatly diminishes their activity. Both the roots and seeds are bitter, and probably active.

Digitalis yields several active principles :—

(1) **Digitalin**, or digitalinum, a bitter glucoside, insoluble in water, but readily soluble in alcohol. The four under-mentioned non-nitrogenous substances have also been isolated, but whether these are present in the plant, or are decomposition products of digitalin, has still to be determined. One or more of them are found in the commercial digitalin. Both pure and commercial digitalin are topical irritants and muscle poisons, and hence notable cardiac poisons.

(2) **Digitoxin** is a crystalline body, insoluble in water, but sparingly soluble in cold alcohol. It is the only one of the five which is not a glucoside.

(3) **Digitaleïn** is bitter and amorphous, and readily soluble both in water and alcohol. Digitoxin and digitaleïn act in the same manner as digitalin.

(4) **Digitonin** is freely soluble in water; resembles saponin, the active principle of quillaia, the Chili soap bark; is a powerful irritant, local anæsthetic, and muscular paralytant; and hence is in some degree antagonistic to digitalin, digitoxin, and digitaleïn.

(5) **Digitin** appears to be inert.

These five bodies, in variable proportion, are obtainable from the plant grown in different climates and circumstances, and also from different preparations, depending chiefly upon differences in their solubility in water and alcohol. The tincture contains the first three, and appears to be most suitable as a heart tonic, while the infusion, containing more digitoxin, is stated to be more active as a diuretic. They readily yield products of decomposition, especially when exposed to high temperatures, and several of these products are convulsants like picrotoxin.

ACTIONS AND USES.—*Digitalis* and digitalin are topical irritants and contractors of voluntary and involuntary muscles. Medicinal doses are vascular and cardiac stimulants and tonics, and are prescribed to increase the force and co-ordinating power of the heart, and relieve congestion of veins and capillaries. They are diuretic. Large doses are muscle poisons: they contract spasmodically and even tetanically the heart and other muscles, and kill usually by cardiac paralysis.

GENERAL ACTIONS.—Digitalis owes its action chiefly to digitalin, which, in contact with living tissues, is an irritant. Injected into the skin or trachea it irritates and inflames. Placed in the mouth, besides a sensation of bitterness, it causes salivation and redness. Introduced into the stomach and bowels, it induces irritation and nausea; in carnivora, vomiting, colic pains, and diarrhoea. It is absorbed slowly, and **contracts muscular fibre, notably of the heart and arterioles.** Properly regulated doses strengthen and prolong the cardiac diastole, both auricles and ventricles are more fully dilated, systole is more vigorous, and consequently the heart is more perfectly emptied. The muscular fibres of the arterioles have their tonicity increased. Blood-pressure accordingly is raised. Such doses, while increasing the volume of the pulse, diminish the heart-beat of healthy horses three to five beats, and of dogs ten to fifteen beats per minute, and these effects last from six to twelve hours. The action on the heart is more notable on the dog and sheep than on the horse and ass.

The action on the circulation is divided by Schmiedeberg into the following four stages, and this division has been adopted by Dr Lauder Brunton:—

(1) Medicinal doses cause a fuller stream of blood to be thrown into the circulation, blood-pressure rises, the pulse is usually slowed, but increased in volume. These effects, depending chiefly on contraction of muscular fibre, are intensified by stimulation of the vagus roots in the medulla, and of the nerve-endings in the heart itself.

(2) Continued rise of blood-pressure. The pulse, previously slowed from stimulation of the vagus roots and cardiac nerve-endings, owing to paralysis of the vagus endings, now becomes quickened.

(3) Larger or more frequently repeated doses increase or maintain the high pressure, and gradually cause direct cardiac paralysis, inducing irregularity of the heart action and pulse rate.

(4) Still larger doses produce rapid fall of blood-pressure, sudden stoppage of the heart, and death. The heart usually stops before the respiration.

Neither digitalis nor digitalin has any direct action on the brain or spinal cord, nor any marked effect on sensory or

motor nerves. They temporarily quicken, and more notably and permanently slow, respiration. By increasing general blood-pressure, a fuller stream of blood passes through the kidneys, the renal as well as other arterioles are strengthened and contracted, and thus **diuresis** is tardily produced, usually with increase of the urinary solids. No direct irritation of the kidneys occurs; but large doses, dilating arterioles, diminish renal excretion, and, the drug consequently being longer retained, its general effects are intensified, and its so-called **cumulative action** developed.

The following **drugs resemble** digitalis, and, like it, most of them contain an active glucoside:—

Liliaceæ. . . Urginea Scilla. Squills. Contains the active neutral body Scillain.
Convallaria majalis. Lily of the Valley.
Convallamarin.

Ranunculaceæ. Helleborus niger. Helleborein.
Adonis vernalis. Adonidin.

Leguminosæ. . Erythrophlœum guinense, which yields the African poison casa, or doom. Erythrophlœin.

Apocynaceæ. . Stropanthus hispidus, and the variety S. Kombé.
Nerium oleander. Nereïn.
Apocynum cannabinum. Canadian hemp.
Apocynin.
Thevetia neriefolia.
Tanghinia veneniflua.

Artocarpaceæ. Aretia toxicaria. Antiarin.

Toxic Actions.—The toxic dose of the powdered leaves is thus stated by Kaufmann:—For horses, six to eight drachms; for dogs, one to two drachms; for cats, thirty grains. The toxic dose of amorphous digitalin for horses is one and a half grains; for dogs, one quarter grain.

A horse was poisoned in twelve hours by two ounces of dried powdered leaves (Moiroud). One ounce, and in some cases six drachms, given to horses in bolus, caused, in three to ten hours; loss of appetite, frequent urination, fluid fæces, sometimes tinged with blood, a pulse at first full and increased,

but afterwards small, slow, and irregular, contraction of the pupil, difficulty of breathing, languor, and, after twelve or sixteen hours, death (Hertwig). Messrs Bouley and Reynal, administering large doses to horses, observed quickened circulation, abrupt and energised heart-beats characterised by a vibratory thrill, and subsequently by a bellows murmur, with intermittence, the pulse, as death approached, numbering 120 to 140. Smaller doses, after slight acceleration, lowered pulsations 20 or 25 beats per minute, and rendered the several cardiac sounds particularly distinct.

The following cases, in which I gave full medicinal doses of digitalis to healthy horses, illustrate its effects on the heart, its nauseating action, and its irritation of the digestive organs.

In February 1856, powdered digitalis was given to three horses in good health, and receiving daily 12 lbs. hay, 5 lbs. oats, and 5½ lbs. bran. On the 20th they each received a drachm of the powder at 12 noon, and another drachm at 6 P.M.; on the 21st and 22nd one drachm at 6 A.M., at 12 noon, and 6 P.M.; and on the 23rd a drachm at 6 A.M.—in all, nine doses of a drachm each in three days.

No. 1. Brown Mare, 3 years old:—

Feb. 20,	12 noon,	pulse 38,	respirations 8.
" 21,	" "	" 34,	" 6.
" 22,	" "	" 28,	" 7.
" 23,	" "	" 28,	" 7.

On the evening of the 22nd she became dull and refused her feed. 23rd, 10 A.M., still dull, without appetite, pupil contracted, passing wind, with small quantities of fluid fæces. 4.30 P.M., pulse 32, more distinct than at noon, pupil considerably contracted, rather less dullness. On the 25th, two days after the medicine was withdrawn, the mare was eating and perfectly well again.

No. 2. Bay Gelding, 3 years old:—

Feb. 20,	12 noon,	pulse 36,	respirations 7.
" 21,	" "	" 36,	" 8.
" 22,	" "	" 30,	" 6.
" 23,	" "	" 32,	" 6.

23rd, 12 noon.—Pulse, both yesterday and to-day, slightly irregular; no appetite, very dull and stupid, with the pupil somewhat contracted. 4.30 P.M., pulse 34, tolerably firm, but unequal; eating a little, and scarcely so dull. No more digitalis being given, the animal recovered its appetite, and by the 26th was well again.

No. 3. Brown Mare, 3 years old:—

Feb. 20,	12 noon,	pulse 38,	respirations 8.
" 21,	" "	" 33,	" 7.
" 22,	" "	" 34,	" 7½.
" 23,	" "	" 120,	" 20.
" 24,	" "	" 120,	" 25.

Towards the evening of the 22nd the mare became dull and would not feed. 23rd, 10 A.M., very much nauseated; nose, mouth, and ears cold; abdomen tympanitic, with colicky pains, and occasional pawing; pupil

somewhat contracted; pulse firm at axilla and heart, but not very perceptible at jaw. Had four drachms of carbonate of ammonia and clysters occasionally, the stimulant being repeated at two o'clock and four. At 4.30 P.M. she was down, much pained, attempting to roll; pulse 82, but unequal. 24th, 12 noon, pulse, imperceptible at jaw, about 120; respirations 25, and very much laboured; lips retracted and saliva dripping from the mouth; enormous abdominal tympanitis and much pain; rapid sinking; died on 25th, at 11 A.M.

Post-mortem examination made next morning at 9.30. Voluntary muscles unusually pale; spots of ecchymosis found in the areolar textures, between the muscular fibres, and in places underneath the skin. Lungs and pleuræ healthy; anterior extremity of lungs contained more blood than posterior; venæ cavæ contained the usual amount of dark non-coagulated blood; bronchial tubes inflamed for about six inches along their anterior ends; windpipe inflamed half-way up the neck, and containing flakes of greenish pus mixed with mucus; no froth here or in bronchi. Heart pale, friable, containing a small clot of blood in its left ventricle, and about five ounces of non-coagulated blood in the right ventricle. A rent of eight inches long was found in the inferior curvature of the stomach, through which food had passed into the omentum; the mucous membrane of the stomach was quite healthy; the organ itself very large, but collapsed, in consequence of the rupture; the intestines were pale and flaccid, and contained enormous quantities of food and gas, but their mucous membrane was quite healthy. The kidneys and generative organs, with the brain and spinal cord, were perfectly healthy.

Dogs receiving one or two drachms were nauseated, and, when vomiting was prevented, moaned and exhibited abdominal pain, green-coloured fluid dejections were passed, the pulse was feeble and indistinct, breathing irregular and distressed, spasmodic efforts were made to empty the bladder, muscular debility preceded death (Tabourin). **Figs** poisoned by decoction of the leaves are reported to be languid, attempt to vomit, strain, and pass small quantities of fæces; whilst after death the mucous coat of the stomach and small intestines is inflamed, the kidneys slightly congested, the bladder empty (*Veterinarian*, March 1872). In poisoning with large doses the power of the muscles to lift weight is diminished, and their tetanic contractions persist until post-mortem decomposition sets in.

MEDICINAL USES.—Dr. Ringer believes that digitalis exerts its curative effects in one or more of the following ways—first, by strengthening the action of the heart; second, by reducing the strength of the beats of a heart acting too powerfully; third, by lessening the frequency of the heart-beats; fourth, by correcting irregular action of the heart (*Handbook of Therapeutics*).

When the heart is enfeebled or acting irregularly, as in

horses suffering from influenza or other exhausting disease, in cattle convalescing from pleuro-pneumonia or rheumatic fever, in dogs debilitated by distemper or over-work, digitalis **imparts co-ordination and expulsive power to the heart**, and tone to relaxed capillaries, rendering the quick, weak, irregular pulse-beat slower, stronger, and steadier. Difficulty of breathing and dropsical effusion resulting from imperfect action of the heart are usually relieved, and general as well as cardiac nutrition is improved. In such cases digitalis is usefully conjoined with potassium chlorate or nitrate, or with alcohol, ether, or ferric-chloride. **Palpitation** in horses, resulting from unwonted over-exertion, or from fast work performed shortly after a full meal, occasionally persists for several days; the violent, irritable impulse of the heart, accompanied by lifting of the flanks, comes in paroxysms; repeated doses usually control such inordinate, tumultuous functional disturbance. In the more violent of these cases Professor Robertson conjoined with the digitalis small doses of aconite, and in other cases prescribed it with belladonna. In **dilatation** of the heart, with insufficiency of the mitral valves, carefully regulated doses of digitalis abate the dyspnoea, cold extremities, venous pulse, and œdema. In **dilatation or hypertrophy** of the left ventricle—common in hard-worked, aged horses—even when accompanied by a slight amount of valvular disease, the full, strong, intermittent pulse is usually moderated, its unduly forcible impulse quieted, and the breathing relieved by digitalis. In such cases of hypertrophy, when the pulse is full and strong, one or two small doses of aconite may first be tried.

In pericarditis, after the more acute symptoms have been subdued by salines, digitalis frequently lessens the embarrassed breathing and the friction sound. In endocarditis, occurring occasionally in cattle, it renders the heart-beat more regular, and gives more fulness to the small thready pulse. Quieting and regulating cardiac action, and contracting arterioles, it is recommended in **hæmorrhages**, especially from the lungs and stomach.

In pneumonia, especially in the second stages, and in horses, digitalis frequently relieves engorgement, probably by propelling blood in fuller stream into the abdominal and other vessels.

Promoting circulation, it moreover aids arterialising of blood, and hence is also useful in congestion and purpura. It is a frequent constituent of **cough mixtures**.

Professor Dick's recipe for thick and broken wind consists of thirty grains each of calomel, digitalis, opium, and camphor, and its efficacy in great part depends upon the calomel regulating the bowels, while the other three drugs abate the cardiac irritability so notable in such cases. Where the medicine was to be persisted with daily for a week, or longer, the professor advised omission of the calomel.

Digitalis relieves many cases of **dropsy** by regulating faulty heart-action, stimulating dilated capillaries, as well as by inducing diuresis. In pleuritic effusions Professor Robertson gave horses digitalis, grs. xx. to grs. xxx.; potassium nitrate, ℥ij.; powdered cantharides, grs. iv. to grs. x., made into bolus, and repeated twice daily for a week. Diuresis is determined by prescribing digitalis with salines—a combination often useful in the several conditions of cardiac dropsy. Applied locally, it contracts the small arteries (Dr Fothergill).

The chief **indications for the use** of digitalis are an enfeebled, irritable, jerking, or irregular action of the heart, deficient arterial pressure, venous engorgement, and scanty secretion of urine. It is more suitable for chronic than acute cases, for combating functional rather than organic mischief. As with other tonics, it is best tolerated in those weak and irritable states of the heart in which it is most serviceable. It is of little use in difficulty of breathing or dropsical conditions chiefly dependent on lung disease. It does harm in aortic disease or in hypertrophy, where the pulse continues strong, firm, and regular; or in enfeebled circulation dependent on advanced fatty degeneration. Nausea or irritability of the digestive organs, coldness of the extremities, unwonted force of the pulse-beats, indicate that the medicine should be stopped, or given in reduced amount. The effects of **over-doses are combated** by alcohol or other stimulants, and by keeping the patient perfectly quiet.

DOSES, &c.—Of the powdered leaves, horses take grs. x. to grs. xxx.; cattle, ℥ss. to ℥j.; sheep and pigs, grs. v. to grs. x.; dogs, grs. i. to grs. iv. But the drug is not very soluble or

readily absorbed, and being moreover an in-contact irritant, should be used in a fluid form. The **infusion** is made by digesting for fifteen minutes one part dried leaves with 156 fluid parts of distilled water. The **tincture** is made by maceration and subsequent percolation of $2\frac{1}{2}$ ounces dried leaves with one pint proof spirit (B.P.) It contains $54\frac{1}{2}$ grains to the fluid ounce, is about twenty times the strength of the infusion, and is the most suitable preparation for cardiac cases. Horses and cattle take ℥iij. to ℥iv.; sheep, ℥ss. to ℥j.; dogs, ℥ij. to ℥x. The **fluid extract** used in the United States is nearly ten times the strength of the B.P. tincture.

Commercial **digitalin** is upwards of 500 times the strength of the tincture, the dose for the horse being gr. ss. to gr. j. The several preparations are administered *per orem*. Even when diluted they are apt to irritate if given hypodermically or intratracheally. They are not always of uniform strength; this depends upon the varying activity of the plants grown under different conditions, prolonged keeping, variations in the method of preparation, and differing proportions of the active constituents. It is hence desirable, when using unfamiliar specimens of the drug, or of its preparations, to begin with moderate doses, and narrowly watch their effects.

ERGOT OF RYE.

ERGOTA. Spurred or Horned Rye. *Secale cornutum*. Ergot.

The sclerotium of *Claviceps purpurea*, produced between the pales and replacing the grain of *Secale cereale*, the common rye. (B.P.) *Nat. Ord.*—Graminaceæ.

Ergot attacks not only rye, but the other Graminaceæ, the Cyperaceæ, and palms. The earliest symptoms occur about the time of blooming, when the ears of the rye exhibit drops of yellow, sweet, fungous slime, called honey-dew, which attracts ants and beetles, and which after a few days dries up. The soft ovaries of the grains attacked are meanwhile covered and filled by white, spongy, felted-together cells—the mycelium of the *Claviceps purpurea*. The grain is disintegrated; at its base the mycelium cells separate, swell, solidify, and form a compact dark violet body, which, as it grows in a curved, horn-

like shape, protrudes from the pales, and constitutes the ergot. The further history of this biennial fungus, investigated by Tulasne, shows that it reaches its fully-developed sclerotium or ergot state in July; it should be gathered in August or September, before any putrefaction appears; it usually remains in a quiescent state during winter; on moist mould, in March or April, it produces fruit heads of the perfect fungus, the *Claviceps purpurea*, which, after a few weeks, is again ready to distribute its earlier spores. Close, damp weather and un-drained soils favour development and distribution of these ergot spores as of other fungi. The injury done to the rye crop by ergot varies much; sometimes only a few grains in each head are diseased, sometimes scarcely one is altogether sound; five to ten on an average are affected. It abounds both in grain and grasses in various parts of the United States of America, where it is stated that as much as 1 lb. has been got from 100 lbs. of hay. It should be collected before the plants are cut.

PROPERTIES.—Ergot of rye is cylindrical, curved, resembling a horn or a cock's spur; it varies in length from one-third of an inch to an inch and a half, and in breadth from one to four lines; is marked by a longitudinal furrow on its concave side; is obtuse at its ends; has at its apex a pale grey fragile excrescence, the shrivelled remains of the style, and is covered by the grey, powdery conidia or spores. It is dark violet-coloured externally and greyish-yellow within. Its odour is dull and musty; its taste, at first sweet, becomes bitter and slightly acrid. When dry it is inflammable, hard, and brittle; when moist, or long exposed, it becomes soft, darker in colour, and covered with acari. Its structure is made up of felted thread-like cells, amidst which lie drops of oil. Infused in boiling water, it forms a claret-coloured solution, retaining the odour, taste, and actions of ergot.

Ergot consists of about thirty per cent. of a non-drying fixed oil, which has no special action; a peculiar sugar termed mycose; lactic, acetic, and formic acids; colouring matters; and, according to Kobert, of Strasburg, three active principles—an alkaloid, **cornutine**, and **sphacelinic and ergotinic acids** (*Practitioner*, vol. xxxiii. p. 429). Another base, ergotinine, has been described; but is inert. Amine and ammonia bases are

formed normally, and are also produced by decomposition. **Ergotin** is a red-brown watery extract, containing, as prepared by different makers, variable proportions of the active principles.

ACTIONS AND USES.—Ergot, cornutine, and sphacelinic acid stimulate and contract involuntary muscular fibre, and hence diminish the blood-stream passing through the arterioles. Large or continued doses thus produce ergotism. Medicinal doses are given to contract the uterus, and also the blood-vessels in cases of hæmorrhage.

GENERAL ACTIONS.—The physiological effects of the three active principles of ergot are thus described by Dr Lauder Brunton :—

Cornutine causes spastic rigidity in frogs, lasting many days, even when given in very minute doses ($\frac{1}{32}$ of a milligramme). In warm-blooded animals half a milligramme causes salivation, vomiting, diarrhœa, and active movements of the uterus, which are clonic and not tonic. The vessels are contracted and blood-pressure raised.

Sphacelinic acid causes at first great spasmodic contraction of the blood-vessels, with rise of blood-pressure, and subsequently gangrene. The heart is unaffected. Tetanus of the uterus is produced. Cornutine and sphacelinic acid are evidently the principles which cause uterine contraction (Kobert).

Ergotinic acid causes ascending paralysis of the spinal cord and brain both in frogs and mammals, with loss of voluntary motion, paralysis of the vaso-motor centre, and fall of blood-pressure, while respiration and reflex irritability continue. It does not appear to have the power of increasing uterine contractions, and hence cannot be regarded as the most important constituent of ergot (*Pharmacology*).

Ergotin, Bonjean's ergotin, or any well-prepared fresh extract, injected into animals, causes inco-ordination, cutaneous anæmia, anæsthesia, and paralysis, and in large doses death, due to **paralysis of respiration**. The voluntary muscles are unaffected; the motor nerves are not paralysed, but, on the contrary, have their power somewhat increased; the sensory nerves are paralysed; but it is uncertain whether this action is central or peripheral. The spinal cord is paralysed (Brunton). The action of the heart is weakened; the pulse-rate slowed.

Blood-pressure is first lowered and then raised. Respiration in dogs is first quickened, but in most animals it is slowed from the beginning. **All unstriped muscular fibre is contracted**; the calibre of blood-vessels is hence diminished, as may be readily seen in the web of the frog's foot; the iris is contracted; intestinal peristalsis is increased; the urinary bladder is emptied, and the contents of the pregnant uterus expelled. The contractions of the uterus are continuous and tetanic, are usually produced in fifteen or twenty minutes, and last about an hour. They result mainly from general contraction of unstriped muscular fibre, but are also believed to be in part determined by stimulation of the uterine centre in the spinal cord (p. 121).

Ergot, given experimentally in large or continued doses, or the protracted use of ergotted grain, causes **ergotism**, which is characterised by gastro-intestinal derangement, nausea, diarrhoea and vomiting in animals capable of emesis, and from the impaired circulation and nutrition affecting different areas, subsequently assumes two forms—(1) dry gangrene, chiefly involving the extremities, ears, and tail; or (2) inco-ordinate spasms, and sometimes epileptiform convulsions. This latter form is believed to result from irritation and paralysis of the sensory centres of the spinal cord.

Ergot **resembles** *Ustilago* or corn-smut—a fungus occurring on Indian corn (*Zea Mays*), recognised by the U.S.A. Phar., and probably containing the same active principles as ergot. Savin and thuja also cause uterine contractions. Digitalis and its analogues contract the involuntary fibres of arterioles. The physiological **antagonists** of ergot are ethers and amyl-nitrite.

Toxic Effects are not so marked on horses, cattle, sheep, and rabbits as on men and dogs. Thirty **cows** amongst them took daily with impunity 37 lbs. for three months; two milk cows had between them 9 lbs. daily, with no further evil effect than that the butter was badly tasted. Twenty **sheep** amongst them ate daily for four weeks 9 lbs. without injury (Phœbus and Pereira). **Dogs** receiving six to twelve drachms suffered from vomiting, tenesmus, prostration of muscular power, enfeebled pulse, convulsive twitchings, spasms, and coma (Tabourin). Three ounces proved fatal to a terrier bitch in twenty hours.

Chronic poisoning occurs especially in patients placed in unfavourable sanitary surroundings. Dr Samuel Wright (*Edinburgh Medical and Surgical Journal*, vols. lii., liii., and liv.) found that ergot, given for several weeks to dogs and rabbits, caused nausea, impaired appetite, a weak, irregular pulse, soon becoming intermittent, diarrhoea, excessive fœtor of the secretions and excretions, paralysis, particularly of the hind extremities, enlargement of the liver, contraction of the spleen, formation of tubercles both in the lungs and mesentery, impairment of the special senses, wasting, and general debility. Gangrene of the extremities is not, however, produced so readily as in man. Dogs, cats, and rabbits showed great aversion to it, even when it was mixed with sound grain, or considerably diluted with water; and, although pressed by hunger, would scarcely eat it of their own accord. Ergot of maize, according to Roulin (*Gamgee's Veterinarian's Vade Mecum*), is common in Columbia, and its continued use is stated to cause shedding of the hair, and even of the teeth, both of man and beast. Mules freely fed on it lose their hoofs, and fowls lay eggs without shells. Poultry restricted to ergotted grain have their combs, tongue, and bill mummified by dry gangrene.

Abortion from eating ergotted grasses occurs amongst cows, ewes, and deer in many grass districts of England and Ireland, especially in wet seasons. The hay from pastures subject to ergot is seldom, however, so injurious as the grass, for it is generally cut before the fungus is matured. Cows abort from this cause more frequently than ewes or deer; for they are more prone to eat the coarser, longer ergotted grasses, and, moreover, are often pregnant in the later months of summer, when ergot occurs. Experimentally, abortion has been produced in guinea-pigs, sows, bitches, cats, cows, and ewes, rabbits, and poultry (Stillé, *Therapeutics*). Youatt declared that he had never known ergot fail in its action on the pregnant uterus either of monogastrics or ruminants. The negative results obtained by some experimenters are doubtless explained by their having used specimens of the drug or its preparations which have been spoilt, frequently by long keeping.

MEDICINAL USES.—As a **parturient**, ergot is seldom needed in the lower animals. The offspring, coming naturally at the

full period, if assistance is requisite, are generally got hold of with the hands or forceps, and brought away with judicious traction. When useful, it is in cases where there is uterine inertia, where the throes are languid and occurring at long intervals, where the animal has been in labour for some considerable time, where no obstruction is present, and where the os uteri is considerably dilated. It is unsuitable where there is malformation either of the mother or foetus, where the position of the foetus prevents its ready expulsion, and sometimes also in first pregnancies, where the uterus, roused to the continuous tetanic contractions, is more liable to be injured or torn. After parturition, if the **uterus** remains **flaccid**, and especially if **hæmorrhage** occurs, as occasionally happens both in cows and ewes, ergot effectually contracts the organ, and thus arrests bleeding. In such cases it may be given by the mouth, or, where prompt effects are sought, ergotin is injected into the substance of a muscle. It is sometimes prescribed to remove uterine cysts and hasten expulsion of the placenta, which in the lower animals may usually, however, be readily removed by the hand. Given either by the mouth or injection, it is useful in all animals in hæmoptysis, and sometimes in hæmatemesis, and other hæmorrhages. It is of no avail in purpura. Professor Robertson recommended it in cerebrospinal meningitis in horses; and several practitioners have tried it, but without much success, in parturient apoplexy in cows. The reduction of aneurismal sacs and of fibroid and other tumours has sometimes been effected by injecting them with ergot.

Doses, &c.—Ergot as an ecbolic for the mare or cow, ℥ss. to ℥i.; for sheep, about ℥i.; for swine and bitches, ℥ss. to ℥i., repeated at intervals of half an hour or an hour. The decoction, swallowed, dregs and all, is the most economical and convenient preparation for veterinary practice. **Ergotin** is prescribed for horses or cattle in doses of grs. xv. to grs. xxv.; for dogs in grs. i. to grs. iv. For injection the smaller doses should first be tried, and on account of their irritant effects should be injected intramuscularly.

ETHER.

ÆTHER. Sulphuric Ether. A volatile liquid, prepared from alcohol, and containing not less than 92 per cent. by volume of pure ether. $(C_2H_5)_2O$. (B.P.)

Ether is prepared by heating in a glass flask, connected with a Liebig's condenser, one part of sulphuric acid and five of rectified spirit, which is added gradually. In this process sulphethylic or sulphovinic acid is formed $(HC_2H_5SO_4)$, which, with continuance of heat and in presence of more alcohol, is decomposed into ether and sulphuric acid. The crude ether which distils over is purified by agitation with calcium chloride and quicklime, and redistilling.

Every alcohol, by substitution of an alcohol radicle for the H. in the hydroxyl (HO), forms a corresponding ether. Thus, methyl-alcohol (CH_3OH) yields $CH_3.O.CH_3$, which, being considerably cheaper than ethyl-ether, is sometimes substituted for it.

The B.P. ether contains about eight per cent. of alcohol and water; is a colourless, very volatile, inflammable liquid, with a peculiar ethereal odour. Its specific gravity is .735. It boils at 105° Fahr.; yields a vapour two and a half times heavier than air, but half that of chloroform; is miscible with alcohol in all proportions, and is soluble in ten volumes of water. It readily dissolves fats, volatile oils, balsams, resins, and, next after chloroform, is the best solvent for alkaloids.

Absolute or pure ether, free from alcohol and water, is prepared by washing the commercial ether with water, and distilling from calcium chloride and recently calcined lime. Its specific gravity is .720; it boils at 95° Fahr.; remains liquid at -146° Fahr.; but below that solidifies in shining plates.

ACTIONS AND USES.—Ether is an active member of the alcohol series. It is exceedingly volatile. Applied externally it is irritant, refrigerant, and local anæsthetic. It is quickly absorbed; acts specially on the central nervous system and on nerve centres and nerves generally; primarily, and in small doses, stimulating; secondarily, and in larger doses, paralysing,

and when inhaled producing anæsthesia. Poisonous doses almost immediately cause inebriant narcosis, and kill by paralysis of respiration. It is prescribed as a general stimulant, carminative, and antispasmodic, and is also expectorant, diaphoretic, diuretic, antiseptic, and parasiticide. Next to chloroform it is the most generally used anæsthetic. It is a solvent for fats, oils, alkaloids, &c.

GENERAL ACTIONS.—Applied to the skin, ether evaporates and **abstracts heat**. If evaporation is prevented, redness, irritation, and even desquamation occur. Continued or repeated application produces **local anæsthesia**, which, if maintained too long, the frozen part may be killed, and a slough formed. Swallowed in medicinal doses, it **stimulates** the mucous surfaces of the mouth and alimentary canal, increasing secretions and movements, and hence developing sialogogue, carminative, and antispasmodic actions. But full doses, especially if undiluted, when swallowed are so rapidly vaporised and so irritant that they cause gastro-intestinal distension and nausea, occasionally with vomiting in carnivora, and in dogs and rabbits have produced rupture of the stomach. It is quickly absorbed from the stomach and intestines, and still more so when introduced as vapour into the lungs, and promptly acts upon the **central nervous system**, nerve centres, and nerve endings. Small doses stimulate; larger doses, after brief stimulation, paralyse and anæsthesise the centres, first of the brain, next those of the spinal cord, and eventually those of the medulla, killing by respiratory arrest. The glycogenic functions of the liver are stimulated, rendering the animal temporarily diabetic. It is removed by all the secreting channels, stimulating them, and hence exerting expectorant, diaphoretic, and diuretic actions.

General anæsthesia cannot be safely induced by administration of ether by the mouth, rectum, or hypodermically, but is produced in any of the domestic animals by its inhalation in tolerably concentrated form in from three to ten minutes. Cats are anæsthesised more quickly than dogs or horses, which are generally made insensible in eight or ten minutes. A donkey is stated to have been fully affected in four minutes, another in five minutes, and a third in three minutes and a half, the last remaining insensible to pain for about half an

hour (*Veterinarian*, 1847). The effects may be safely maintained for half an hour or longer.

Compared with chloroform, ether has the disadvantage of having a more disagreeable taste. As it has to be given in more concentrated state, it is also more irritable. Larger doses have to be used. Its vapour is dangerously inflammable. On account of its extreme volatility it cannot be used in hot climates. It is, however, less liable to paralyse the heart or vaso-motor centre. Ether and chloroform may be used together (p. 65), or the anæsthesia produced by chloroform may be maintained by ether. But the Hyderabad experiments showed that respiration and heart action are more quickly arrested when ether is first given, and anæsthesia subsequently carried on by chloroform, than when chloroform alone is used. Ether is preferable when heart action is feeble, when the anæsthesia has to be kept up for a considerable period, when operations likely to be attended with collapse are undertaken in pregnant animals, and in dogs, which, according to some authorities, are specially liable to cardiac failure during chloroform anæsthesia.

Ether **resembles** most of the bodies of the alcohol series. Like alcohol, it has a twofold stimulant and paralyzant action; but it acts more promptly, its effects pass away more quickly, and, in virtue of its volatility, it is markedly anæsthetic. It stimulates more powerfully than ethyl-acetate or spirit of nitrous ether, neither of which are used as anæsthetics. Its stimulant properties ally it to oil of turpentine and the other volatile oils.

MEDICINAL USES.—Ether, diluted with a little spirit and water, is a prompt and effectual **carminative** in indigestion in all animals. It checks undue gastric fermentation, expels flatulence, and overcomes irregular, violent gastro-intestinal movements (p. 62). In colic in horses this **antispasmodic** effect is frequently aided by conjoining the stimulant with such anodynes as opium, Indian hemp, or belladonna. Horses with sleepy staggers are frequently roused and the action of the bowels promoted by ether, hypodermically injected. It is sometimes given for the expulsion of intestinal worms, and especially of ascarides, which, when in the rectum, are readily

dislodged by enemata of diluted ether. Such enemata also relieve spasmodic affections of the intestines.

As a prompt and powerful **diffusible stimulant** ether is useful in collapse, whether caused by shock, hæmorrhage, or exhausting disease. Along with alcohol, it is used in puerperal apoplexy in cows, and in such cases, when the patient is unable to swallow, it is advantageously given hypodermically. Chills and shiverings, which usher in many attacks of disease, are sometimes checked by a dose or two of ether. It equalises irregular circulation, restores imperfect action of the skin and kidneys, and gives tone to the enfeebled heart. Hard-worked horses, especially in towns, prostrated by catarrhal fever, are thus benefited, even from the outset of the attack, by ether, given with alcohol and salines. In convalescence from inflammatory and exhausting diseases in all classes of patients, conjoined frequently with aromatics and bitters, it improves the appetite, strengthens the feeble pulse, and sometimes allays cough.

As a stimulant it may be safely persisted with wherever it reduces the number and increases the strength of the pulse, lowers excessive temperature, and promotes secretion. It should be avoided where there is much vascular excitement and inflammatory fever.

As an anæsthetic it is used for the same purposes as chloroform, and is administered in the same manner and with similar precautions (pp. 62, 366).

Local anæsthesia is usually induced by applying the ether from a spray producer. For such purposes the ether must be tolerably pure, for water, if present, gets frozen and blocks the instrument. About an ounce usually suffices for the painless opening of abscesses and fistulæ, or for neurotomy or tenotomy. The effects, however, are more superficial and transient than those of cocaine, and are more apt to be followed by irritation and reaction, which retard healing of surgical or other wounds. A minor degree of local anæsthesia sometimes allays neuralgic pains and those of toothache and earache.

DOSES, &c.—The B.P. ethyl-ether, containing eight per cent. of alcohol and water, is generally used for medicinal and pharmaceutic purposes; but good methyl-ether, on account

of its cheapness, is sometimes substituted. **As a stimulant** horses take fʒi. to fʒii.; cattle, fʒii. to fʒiii.; sheep and pigs, fʒii. to fʒiv.; dogs, fʒss. to fʒi. It is administered in cold water or diluted spirit, is sometimes sweetened with sugar or treacle, or flavoured with aromatics. Combination with opium, Indian hemp, or belladonna, increases its antispasmodic and anodyne effects. Where immediate results are required, as in violent attacks of colic, or in collapse, it is administered hypodermically.

As an anæsthetic, ether made from ethyl-alcohol is generally preferred. The larger animals take fʒiii. to fʒviii.; the lesser, fʒiv. to fʒi.

SPIRIT OF ETHER, or spiritus ætheris, is a mixture of one part ether and two rectified spirit, and is used as a stimulant and antispasmodic.

ETHEREAL OIL, oleum ætherum, or oil of wine, is an oily, yellow, neutral liquid, with a bitter taste and aromatic odour, soluble in ether and alcohol, produced towards the close of the distillation of ether, containing ether mixed with various hydrocarbons, and possessed of anodyne and hypnotic properties.

SPIRITUS ÆTHERIS COMPOSITUS, or Hoffman's anodyne, consists of oil of wine, 3 parts; ether, 64; rectified spirit, 128.

ACETIC ETHER, or ethyl-acetate ($C_2H_5.C_2H_3O_2$), is prepared by distilling rectified spirit with sodium acetate and sulphuric acid. It is a transparent, colourless, neutral liquid, of an ethereal, acetous odour and taste. Its actions nearly resemble those of ether. It is used as a stimulant, carminative, and antispasmodic, but is unsuitable as an anæsthetic.

COLLODION is prepared by mixing one part of gun-cotton with 36 of ether and 12 of rectified spirit. The solution, preserved in well-corked bottles, is clear, colourless, inflammable, evolves a strong ethereal odour, and, on exposure to the air, dries rapidly, leaving a thin transparent film, insoluble in water or spirit. It is hence a useful substitute for sticking plaster; repeated applications are laid on with a fine brush at intervals of a few minutes, and produce a protective covering, holding together the edges of slight wounds. The **flexible collodion** adheres still more firmly, gives support without splitting or cracking; is made by mixing 48 parts of collodion, 2 parts

Canada balsam, and 1 part castor oil, and is kept in well-corked bottles. **A styptic, antiseptic protective** is made by thoroughly mixing with 100 parts of collodion 5 parts each of carbolic, tannic, and benzoic acids. As a stimulating antiseptic protective for abraded skin or mucous surfaces, and notably for sore teats in cows and ewes, 100 parts of collodion are mixed with 2 of glycerine and 1 of carbolic acid. Collodion is occasionally used for coating boluses, but it is now greatly more important in photography than in pharmacy or surgery.

EUCALYPTUS.

OLEUM EUCALYPTUS. The oil distilled from the fresh leaves of *Eucalyptus Globulus*, *E. amygdalina*, and probably other species of *Eucalyptus*, or blue gum-trees. $C_{12}H_{20}O$. (B.P.)
Nat. Ord.—Myrtaceæ.

The leaves and flower-buds of various Myrtaceæ, such as cloves, pimenta, myrtle, and cajeput, as well as eucalyptus, yield when distilled aromatic, antiseptic, volatile oils. The rapidly-growing eucalyptus trees, indigenous to the Australian colonies, are now largely cultivated in many temperate regions with the view of preventing malarial fevers.

The dried leaves yield 5 to 7 per cent. of eucalyptol, a colourless or pale straw-coloured liquid volatile oil, darkening by exposure, of an aromatic odour and spicy, pungent taste, and soluble in about its own weight of alcohol. Its antiseptic powers increase as it undergoes oxidation by keeping.

ACTIONS AND USES.—The oil possesses in marked degree the **group characters of volatile oils** (p. 243). When freely used in concentrated form it is an in-contact irritant. It is antiseptic and disinfectant, destroying the lower forms of animal life. Locally applied it impairs sensibility. It is readily absorbed, increasing cardiac action, and is hence a stimulant and antispasmodic; and as it passes out of the body it increases the activity of the excreting channels, chiefly the respiratory mucous membrane and the kidneys. Its antiseptic properties confer some anti-malarial action; but it cannot, as has been suggested, take the place of the cinchona alkaloids.

It is used as a stimulant and antiseptic gargle and inhala-

tion to diminish excessive quantity and fœtor of nasal, pharyngeal, and bronchial secretions. It is administered in protracted cases of strangles, influenza, and purpura in horses, septicæmia in all animals, and in distemper in dogs—in such cases being usefully combined with quinine, ethers, and alcohol. Arloing and Thomas state that solutions containing one eight-hundredth part destroy the virus of symptomatic anthrax. In surgical cases it is sometimes substituted for carbolic acid. In fœtid uterine discharges, eucalyptol injections or pessaries are useful.

DOSES, &c.—Horses and cattle take fʒi. to fʒiv.; dogs, ℥ii. to ℥x., dissolved in diluted spirits, mucilage, or milk. For external purposes it is dissolved in oil or cocoa butter, and is often usefully conjoined with iodoform.

EUPHORBIIUM.

An acrid resin obtained from *Euphorbia resinifera* (Berg.)
Nat. Ord.—Euphorbiacæ.

The Euphorbiacæ include the shrubs yielding croton and castor oil, the Brazilian tree producing danda or assu juice, and cascarilla bark. The cactus-like plants yielding medicinal euphorbium grow in the kingdom of Morocco and in the region skirting the Atlas range. From incisions made into their angular, jointed, prickly stems and branches, an acrid, milky, resinous juice exudes, and concretes in irregular, dull-yellow tears, which are gathered in September, are about the size of large peas, often hollow, and perforated with little holes. Euphorbium has an acrid, persistent taste, is without odour, but is so irritant that its minutest particle in contact with the nostrils provokes immediate violent sneezing. The powder is grey, and insoluble in water; but its active resinous principle dissolves in alcohol, ether, and oil of turpentine. When heated it melts, swells up, and burns with a pale flame and an agreeable odour. It contains 38 per cent. of an amorphous, **acrid resin** ($C_{20}H_{32}O_4$), 22 of the colourless, tasteless **euphorbon**, allied to lactucerin, a constituent of lettuce (Flückiger and Hanbury, *Pharmacographia*).

ACTIONS AND USES.—Euphorbium is an energetic irritant, vesicant, and pustulant. Introduced into the stomach or

areolar tissues, rubbed into the skin, or inhaled into the nostrils, it causes violent and sometimes fatal inflammation. Two ounces given internally caused fatal gastro-enteritis in a horse; four drachms retained in the stomach of a large dog had the like effect in twenty-six hours (Orfila). So intensely irritating is euphorbium, that the workmen employed in grinding it, although wearing masks or handkerchiefs over their faces, often suffer severely from headache, inflammation of the eyes, and sometimes even delirium.

It is occasionally added to blisters, but the ordinary ointments made with fatty matters are apt, especially in horses and dogs, to inflame the deeper layers of the skin, destroy the hair roots, and induce sloughing and blemishing. Kaufmann states that a tincture containing one part to sixteen of spirit may, however, be used as an energetic vesicant for horses without injuring the hair roots (*Traité de Thérapeutique*). Unlike cantharides, it has no tendency to act on the kidneys.

FERN ROOT.

The rhizome, with the persistent bases of the petioles of *Aspidium Filix-mas* (and of *A. marginale*, U.S.) Collected late in the autumn, divested of its scales, roots, and all dead portions, and carefully dried with a gentle heat. Should not be used if more than a year old. (B.P.) *Nat. Ord.* —Filices.

The male fern grows wild throughout most temperate regions, on the sides of roads and in open woods, especially where the soil is light. Its annual bipinnate fronds reach to the height of three feet; a section of their bases, examined by a pocket lens, discovers eight vascular bundles, whilst allied ferns contain only two (Flückiger). Its root stock is perennial, about a foot long and two inches thick; is scaly, tufted, greenish-brown, and firmly fixed in the ground by numerous black root fibres. The dried root has a disagreeable odour, and a sweet, astringent, nauseous taste. Besides the usual plant constituents, it contains about 4 per cent. of resin, 6 of a green fixed oil, a small amount of a volatile oil, with 8 per cent. of the crystalline **flicic acid** ($C_{14}H_{18}O_5$), which is its most irritant

constituent. The root is preserved in stoppered bottles, and the supply renewed annually. Deterioration from keeping, and the substitution of the roots of inactive ferns, in great part explain the depreciatory accounts sometimes given of its efficacy. The green parts are most active, and should alone be used.

ACTIONS AND USES.—Male shield fern is irritant, vermicide, laxative, and in large doses causes hæmorrhagic gastro-enteritis. It is one of the most effectual remedies for tape-worm, especially in dogs, and Kuckenmeister considers it quite as poisonous to the genus *Bothriocephalus*. Dr John Harley believes that, like ergot, it stimulates the involuntary muscular fibres of any hollow viscus in which it is placed, and thus explains the vomiting and intestinal peristalsis which full doses produce when swallowed, and the contractions induced when it is injected into the urinary bladder (Royle's *Materia Medica*). Professor Fröhner made various experiments with the ethereal extract. He poisoned a small dog with ℥xxx., a dog of 40 lbs. with fʒv., a sheep of 88 lbs. with fʒvi., a cow of 660 lbs. with about fʒiij.

DOSES, &c.—The powdered root is given to horses and cattle in doses of ʒiv. to ʒvi.; sheep, ʒj. to ʒiv.; dogs and cats, ʒi. to ʒii. But the powder is inconveniently bulky, and less certain than the ethereal or liquid extract, which the B.P. thus directs to be made: "Pack two pounds of the male fern in coarse powder closely in a percolator, and pass four pints or a sufficiency of ether slowly through it until it passes colourless. Let the ether evaporate on a water-bath, or recover it by distillation, and preserve the oily extract." These quantities yield three ounces of extract, of which the dose for horses or cattle is fʒij. to fʒvi.; for sheep and pigs, fʒi. to fʒij.; for dogs or cats, ℥x. to fʒj. It is given sometimes with half a dose of turpentine in a little oil or gruel, when the bowels have been emptied by a laxative and several hours' fasting. Professor Williams states that the extract, with half a dose of areca-nut, constitutes the most effectual remedy for tape-worm in dogs. If the parasite is not expelled, the medicine may be repeated in three days. Kaufmann recommends doses to be given in the morning, at noon, and at night. The *tænia*, narcotised, relinquish their hold, and are swept out by the laxative, prescribed a few hours after the last dose of extract.

G A L L S.

GALLA. Oak Galls. Excrescences on *Quercus lusitanica* (var. *infectoria*), caused by the puncture and deposit of an egg or eggs of *Cynips Gallæ tinctoriæ*. (B.P.) *Nat. Ord.*—*Cupuliferæ*.

Galls, or gall-nuts, found on the young branches and shoots of a shrubby species of oak, are caused by the female of a species of *Cynips*, which punctures the buds, and deposits its ova. Irritation follows, the punctures become surrounded by woody matter, within which the larva develops, until, about July, it becomes a perfect fly, perforates its cell, and escapes. Before this the galls ought to be gathered. The best commercial variety, known as Levant galls, is imported from Syria, Smyrna, and Constantinople; the light, hollow Chinese, Japanese, or East Indian galls, are yielded by the *Rhus simialata*; large Mecca galls, called Dead Sea apples, are imported from Bussorah. Home-grown galls from the common oak (*Quercus robur*) are in some seasons abundant throughout the southern and midland counties of England, but seldom contain more than half the tannic acid found in the foreign.

Galls vary from the size of a bean to that of a hazel-nut, are round, hard, and studded with tubercles; of a bluish-grey colour externally, and yellow within. An inferior variety, from which the larva has escaped, are smoother, of lighter colour, lower density, and less astringency. Galls are easily reduced to a yellow-grey powder, devoid of odour, but having a powerful astringent taste. The active principles are dissolved by forty parts of boiling water and still less proof spirit. Ferric salts, added to a watery solution, slowly precipitate the dark-blue or black iron tannate, the basis of writing ink. An aqueous solution of gelatin throws down a grey flocculent precipitate of tanno-gelatin—the essential principle of leather. These reactions, and other important properties, depend on the presence of tannin or gallo-tannic acid, which, according to the quality of the galls, ranges from 15 to 70 per cent., and is associated with about 3 per cent. of gallic acid.

TANNIC ACID, tannin, or digallic acid ($C_{13}H_9O_7 \cdot CO_2H$), is the

glucoside to which oak bark, galls, logwood, and many vegetable astringents owe their properties. The tannic acid from these several sources has, however, somewhat different characteristics, and generally receives such special designations as gallo-tannic, cincho-tannic, catechu-tannic acids. Gallo-tannic acid is prepared by softening powdered galls by keeping them for two days in a damp place, digesting them for several hours simultaneously with water, which dissolves the tannic acid, and with ether, which dissolves colouring matter and gallic acid. The mixture, filtered and allowed to stand, forms into two layers, and the lower, carefully evaporated, yields tannic acid. It occurs in pale yellow vesicular masses, or thin glistening scales; has a strongly astringent taste and an acid reaction; is readily soluble in water and dilute alcohol, but very sparingly soluble in ether. The aqueous solution gives an olive-brown precipitate with ferric-chloride, a yellow-white precipitate with gelatin, and a red coloration having a blue fluorescence with alkalis. It is also precipitated by, and hence is incompatible with, most metallic salts, the mineral acids, and the vegetable alkaloids. In several ways tannic acid may be decomposed, yielding gallic acid and glucose, and hence is termed a glucoside.

GALLIC ACID, or tri-hydroxy-benzoic acid ($C_6H_2(OH)_3.CO_2H$) is prepared by keeping moistened powdered galls in a warm place, when fermentation occurs; one equivalent of tannic or digallic acid, assuming one of H_2O , produces two of gallic acid, which is dissolved by boiling water, and crystallised. It may also be prepared by boiling tannic acid with dilute sulphuric acid. It occurs in acicular prisms, or silky needles, which are colourless or pale fawn. It requires for solution about 100 parts of cold water and 3 of boiling water; but is more soluble than tannic acid in alcohol and ether. Its aqueous solution gives a blue-black precipitate with ferric salts. Unlike tannic acid, it is not precipitated by gelatin, hydrochloric or sulphuric acids. Lime water browns tannic acid slowly, browns gallic acid immediately, and with pyrogallic acid yields a purple red, which becomes brown as it absorbs oxygen (Attfield).

ACTIONS AND USES.—Galls and tannic acid differ only in the degree of their action. They are astringent and antiseptic. Powdered galls are about one half the activity of tannic acid.

Gallic acid does not coagulate either gelatin or albumin, and is scarcely entitled to be considered an astringent.

Tannic acid may be taken as **the type of the group** which includes galls, oak bark, catechu, kino, and rhatany. It has little effect on the unbroken skin; but on abraded, atonic, and hypersecreting skin and mucous surfaces it coagulates albumin, causes dryness and tanning, with some contraction of the soft textures. But, unlike salts of lead, silver, or other mineral astringents, it does not contract capillary vessels. It paralyzes sensory nerves, and diluted solutions hence relieve irritation. It coagulates blood and arrests bleeding. In the digestive canal it combines with albuminoids and alkalies. It is slowly and partially absorbed, but when thus neutralised it can have little astringent or hæmostatic power (p. 51). It is excreted as gallic acid, or as some oxidised product thereof.

MEDICINAL USES.—Tannic acid and galls, in powder, solution, or spray, are applied in stomatitis and relaxed conditions of the pharynx and throat. In diarrhœa and dysentery the slowly dissolving catechus and kino are sometimes preferred to tannic acid, as they reach the intestines and exert their in-contact effects before they are neutralised. They are frequently prescribed with chalk, acids, aromatics, and opium, and given either in bolus or mucilage. For arrest of internal hæmorrhage, neither tannic nor gallic acid is so effectual as ergot, ferric-chloride, or lead acetate and opium. Dr Stockman's investigations, reported in the *British Medical Journal*, December 1886, have shown that gallic acid, even in full doses, has no special general astringent action. Both tannic and gallic acids are used as antidotes for poisoning by alkaloids; but in combating metallic poisoning they are not so serviceable as eggs.

Externally, tannic acid is used with glycerine and water in the weeping stages of eczema; as an astringent wash with opium in prolapsus of the uterus and rectum; while it also allays the discharge and irritability of otorrhœa, which is not uncommon in dogs. It is applied to soft ulcerating bleeding surfaces. For piles in dogs, gallic acid is used as an ointment, opium being added if there is much irritability; and such applications are often advantageously alternated with calomel ointment.

Doses, &c.—Of tannic acid horses take grs. xxx. to ℥ij.; cattle, ℥iij.; sheep and large pigs, grs. xv. to ℥ij.; dogs, grs. ij. to grs. x. Gallic acid is used in the same doses; powdered galls in about double these doses. **Glycerines** of tannic and of gallic acids, made by stirring one part of acid with four of glycerine, and assisting solution with gentle heat, are soothing antiseptic astringents, used diluted with water as required. **Gall ointment** is made with two parts powdered galls, one opium, and twelve of lard or vaselin. **Styptic colloid** is usually prepared with one of tannin and eight of alcohol, mixed with four of collodion. **Pyrogallic acid** is an antiseptic, astringent, and caustic, recommended in cases of psoriasis and lupus, and for tanning and shrivelling carcinomatous growths (p. 296).

G A M B O G E.

CAMBODIA. A gum-resin obtained from *Garcinia Hanburii* (*G. morella*, var. *Pedicillata*). (B.P.) *Nat. Ord.*—Guttiferae.

Gamboge is imported from Singapore, Siam, and Ceylon, is the produce of a moderate-sized diœcious tropical tree, and is obtained from incisions into the middle layer of the bark, or by breaking the leaves and branchlets, when the yellow milky juice exuding is collected in leaves, in cocoa-nut shells, or in joints of bamboo, is transferred into flat earthen vessels, and dried in the sun. It occurs in cylindrical yellow pieces or rolls, four to eight inches long, two to three inches in diameter, and in cakes; breaks easily with a smooth conchoidal glistening orange-yellow fracture, is odourless, but has an acrid taste. It is feebly soluble in water, makes with it a yellow emulsion, and is soluble in alcohol and ether. It consists of 15 to 20 per cent. of soluble gum, about 70 of an active orange yellow resin and gambogic acid. It is largely used as a pigment.

ACTIONS AND USES.—It is a powerful irritant and drastic hydragogue cathartic, inferior in activity only to croton and elaterium.

It undergoes solution in the alkaline intestinal juices, and

in large doses causes gastro-enteritis. Moiroud gave **horses** six to twelve drachms, and found the dejections frequent and fluid, the pulse irregular, the animal shivering and anxious. Two drachms killed a **sheep**, two ounces and a half had little effect upon a cow, but five ounces caused dysentery, which continued for seventeen days.

Gamboge is too drastic and uncertain to be safely given either to horses or dogs. It causes profuse watery discharges and increased peristalsis, and although Professor Rutherford's experiments demonstrate that it has no special stimulant action on the liver, like all purgatives acting on the small intestines it is a cholagogue, in the sense that it promptly moves onwards the bile in the duodenum, and thus prevents its reabsorption. It has no direct vermicide effect, but produces diuresis, especially when given in small doses dissolved in alkalis. **For ruminants** it is safe, speedy, and manageable when in combination with other purgatives. Half a pound each of Epsom and common salt and an ounce of gamboge proves a prompt and effectual purgative in indigestion, fardel-bound, and brain diseases of cattle. Although neither gamboge nor aloes is particularly certain when used alone, an ounce of each, rubbed down and given in solution, proves an effectual purge for ordinary cattle cases.

Doses, &c.—For cattle, ℥ss. to ℥j.; for sheep, grs. xx. to grs. xxx., given in combination with other purgatives, and in solution.

GELATIN—GLUE.

Nitrogenous matters extracted by the action of hot water from bones, tendons, and animal membranes.

Gelatin is chiefly made from damaged hides and skins, and their parings; also occasionally from bones, limed, cleaned, and boiled, to remove fatty matters, and then crushed and steamed in a partial vacuum. **Glue**, a coarse variety of gelatin, is made from similar materials, less carefully purified; size is an inferior, weaker variety of glue; **isinglass**, a natural colourless gelatin, is prepared from the air-bladder of the sturgeon, and various species of *Acipenser*; **chondrin** is the gelatinous

matter extracted from cartilage; **ossein**, the title given to that obtained from bones. Gelatin, when dried, is hard and tough; varies in colour according to its purity; forms a viscid, tremulous mass, even when one per cent. is dissolved in water and allowed to cool; and is precipitated from watery solutions by tannic acid.

ACTIONS AND USES.—Gelatin, although a product of the disintegration of albuminoid tissues, does not build up the albuminoid or even the gelatinous tissues; but being tolerably easily digested, it appears to **economise** the more valuable **albuminoids**. Men, dogs, and even horses, recovering from exhausting disease, in which disintegration and excretion of proteids is great, exhibit the dietetic value of gelatin when it is given as soup, and along with fats or hydrocarbons. As a **demulcent** it has the disadvantage of becoming hard and dry, and hence is not very suitable as a permanent sheathing for irritable surfaces.

Glue is employed for securing the broken horns of cattle, and occasionally for making **adhesive plasters**. For closing wounds, where sutures cannot be used, two pieces of stout cloth are cut so as to leave a number of tails with uncut margins of several inches, and are smeared with melted glue, usually mixed with pitch, and applied, one on either side of the wound, with the uncut margins towards each other. When the plaster is dry, the uncut margins are sewed together, while, to prevent displacement from movement of the skin, narrow strips of calico moistened with glue are applied in various directions over the injured spot. Such plasters are sometimes useful in keeping sewed or sutured wounds in position, giving support, and preventing annoyance of flies; a dependent opening must, however, be left for egress of discharge. They are sometimes effectual in reducing and retaining in position umbilical hernia, alike in calves and in foals.

Gelatin solutions make useful temporary protectives for limited abraded surfaces; hold well for a day or more if applied dry; are readily washed off with hot water, without irritating the skin, and can be medicated with antiseptics, stimulants, or analgesics. The familiar **court sticking plaster** consists of a strong solution of isinglass painted over thin

silk. In **pharmacy** gelatin is used for clarifying or fining; as a neat and cleanly envelope for pills and boluses; and along with glycerine forms lamellæ or thin discs for enveloping the alkaloids and other active principles used for eye cases and hypodermic injections.

GENTIAN.

GENTIANÆ RADIX. The dried root of *Gentiana lutea*. (B.P.)
Nat. Ord.—Gentianacæ.

The *Gentiana lutea*, or yellow gentian, has a perennial, often forked root, and an annual herbaceous stem, which rises three or four feet, and bears axillary whorls of yellow flowers. It abounds in most parts of temperate Europe, thrives best between 3000 and 5000 feet above the sea-level, and is extensively cultivated in the mountainous districts of the Alps, Vosges, and Pyrenees. All parts of the plant are bitter and tonic, but the root alone is officinal. It occurs in cylindrical, usually more or less branched, often twisted, pieces, or in longitudinal slices, marked by transverse annular wrinkles and longitudinal furrows, and varying in length from a few inches to a foot, and in thickness from half an inch to an inch. The bark is thick, reddish, and separated from the central woody yellow portion by a zone of cambium. It has a peculiar aromatic and rather disagreeable odour, and a taste at first sweet, but afterwards strongly and permanently bitter, but without astringency. When moist, it is tough and flexible; when dry, brittle, and easily pulverised. The powder is yellow, with a shade of brown, and readily yields its bitterness to water, alcohol, and ether.

Gentian root **contains** 12 to 15 per cent. of **uncrystallisable sugar**, which, in Southern Bavaria and Switzerland, is fermented into a drinking spirit, a large amount of pectin, a little volatile oil and fat, the yellow crystalline **gentianin**, or gentianic acid ($C_{14}H_{10}O_6$), which is inert; and about 0·1 per cent. of an intensely bitter glucoside, **gentiopicrin** ($C_{20}H_{30}O_{12}$), obtainable in colourless crystals, which are soluble in water and spirits, rendered yellow by cold potash and soda solutions, and by hot ammonia solution; dissolved, without coloration,

by cold concentrated sulphuric acid; but such solution, when gently heated, changes to carmine red, and, on addition of water, deposits grey flocculi. In its actions gentiopicrin is nearly allied to quinine (Phillips).

Roots of other *Gentianæ* are frequently mixed with those of *G. lutea*; but this is not of much importance, since all are possessed of similar properties. Admixture, however, sometimes occurs of poisonous roots, such as monkshood, belladonna, and white hellebore, which may be distinguished by the absence of the pure bitter taste and bright yellow colour so characteristic of true gentian. Gentian powder, especially that met with abroad, is stated to be occasionally adulterated with yellow ochre, easily detected by heating the suspected specimen with a little sulphuric acid, filtering, and testing for iron.

ACTIONS AND USES.—Gentian is a pure bitter, and is prescribed as a stomachic and tonic for all veterinary patients. It resembles calumba, chiretta, quassia, and *hydrastis canadensis*, or golden seal. As a tonic it has been considered little inferior to cinchona; it is devoid of astringency.

MEDICINAL USES.—Gentian improves the appetite and general tone. In **atonic indigestion** it is particularly useful amongst young animals, and in such cases is often conjoined with ginger and sodium bicarbonate. In relaxed and irritable states of the bowels, and where intestinal worms are suspected, after administration of a laxative, gentian and hydrochloric acid are often serviceable. For horses suffering from simple **catarrh** few combinations are more effectual than an ounce of powdered gentian, two drachms nitre, with two ounces Epsom salt, dissolved in a pint of water, linseed tea, or ale, and repeated night and morning. In inflammatory complaints, after the first acute stage is passed, such a prescription also proves serviceable. Where the bowels are constipated or irregular, or febrile symptoms are insufficiently subdued, two drachms of aloes are sometimes conjoined with the gentian. Where more general tonic effects are sought, iron sulphate is alternated with the gentian and salines. An ounce of gentian, with an ounce of ether or sweet spirit of nitre, given three or four times daily in a bottle of ale, proves an excellent stomachic and stimulating tonic in influenza and other epizootics, helps convalescence from ex-

hausting disorders, and is a useful restorative for horses, jaded, overworked, or suffering from loss of appetite or slight cold.

For **cattle** the above prescriptions are as serviceable as for horses, but require to be given in somewhat larger doses. For **sheep**, gentian is a very useful stomachic and bitter tonic, and when prescribed with salt arrests for a time the progress of liver-rot. Next after quinine it is the best vegetable tonic for **dogs** prostrated by reducing disorders.

Doses, &c.—For the horse, ℥ss. to ℥i.; for cattle, ℥i. to ℥ij.; for sheep, ℥i. to ℥iij.; for pigs, ℥ss. to ℥l.; for dogs, grs. v. to grs. xx., repeated twice or thrice daily. The carefully-prepared Pharmacopœia extract infusions and tinctures, flavoured with orange-peel and aromatics, are scarcely required in veterinary practice. The powder is prescribed in **bolus**, prepared with treacle, glycerine, and meal, or in **infusion**, made by digesting the powder during several hours in hot water, and decanting off the clear fluid. A small addition of proof spirit ensures more thorough solution and better keeping.

GINGER.

ZINGIBER. The scraped and dried rhizome of *Zingiber officinale*.
(B.P.) *Nat. Ord.*—Zingiberaceæ.

The *Zingiber officinale*, grown in many tropical countries, has a biennial, creeping, fleshy, and nodulous rhizome, which gives off numerous descending short radicles, with several ascending annual leafy stems, reaching three or four feet in height, invested with alternate elliptical leaves, and terminated by spikes and racemes of purple flowers. For making **green** or **preserved** ginger, the rhizomes are gathered while still soft and juicy, and when about three months old. For other purposes they are taken up when about a year old, when the aerial stems have withered, but while the rhizome is still plump and soft. They are scalded to check vegetation, usually scraped to remove the brown wrinkled epidermis, and dried in the sun.

PROPERTIES.—Several sorts are recognised. The Jamaica, in plump, flat, pale pieces or races, the bark stripped of epidermis, producing a light-coloured powder of superior quality; Malabar or Cochin China, a little darker, but usually good;

Bengal and African, imported both coated and uncoated, and generally cheap and excellent; Barbadoes, in short thick races, retaining its brown corrugated epidermis. The unstripped descriptions are sometimes termed black gingers. The several varieties are in flat, irregular-lobed, knotted, zig-zag pieces, two to four inches in length, externally pale yellow, striated, and fibrous, breaking with a mealy, short, somewhat fibrous fracture, having a strong, agreeable, aromatic odour, a warm, pungent taste, and dissolving in water and alcohol. To imitate the finer Jamaica ginger, inferior varieties are exposed to the action of sunlight, sulphurous acid, or calx chlorata; but such bleaching cannot impart the resinous structure or aroma which distinguish good specimens.

Ginger owes its taste to a **pungent resin**, its aroma to a **volatile oil**, and its medicinal and flavouring properties to both constituents, which are chiefly found in the delicate felted layer of skin lying between the starchy, mealy parenchyma and the brown, horny, external covering. As a condiment and medicine Great Britain annually imports about 300 tons of ginger.

ACTIONS AND USES.—Ginger is an aromatic stimulant, and is used as a stomachic and carminative in all patients, notably in cattle and sheep.

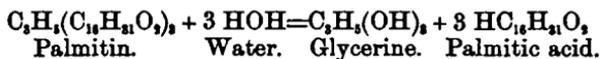
Blown into the nostrils it increases nasal discharge; chewed, it reflexly augments the flow of saliva; administered internally, it promotes gastric secretion, digestion, and appetite. It is prescribed in atonic dyspepsia, often along with antacids and laxatives. Conjoined with purgatives, it diminishes their tendency to nauseate and gripe, and also somewhat hastens their effects. Allied to ginger, and belonging to the same natural family, are turmeric and galangal, the rhizomes of plants of Southern Asia.

DOSES, &c.—For the horse, ℥iv. to ℥i.; for cattle, ℥i. to ℥iij.; for sheep, ℥i. to ℥ij.; for pigs, ℥ss. to ℥i.; for dogs, grs. x. to grs. xxx. A bolus is made with any suitable excipients; the infusion is used sometimes sweetened with treacle or sugar; the B.P. tincture is prepared with 2½ ounces powdered ginger to a pint of rectified spirit by maceration and subsequent percolation.

GLYCERINE.

GLYCERINUM. Glycerol. Prophenyl Hydrate. A sweet principle obtained by reaction of fat and fixed oils with aqueous fluids, and containing a small percentage of water. (B.P.) $C_3H_5(OH)_3$.

Glycerine was discovered in 1789, by Scheele, as a product in the manufacture of lead plaster; it occurs in small amount during the fermentation of sugar. It is chiefly obtained by **decomposing palm oil**, which consists of palmitin, in a still, by the action of super-heated steam, at a temperature of about 600° Fahr. The crude product is freed from water by subsequent distillation. The decomposition occurring is thus represented:—



Glycerine likewise occurs as a by-product in the manufacture of soap and stearin candles. Fats yield, however, only ten per cent., and its extraction either from soap or candle-makers' refuse does not now pay.

PROPERTIES.—It is a clear, colourless, viscid liquid, devoid of odour, sweet to the taste, oily to the touch, with a specific gravity of 1.25. It has a strong affinity for water, and is freely soluble both in water and alcohol. It dissolves most substances which are soluble in water, as well as metallic oxides, alkaloids, and others which are not. It burns with a luminous flame, giving off irritating vapours of acrolein. In constitution it is a trihydric alcohol. Cautiously added to a mixture of equal measures of nitric and sulphuric acid it produces nitro-glycerine— $C_3H_5(NO_2)_3$.

ACTIONS AND USES.—Glycerine undiluted irritates the mucous membranes, and even the skin, by abstracting water. Hence its laxative effect, whether when swallowed or used as an enema. Dogs are purged by 1½ ounces. Large doses break down the red globules and cause hæmoglobinuria (Kaufmann). It is antiseptic, and destroys fleas and other skin parasites. Mixed with water, starch, or other bland materials, it is de-

mulcent and emollient. It is the basis of the emollient, antiseptic, and astringent group of glyceryls or glycerines. It is a solvent for fixed alkalies, for alkaloids and their salts, vegetable acids, &c., a frequent constituent of ointments and lotions, and a convenient menstruum for the administration of nauseous medicines.

It is slowly and partially absorbed, but is not nutrient. Small doses are eliminated by the kidneys, larger by the bowels, producing slight laxative effects, increased by combination with castor oil. As a laxative enema it is not more effectual than oil, or soap and water; indeed, Friedberger states that it is of no effect on dogs. Given shortly before meals it has been prescribed to check undue gastric fermentation, acidity, and flatulence, both in calves and dogs. It neither evaporates, dries, nor becomes rancid, and is readily miscible with water, spirit, oils, and other drugs, forming with them emollient, antiseptic, or astringent dressings, used to soften, supple, or soothe dry, rough, scurfy, or irritated skin surfaces. It is the basis of many applications for blisters and burns, for mud fever, cracked heels, and various forms and stages of eczema.

Glycerine of starch is made by stirring and heating gently one part starch, three parts water, and five parts glycerine, and is used for aphthous and other eruptions about the mouth, nostrils, and udder, and as a soothing and drying dressing for erythema and the early weeping stages of eczema, especially in dogs. **The glycerines** of carbolic, gallic, and tannic acids are prepared with one part of the acid and four of glycerine. Glycerine of alum is made with one of alum to five of glycerine. Similar antiseptic and astringent preparations are made with glycerine and borax, and also with glycerine and acetate and oxide of lead, with water to effect thorough solution. A handy antiseptic and astringent application is extemporised by mixing equal parts of glycerine and Goulard's Extract. It is diluted as required, and used for erythematous and eczematous conditions of the skin. **Boro-glyceride**, prepared by heating 92 parts glycerine and 62 boric acid, and used diluted with 20 to 40 parts water, is an effectual non-poisonous antiseptic, useful for relaxed and diphtheritic con-

ditions of the throat, as a dressing for wounds, for the preservation of food, and as a vehicle for applying carbolic acid, iodine, and iodoform.

For various itching, erythematous, and eczematous diseases, a **soothing, drying protective** is prepared by mixing, with the aid of gentle heat, three parts each of glycerine, gelatin, and water, with one of zinc oxide; and with such a mixture may be incorporated, as required, creosote, carbolic acid, resorcin, or naphthol.

GUM ARABIC—GUM TRAGACANTH.

ACACIÆ GUMMI. A gummy exudation from the stem and branches of *Acacia Senegal*, and from other species of *Acacia*. (B.P.)

TRAGACANTHÆ. Gum Tragacanth. A gummy exudation obtained by making incisions in the stems of *Astragalus gummifer*, and some other species of *Astragalus*. (B.P.)
Nat. Ord.—Leguminosæ.

Gum is obtained from many plants, notably from various species of *Acacia*. These are stunted, withered-looking trees, occurring in tropical countries, most prolific when old and stunted, and during dry, hot seasons. In June and July, from natural cracks or artificial incisions in the bark, a viscid juice exudes, and concretes into round masses or tears, varying in size from a pea to a walnut, brittle, usually shining, colourless, yellow or brown, odourless, and of a bland, sweet taste. Gum dissolves in water, forming an adhesive, viscid fluid or mucilage.

Gum acacia, or **gum arabic**, is chiefly collected in Kordofan, in Eastern Africa, and forwarded from Alexandria. When imported, it is picked and sorted, usually into three different qualities, distinguished by the size, colour, and transparency of the tears. It is soluble in about its own weight alike of hot and cold water, is insoluble in and incompatible with alcohol, ether, and oils. Boiled with dilute sulphuric acid, it is converted into gum sugar; oxidised by nitric acid, it is converted into mucic acid. It consists of **arabin**, or **arabic**

acid ($C_{12}H_{22}O_{11}$), which occurs in gum as arabate of calcium, magnesium, and potassium.

Gum senegal is similar to gum arabic, but less brittle, and requires four or five parts of water to dissolve it. The East Indian gums are generally dark-coloured, more difficult of solution, and less valuable. The gums of Australia and the Cape, now imported in considerable quantity, are also inferior to gum arabic.

Gum tragacanth is collected in Asia Minor, mostly exported from Smyrna, and occurs in thin, semi-transparent, tough, horny, white-grey or yellow lamellæ or plates, and marked with arched or concentric ridges. It is tasteless and odourless. Although readily soluble in boiling water, it is sparingly soluble in cold water, which swells it into a jelly containing starch, as is indicated by the iodine test. Tragacanth contains a neutral gum, **bassorin**, which, gelatin-like, swells up, is not dissolved either by hot or cold water, but is soluble in alcohol.

British gum or dextrin ($C_6H_{10}O_5$), much used in calico printing, is made by treating starch with dilute nitric acid, drying it, and heating it to about 240° Fahr.

ACTIONS AND USES.—Gums are the least nutritive of the carbo-hydrates; when swallowed, they are dissolved by the alimentary secretions, and in part converted into sugar. They are occasionally prescribed for ensheathing the mucous surfaces in catarrh and diarrhœa, and as demulcent injections in inflammation of the bowels and bladder, but for veterinary purposes are usually superseded by well-boiled linseed or starch gruels. For making emulsions, electuaries, and boluses, gums have the disadvantage of speedily drying and hardening.

DOSES, &c.—Gums may be taken almost *ad libitum*. Horses and cattle may have ℥ij. to ℥iij.; foals, calves, and sheep, ℥i.; and dogs, grs. xx. to grs. xl. An ensheathing mucilage is made with one part gum to ten of water.

HELLEBORE.

BLACK HELLEBORE. Dried rhizome and radicles of *Helleborus niger*. *Nat. Ord.*—Ranunculaceæ.

The *Helleborus niger*, Christmas rose, or bear's foot, is cultivated in this country, and is indigenous to many parts of Continental Europe; the chief supplies come from Germany. It is herbaceous, one to two feet high, with numerous digitated, dirty-green leaves, flowers which appear in January and February, and a perennial, black, knotted, scaly rhizome, one to three inches long and scarcely half an inch thick, from which descend numerous dark-coloured radicles, about the thickness of goose quills; having a faint, unpleasant odour, and an acrid, bitter taste. The plant generally is acrid, but the rhizome and rootlets are most active. The rhizomes of *Helleborus viridis* and *fetidus*, often mixed with those of the *niger*, are very similar in action. Hellebore contains a bitter, neutral, non-volatile, irritant glucoside, **helleborin** ($C_{36}H_{42}O_6$); a slightly acid, irritant glucoside, **helleborein** ($C_{26}H_{44}O_{15}$); other crystalline principles, and an organic acid, probably equisetin (Flückiger).

ACTIONS AND USES.—Black hellebore is an acrid irritant, but scarcely so active as *veratrum album*, or white hellebore. It is emetic, a drastic purgative, anthelmintic, and parasiticide. Full doses produce in all animals gastro-enteritis, with cardiac depression. Two drachms swallowed by a medium-sized dog killed him in a few hours, and smaller quantities have proved fatal in a shorter time when applied to wounds (Christison). Two or three drachms produce in horses colic and enteritis; two or three ounces are invariably fatal in forty to fifty hours; one to three drachms induce similar effects among sheep and goats (Hertwig). It is not prescribed in regular practice. Even for promoting discharges, and as a constituent of blistering ointments, it must be used with caution, as it is liable to act with unexpected violence. An ounce of powdered hellebore and two ounces of alum, dissolved in a gallon of hot water, are used to destroy caterpillars infesting gooseberry, rose, or other trees.

HEMLOCK.

HEMLOCK LEAVES. *Conii Folia.* The fresh leaves and young branches of *Conium maculatum*, gathered from wild British plants when the fruit begins to form. (B.P.)
Nat. Ord.—Umbelliferae.

HEMLOCK FRUIT. *Conii Fructus.* The fruit of *Conium maculatum*, gathered when fully developed, but while still green, and carefully dried. (B.P.)

Hemlock grows wild in hedges and waste places in most parts of Europe. When one year old it has a small slender root, and a few leaves lying flat on the ground. During its second year's growth, when it is collected for use, the root is one or two feet long, an inch in diameter, white, and fusiform. The flowering stem is two to five feet high, round, hollow, jointed, smooth, branching towards the top, and covered with purple spots. The large bi- or tri-pinnate leaves are glabrous and dark-green, have clasping petioles of varying length, a nauseous, bitter taste, and a strong, peculiar odour, which is characteristic of all parts of the plant, and aptly compared to that of mice or of cats' urine. The flowers are small, white, and, like those of the other plants of the family, arranged in umbels. The fruit resembles that of anise, is of a brown colour, about one-eighth of an inch in length, broadly ovate, separable into two mericarps, each marked with five ribs. It is mostly imported from Germany, should be gathered before it is fully ripe, when it has attained its full size, but is still soft and green. Nine pounds of such fruit produce an ounce of **coniine**, which, with a bitter oleo-resin and a non-poisonous volatile oil, is found stored chiefly in cubical cells in the endocarp. Dried in thin layers in a warm, darkened room, at a temperature of 80° Fahr., and kept in close-fitting tin canisters, the fruit may be preserved for a year. When fully ripened it contains less coniine, and besides keeps badly.

The leaves should be gathered in July, when the fruit begins to form, are rapidly dried in stoves at about 120° Fahr., and preserved in tins, bottles, or jars, excluded from light. By drying they lose three-fourths of their weight, and, according

to Dr Harley, one-half of their volatile principle, of which scarcely a trace remains after they are kept twelve months (Royle's *Materia Medica*). Long keeping of the fruit and leaves, and their exposure to temperatures exceeding 120° Fahr., account for the inertness of many hemlock preparations.

Commercial coniine contains several volatile alkaloids:—

(1) **Pure coniine**, which, like curare, paralyses the endings of motor nerves and of the vagus, and, later, the motor centres of the brain and cord.

(2) **Methyl-coniine**, which acts on the spinal cord, paralysing reflex action.

(3) Traces of di-methyl-coniine, which resembles coniine, but is less powerful.

The relative proportion of these alkaloids in hemlock, in its preparations, and in the commercial coniine, modify their actions.

Pure coniine ($C_8H_{16}N$) may be obtained by distilling the leaves or fruit with dilute caustic potash. It has the specific gravity .89, boils about 334° Fahr., rapidly oxidises into a brown semi-solid, has an intense odour of mice, a peculiar acrid taste, is sparingly soluble in water, but readily dissolved by alcohol and ether. Nitric acid dropped on coniine produces a blood-red colour, sulphuric acid a purple red, passing to olive-green.

The leaves and fruit of hemlock are distinguished by their appearance, and, if triturated with diluted caustic potash solution, evolve the characteristic odour of mice. Fool's parsley (*Æthusa cynapium*), water hemlock or cowbane (*Cicuta virosa*), the fine-leaved water hemlock (*Phellandrium aquaticum*), the water parsnip (*Enanthe crocata*), are Umbelliferæ with physiological actions similar to those of conium maculatum, and when freely eaten have poisoned most of the domestic animals (Professor Gamgee's *Veterinarian's Vade Mecum*). Of wholesome dietetic Umbelliferæ, parsley, parsnip, and celery are illustrations. The natural family is rich in aromatic carminative seeds (p. 242).

ACTIONS AND USES.—Hemlock and its alkaloids, applied to mucous or denuded skin surfaces, diminish sensibility, and are analgesic. When absorbed they paralyse the endings of motor

nerves and of the vagus, and are sometimes prescribed to quiet motor irritability.

GENERAL ACTIONS.—Hemlock was the state poison of the Athenians, the death potion of Socrates. It has paralytant effect on sensory nerves, as exhibited when applied to mucous and delicate skin membranes, and when absorbed paralyses (without the preliminary stimulation exerted by nicotine or pilocarpine) the extremities of motor nerves, and those vagus endings which inhibit the heart and lungs. It increases the secretion of the sweat, bronchial, and intestinal glands. Full doses paralyse the motor centres of the brain and spinal cord, and cause a weak and staggering gait, the hind extremities being first affected. Convulsions occasionally occur in warm-blooded animals, depending upon the presence of methyl-coniine, which, as indicated, acts upon the spinal cord and paralyses reflex action. Death results from paralysis of the muscles of respiration. It is **excreted** mainly by the kidneys, possibly in part by the lungs. It acts more powerfully on man and carnivora than on graminivora or herbivora. Goats with impunity eat considerable quantities of the fresh leaves (Kaufmann). Its physiological **antagonists** are nux vomica, strychnine, and other tetanisers.

Toxic Actions.—Dr John Harley and Mr Frederick Mavor gave a two-year-old thoroughbred colt six, eight, and twelve ounces of succus conii without appreciable effect. Sixteen ounces produced in twenty-five minutes dulness and stupidity, drooping and swollen eyelids, but no change in the pulse or pupils. A few minutes later the colt went down upon his knees, appeared to require special efforts to keep himself on his legs, stumbled, and walked slowly when led; but in two hours the symptoms had entirely disappeared (*Old Vegetable Neurotics*, by Dr John Harley, 1869). Moiroud poisoned a horse with half a pound of the dried leaves given as a decoction, and observed nausea, spasmodic twitching of the muscles of the extremities, cold sweats, dilatation of the pupils, and dulness. In Italy asses eating hemlock have sometimes been so thoroughly paralysed that, supposing them to be dead, the peasants have begun to skin them (Matthioli).

Cattle poisoned lie as if lifeless, with slow, feeble pulse

cold extremities, and dilated pupils (Holford in *Veterinarian's Vade Mecum*). **Sheep** become giddy, listless, and sometimes die (*Veterinarian* for 1845). Fifteen grains of the succus injected into the blood-vessels of a full-grown mouse produced, in half an hour, paralysis, continuing for five hours. Sir Robert Christison found that an ounce of the extract swallowed by **dogs** proved fatal in forty-five minutes; ninety grains applied to a wound had the same effect in an hour and a half; while twenty-eight grains poisoned in two minutes when injected into the veins (*On Poisons*).

Mr John Gerrard, of Market Deeping, records (*Veterinarian*, February 1873) the poisoning of **pigs** which strayed into an orchard and ate growing hemlock. They lay prostrate and unable to rise, no pulse perceptible, the body cold, the eyes amaurotic, and when left alone they lapsed into a comatose state. There were no convulsions, and no pain was apparent when they were pricked with a pin. In fifteen hours two died, and two a few hours later. Examination discovered the blood throughout the body, and especially in the large organs, dark-coloured and fluid, the result of the fatal asphyxia; the intestines distended with gas; the mucous coat of the stomach, particularly its cardiac portion, much congested, while similar spots of congestion were observed throughout the intestines.

Coniine is generally used in the form of hydrobromate. One drop applied to the eye of a rabbit arrested respiration in nine minutes; three drops in the eye of a cat killed it in a minute and a half; five drops swallowed by small dogs began to operate in thirty seconds, and proved fatal in one minute. Still smaller quantities injected into the veins poisoned with even greater rapidity (*Christison On Poisons*).

The **antidotes** are tannic acid, the cautious administration of coffee, chloral hydrate, and other stimulants, ammonia to the nostrils, stimulating enemata, enforced exercise, and artificial respiration.

MEDICINAL USES.—Hemlock is occasionally given to relieve the muscular spasm of chorea. It is of no avail in tetanus in horses, nor, as demonstrated by experiment, in strychnine poisoning. **Spasmodic cough** connected with muscular irritability, such as occasionally occurs in epizootic sore-throat

and bronchitis in horses, is sometimes relieved by inhalation of steam medicated by hemlock, or by swallowing slowly an electuary of succus conii, glycerine, and ammonia acetate. **Injections** and **suppositories** are applied in irritable, painful conditions of the urino-genital organs.

Doses, &c.—Neither the dried leaves nor the fully-ripened dried fruit are to be depended upon. The fresh leaves and young branches, and preparations promptly obtained from them without heat, are, however, reliable, and the best is the **succus**. Three parts of juice are mixed with one of rectified spirit, allowed to stand for seven days, and then filtered and bottled. This succus has a dark sherry colour, an agreeable odour, and acid reaction; one fluid ounce yields thirty grains of soft extract. Horses and cattle take ℥ij. to ℥iv.; sheep and pigs, ℥ss. to ℥j.; dogs, ℥ss. to ℥j. Its analgesic and anti-spasmodic effects are increased by using it with opium or chloralhydrate. Coniine, employed hypodermically by Dr Harley and Mr Mavor, frequently produced irritation and inflammation, which hindered its absorption.

H E N B A N E.

HENBANE OR HYOSCYAMUS LEAVES. The fresh leaves and flowers, with the branches to which they are attached, of *Hyoscyamus niger*; also the leaves, separated from the branches and flowering tops, and carefully dried. Collected from biennial plants, growing wild or cultivated in Britain, when about two-thirds of the flowers are expanded. (B.P.) *Nat. Ord.*—*Atropaceæ*.

Henbane grows wild in most parts of this country, and is cultivated at Mitcham and Hitchin. The large, sinuate, usually decurrent, yellow-brown leaves are rough, hairy, and clammy, with a fœtid, narcotic odour, and a nauseous, bitter taste. The small, round, yellow-grey seeds sometimes used resemble the leaves in taste and odour, but are difficult to collect in quantity. The root is white, contains much starch, and resembles the parsnip, for which it has occasionally been mistaken. There are two varieties, an annual and a biennial; the latter, alone recognised by the B.P., is larger, stronger, more branched,

clammy, and active. 100 lbs. of the fresh plant when dried weigh 14 lbs., and yield about 4 lbs. of extract.

The active principle, **hyoscyamine** ($C_{17}H_{23}NO_3$), in its impure form is an oily liquid, becoming brown on exposure, but it can be slowly crystallised into colourless translucent needles. It is scarcely soluble in water, but readily dissolves in spirit, chloroform, and dilute acids. It resembles daturine, the active principle of *Datura stramonium*, is identical with duboisine, the active alkaloid of *Duboisia myoporoides*, and is isomeric with atropine. It is decomposed, and its physiological action neutralised by caustic alkalies.

ACTIONS AND USES.—Hyoscyamus closely resembles the other atropaceæ—belladonna and stramonium. Locally applied, it paralyses the endings of sensory nerves. It dilates the pupil, although not so certainly and fully as atropine. Full doses of the drug or the alkaloid stimulate the cerebral centres and paralyse the ends of motor nerves. There are produced dryness of the mouth, general convulsions, paralysis, and stupor, alternated with a peculiar form of delirium, in which a constant desire for action is accompanied by lassitude, failure of the action of the heart, and of breathing, and death from asphyxia (Brunton).

TOXIC EFFECTS.—**Horses** receiving an infusion made with three to four ounces of the leaves have dilatation of the pupils, spasmodic movements of the lips, acceleration and subsequently depression of the heart-beats, but no symptoms of acute poisoning. **Dogs** are acted on exactly as by belladonna. **Cats** become dull and drowsy, the mouth and nose dry, the pulse accelerated, the pupils dilated, and the power of walking or springing impaired (Dr John Harley, *Old Vegetable Neurotics*).

MEDICINAL USES.—Hyoscyamus is prescribed with cathartics to prevent their griping. It is mainly excreted by the kidneys, and occasionally is used as an anodyne in irritable conditions of the kidneys and bladder. It is prescribed in human medicine in cases of mania and nervous or muscular excitement, and has been used with some success in epilepsy and chorea in dogs. It is occasionally substituted for opium as a topical anodyne.

DOSES, &c.—Of the succus and tincture horses and cattle

take fʒj.; dogs, ℥x. to ℥xl. The extract is six times the strength of the succus or tincture. Hyoscyamine, usually prescribed as a neutral sulphate, is one hundred times more active than the extract, and is sometimes used hypodermically.

ICHTHYOL.

Ichthyol is a brown tarry liquid, obtained by the dry distillation of a Tyrolese bituminous shale, and appears to be a residual product of fossilised fish. It is soluble in water, alcohol, benzol, and fixed oils. Purified, it yields a clear sulphurised oil, with a strong empyreumatic smell.

It is antiseptic, stimulant, and antiparasitic. Its properties ally it to the phenols. It has been used by French and German veterinarians as a stimulant and resolvent for rheumatic joints, strains, and contusions; but its chief value is for the destruction of the saropti of scab and mange, and for the treatment of chronic eczema. For such purposes one part is dissolved in ten of oil, lanoline, or a mixture of equal parts of water, alcohol, and ether, and rubbed in daily for several days.

IODINE.

IODUM. A non-metallic element, obtained from the ashes of seaweeds, and from mineral iodides and iodates. (B.P.)

Iodine is present in sea water, and is thence taken up by sea plants and animals. It is prepared from kelp—the semi-vitrified ashes of seaweeds—by solution in water, from which sodium chloride, carbonate, and sulphate, with potassium chloride, crystallise out. The dense dark-brown ley, containing the iodine chiefly in combination with sodium and magnesium, is decanted off, and mixed with one-eighth of its bulk of sulphuric acid, which precipitates sulphur and more sodium sulphate, and drives off carbonic, sulphurous, and hydrogen sulphide gases. The acid fluid is mixed with manganese dioxide, and transferred to iron retorts lined with lead, and heated to 140° Fahr., when the iodine volatilises in violet vapour, and condenses in spherical glass vessels in grey lustrous scales resembling black lead. By a recent process the dry

seaweed is at once economically subjected to distillation in iron retorts, and yields iodine as well as bromine. From the mother-liquors of the Chili nitre mines iodine is now also obtained.

PROPERTIES.—Iodine usually occurs in soft, friable, black or blue-black laminar crystals of a metallic lustre. Its specific gravity is 4.95. It has an acrid, disagreeable taste, and a pungent, unpleasant odour, resembling that of chlorine or sea water. Applied to the skin it produces a brown stain, readily removed by alkalis. At the temperature of the atmosphere it slowly evaporates; at 237° Fahr. it melts; at 392° Fahr. it boils, volatilising entirely in violet-coloured, irritating, antiseptic vapours, nine times as heavy as air. With water it forms a brownish-yellow solution, containing, however, only .05 per cent. It is dissolved by twelve parts of rectified spirit, and still more readily by ether, volatile oils, chloroform, carbon disulphide, and also by solution of potassium iodide, and other salts. It readily unites with metals; the iodides of the alkalis closely resemble iodine in their actions; the iodides of the heavy metals exhibit chiefly the properties of the base.

Iodine is easily **distinguished** by its characteristic odour, by the brown stain it leaves on the fingers, by the violet-coloured vapour it evolves when heated, and by the blue colour it forms with a cold solution of starch. This starch test is inapplicable when iodine is in combination, from which, however, it is readily set free by a drop of weak chlorine solution, or of diluted nitric acid. Iodine is liable to intentional adulterations as well as accidental impurities.

ACTIONS AND USES.—Iodine resembles the other halogens, alike in chemical and physiological actions. Its notable affinity for hydrogen, and its combining with albumin, determine its stimulant, irritant, and caustic effects, as well as its antiseptic, alterative, and resolvent actions. It acts notably on mucous membranes, skin, and lymphatic glands. It is almost a specific for diabetes insipidus in horses. Full doses persisted with produce a state of debility and emaciation termed iodism. Externally, it is applied as an antiseptic, stimulant, counter-irritant, and parasiticide. It is employed for the several purposes of an antiseptic, deodorant, and disinfectant.

GENERAL ACTIONS.—It is an active antiseptic, whether used in the gaseous, fluid, or solid state. One part in 4125 parts of water arrests the action of diastase and ptyalin; one part in 7817 arrests the action of pepsin; one part in 7000 destroys both bacilli and their spores (Wernitz and Koch). Iodine stains the skin yellow-brown, and is almost the only substance that penetrates the unbroken skin; strong solutions cause hyperæmia, irritation, and desquamation of the cuticle; but the irritant action can readily be regulated. The skin and nutritive processes may be stimulated; structures, whether natural or morbid, may be gradually liquefied and absorbed; tissues may be more rapidly dissolved and cauterised. A like gradation of effect is produced when iodine is brought into contact with mucous or other structures. It is volatile, penetrating, and adherent for considerable periods to parts with which it is placed in contact. Large doses if swallowed cause gastro-enteritis, and if inhaled produce rhinitis, laryngitis, and bronchitis. In the stomach it is converted into iodides and iodates. Medicinal doses are absorbed, stimulate glandular activity, and promote metabolism. In the tissues iodine may again be set free, and combine with serum albumin, but iodine albuminates are unstable, and hence readily removed. This appears to explain the action of iodine and its compounds in the liquefaction and absorption of pathological products. It combines with lead, mercury, or other metals present in the body, and hastens their removal. It is excreted by the mucous surfaces and glands, notably in the saliva, perspiration, and urine, while full doses during excretion irritate the excreting channels.

Although the element itself is less active than chlorine or bromine, its compounds are more active, probably because they are more readily decomposed. The iodides of potassium, sodium, and ammonium conjoin the effects of their salt-radicle and base, but are less irritant, less active as gland stimulants, although more prone to affect the kidneys. The iodides of iron, copper, lead, and mercury mainly exhibit the actions of their powerful bases. In stimulating the skin and mucous surfaces iodine shows some resemblance to arsenic and sulphur.

TOXIC EFFECTS.—Hertwig gave horses 40 to 60 grains of

solid iodine twice daily for fourteen days, with the effect of causing slight diarrhœa, with black evacuations and increasing emaciation. Professor Dick repeatedly gave larger quantities for several weeks, without observing any other symptom than the total refusal of water. To one horse he administered for three weeks doses averaging two drachms per day, and towards the end of the experiment amounting to two ounces daily. Several ounces have also been given to cattle with the like negative results. In many of these cases the iodine, having been given in the solid form, must have been slowly, perhaps only partially, dissolved and absorbed, and, during tardy solution, may in great part have been neutralised by contact with starch food.

Dogs receiving two or three drachms of solid iodine speedily get rid of it by vomiting; but when the œsophagus is tied such doses cause fatal gastro-enteritis in two to seven days, leaving numerous yellow spots and little ulcers in the stomach, and a peculiar rose tint of the liver (Cogswell). Hertwig found that such doses killed every dog to which they were given, inducing sero-sanguineous exudation and hæmaturia. Fröhner states that intravenous injection causes solution of the red globules, inducing hæmoglobinuria, anæmia, lung œdema, hæmorrhagic inflammation of the pleura and peritoneum, and bloody discharges from the bowels and kidneys.

Iodism, produced by prolonged administration of full doses, is characterised by loss of appetite, an irritable, catarrhal condition of the mucous membrane of the nostrils, eyes, throat, and digestive organs, a vesicular skin eruption, abstinence from water, diminution of the urinary secretion, languor, inaptitude for exertion, elevation of temperature and emaciation. But iodism is exceedingly rare either in man or the lower animals. Where it occurs, it is arrested by withholding the medicine, exhibiting starch, in order to convert any unabsorbed iodine into the innocuous starch iodide, and giving mineral tonics, bitters, and nutritive diet.

MEDICINAL USES.—Iodine is prescribed as an **alterative** and **resolvent** in enlargement of the liver and udder, in chronic rheumatism, especially involving the joints, in hydrothorax and ascitis, and in persistent cases of psoriasis, in which Professor

Williams uses it both externally and internally in the form of liquor arsenii et hydrargyri iodidi (p. 274). Some American practitioners conjoin iodine with carbolic acid in **febrile attacks**, especially when depending upon malaria. **Dry, congested** conditions of the **respiratory mucous membrane** are sometimes relieved, and secretion of healthy mucus encouraged, by inhalation of steam or warm air, medicated with a little iodine tincture. Similar inhalations are also beneficial in checking muco-purulent discharges from the nostrils or sinuses of the head, and in putrid and infective sore-throat.

Iodine is pre-eminently useful in that variety of **diabetes insipidus**, or polyuria, affecting horses in which twenty or thirty pints of urine are sometimes passed daily, thirst is insatiable, and strength and flesh are rapidly lost. Iodine given night and morning seldom fails to arrest this disease in two or three days. How it does so is not satisfactorily explained. It may exert some specific action on the lymphatic glands concerned in secondary digestion, or its antiseptic effects may control excessive production of injurious enzymes. But neither quinine, iron, nor arsenic, although possessed of notable antiseptic properties, are as effectual as iodine in this form of diabetes. Neither potassium nor iron iodide is as trustworthy as the crude drug. Mr Thomas Dollar, of New Bond Street, London, informs me that he has experimented with various more correct chemical combinations, but finds none so reliable as iodine ℥ss., iron sulphate ℥ij., and powdered gentian ℥iv., made into bolus with treacle, syrup, or meal and water. This is repeated once, in bad cases twice, daily. Rarely are more than six doses required to effect a cure.

Externally, iodine is used as a stimulant and resolvent in chronic synovitis, bursal enlargements, muscular pains, strains of tendons, thickening of periosteum, and indurations of the udder and other glands. It is also used as a counter-irritant in sore-throat in horses, in circumscribed lung consolidation, especially in dogs, and in subacute attacks of pleurisy. It is a serviceable stimulant and deodoriser for unhealthy and malignant wounds. Indolent ulcers are sometimes healed by application of a piece of lint, spread with simple cerate, sprinkled with one to five grains of iodine, and covered with a piece of oiled

silk or tinfoil. But excess of iodine must be avoided, otherwise corrosive instead of healing effects are produced. Dilute iodine solutions are injected, as stimulating antiseptics and promoters of adhesion, into cysts and abscesses from which serum or pus has been withdrawn. On account of its penetrating the hair follicles and ducts, it is serviceable in persistent cases of mange, eczema, and psoriasis, in both the cryptogamic contagious and herpetic non-contagious forms of ring-worm, and in such cases is sometimes mixed or alternated with wood-tar oils, sulphur, or mercurials. Like most effectual antiseptics, it destroys skin parasites. It is an effective but expensive deodoriser and disinfectant.

DOSES, &c.—For horses, grs. xx. to ℥i.; cattle, ℥ss. to ℥iss.; sheep, grs. xv. to grs. xl.; pigs, grs. x. to grs. xx.; dogs, grs. iij. to grs. viij. Such doses are repeated once or twice daily, given a couple of hours after eating, in order to diminish the proportion otherwise converted into the mild, insoluble starch iodide, continued for a week or ten days, withheld for a day or two, and, if necessary, again resumed. Larger doses, although they may be given with impunity, do not ensure better curative results.

Iodine is administered in **bolus**; but, handy although this form is for horses and dogs, it is less certain than a good **aqueous solution**, such as is obtained by mixing two parts iodine and one potassium iodide with six or eight of water. The potassium iodide ensures perfect solution and full action of the iodine. This concentrated solution is diluted with water as required; the dose is easily ascertained, for the iodide is about half as powerful as the iodine. **Tinctures** have nothing to recommend them in preference to the cheaper watery solutions, and, like them, should be made with potassium iodide, otherwise they do not bear dilution.

For **external purposes** the compound aqueous solution is generally suitable. When gentle stimulation and absorption of iodine are desired weak solutions are used. As a counter-irritant about two parts iodine and one potassium iodide are dissolved in sixteen of water or fatty matters. For reducing bony enlargements such an iodine ointment is sometimes mixed in equal proportion with mercury biniodide ointment. For wounds ten grains each of iodine and potassium iodide to an

ounce of water usually suffice. Two parts iodine, one part potassium iodide, four wood-tar oil, and thirty-two of lard or oil, make a serviceable mange dressing.

Iodide of sulphur is a **stimulant** and **parasiticide**. It is prepared by mixing, in a Wedgwood or glass mortar, four parts iodine with one sublimed sulphur, and gently heating until the mixture liquefies. The red-brown liquid, as it cools, becomes a grey-black crystalline mass, insoluble in water and alcohol, but soluble in glycerine and fats, with eight or ten parts of which it is mixed for liniments or ointments, which are suitable for chronic scaly skin complaints, ring-worm, and mange.

IODOFORM.

IODOFORMUM. A product of the action of iodine on a mixture of alcohol and solution of carbonate of potassium. CHI_3 . (B.P.)

It occurs in shining, lemon-yellow, crystalline scales; is volatile; has a persistent, disagreeable odour and taste; is scarcely soluble in cold water, but dissolves in ether, chloroform, and in fixed and volatile oils.

ACTIONS AND USES.—It contains ninety per cent. of iodine, with which it readily parts, exerting **antiseptic** and **parasiticide** actions. It is not so irritant as iodine. It resembles chloroform and bromoform, and, like them, is a **local anæsthetic**. Swallowed in large doses, it acts on the central nervous system, causing general depression, stupor, and occasionally convulsions. Conjoining antiseptic and local anæsthetic actions, it is valuable in the treatment of wounds.

It has little effect on the unbroken skin, but slightly irritates abraded skin and mucous surfaces. It is a more effectual local anæsthetic than chloroform or bromoform, inasmuch as it is neither so irritant nor so volatile. It is slowly absorbed, forms iodides and iodates, and produces many of the effects of iodine; but when swallowed in large doses it is more lethal. In dogs and cats it induces gastric derangement, vomiting, muscular spasms, lowered temperature, impaired heart action, albuminuria, and narcosis; but neither in rabbits nor in man is narcosis produced (Brunton). Fröhner records that for each kilogramme of body-weight dogs are poisoned by 15 grains given by the

mouth, 20 to 30 grains given subcutaneously, or 7 grains injected into a serous cavity. An old cow which received an ounce and a half died in thirty-six hours, with spasms and narcosis. Chronic poisoning induces emaciation and fatty degeneration of muscles and glands (Fröhner). Iodoform is slowly excreted, chiefly in the urine.

It is rarely prescribed internally. Its chief use is as an antiseptic dressing for unhealthy wounds, being especially useful when dressings cannot be conveniently removed, or where they cannot be properly applied, as in wounds of the rectum, bladder, and generative organs. It is used in burns, canker in horses' feet, and fistulæ. Small doses maintain wounds in an aseptic state, promote granulation, and allay irritation. Wounds are dusted with the powder, used alone or mixed with boric acid; are covered with iodoform gauze, or moistened with an ethereal or oily solution. Oil of eucalyptus, or balsams of Peru or Tolu, are convenient solvents, which also cover the disagreeable smell and taste. As a parasiticide it is used in the same cases as iodine. Ethereal solutions are injected in ozæna and ulcerated sore-throat. Pencils made with 50 to 70 per cent. of iodoform, mixed with starch and gum, are used in wooden holders for dressing wounds; while injections and suppositories made with eucalyptus oil and cacao butter, are serviceable as deodorisers and local antiseptics in painful conditions of the rectum and urino-genital organs. Although not liable to cause injury by absorption, dogs, unless muzzled, are prone to lick the dressed surfaces, and in this way are sometimes poisoned.

Iodol (tetra-iodopyrol) (C_4I_4NH), is a light-brown, tasteless, crystalline powder, with a faint thymol-like smell, insoluble in water, but dissolved by three parts of alcohol, and also readily in ether and chloroform. It resembles iodoform, and being less irritant, is preferable for internal use. Horses and cattle take grs. xv. to grs. xxv.; dogs, gr. i. to grs. iii. It may be given suspended in glycerine or mucilage.

Aristol is a compound of iodine and thymol, conjoins the properties of its two constituents, and resembles iodoform, but is devoid of its disagreeable taste and toxic effects. It is used for the same purposes as iodoform. It is soluble in fixed oils, but not in water or alcohol.

IPECACUAN.

IPECACUANHA. The dried root of *Cephaëlis Ipecacuanha*. (B.P.)
Nat. Ord.—Cinchonaceæ.

The *Cephaëlis Ipecacuanha* is a Brazilian shrub two to three feet high. The root, the only officinal part, is usually collected during the first three months of the year. It occurs in twisted, knotted pieces, two to four inches in length, of the thickness of a quill. The tough, white, internal woody matter is inert; the brittle brown bark, marked with unequal rings, contains the active principle. The powder is grey-brown, has an acrid, bitter taste, a faint, nauseous odour, and communicates its properties to hot water, alcohol, and diluted acids. Besides other plant constituents, it contains an odorous volatile oil, the amorphous red-brown tannin called ipecacuanhic or cephaëlic acid ($C_4H_9O_7$), and, in combination with it, about one per cent. of the alkaloid **emetine** ($C_{80}H_{44}O_2N_8$), usually occurring in amorphous colourless powder or transparent scales, slightly bitter, soluble in hot water, alcohol, and dilute acids, but not in ether. A volatile alkaloid has also been isolated (*Year Book of Pharmacy*, 1891).

ACTIONS AND USES.—Ipecacuan and emetine are topical irritants and emetics. When absorbed they dilate blood-vessels, reduce blood-pressure, increase secretion, notably from the bronchi, intestines, skin, and liver. They are used as expectorants and diaphoretics, and occasionally as anti-dysenterics.

Ipecacuanha powder, or emetine, like tartar emetic, when applied locally **irritates** the skin and mucous membranes. When swallowed by dogs or other carnivora, they produce similar in-contact irritation, stimulate the ends of the vagus, **causing vomiting**, and when absorbed into the blood likewise produce emesis by irritation of the vomiting centre. Full doses induce gastro-enteritis, with congestion, and œdema of the respiratory mucous membrane and lungs. Professor Rutherford found that 60 grains of ipecacuan powerfully stimulated the liver of dogs; 3 grains given to a dog weighing 17 lbs. produced no purgation, but increased the mucus secreted from the small intestine (*Journal of Anatomy and Physiology*, October

1876). Bracy Clark states that 3 ounces kill a horse. It is more active when given in solution than in bolus.

MEDICINAL USES.—As an **emetic** for dogs, cats, or pigs, it acts more slowly and gently than zinc or copper sulphates, and is less nauseating than tartar emetic. As an **anti-emetic**, drop doses of the vinum, conjoined with morphine or chlorodyne, are sometimes serviceable in dogs. Given in doses insufficient to cause emesis, or used in horses or other animals which do not vomit, it **promotes secretion of bronchial mucus**, and hence is serviceable in the dry stages of catarrh and bronchitis. Mr Thomas A. Dollar, of New Bond Street, frequently gives a drachm of powdered ipecacuan with an ounce of medicinal ammonia acetate solution, in ten ounces of water, repeating the dose several times daily. Following the practice of human medicine, American practitioners prescribe it as an anti-dysenteric, in half-drachm doses, for horses and cattle, and Professor Robertson also recommended it in these cases, in conjunction with opium.

Doses, &c.—Of the powder, as an emetic, dogs take grs. xv. to grs. xxv.; cats, grs. v. to grs. xij.; pigs, grs. xx. to grs. xxx., given in tepid water, either alone or with half a grain to a grain of tartar emetic. Mr Mayhew recommends for the dog, ipecacuan, grs. iv., tartar emetic, gr. $\frac{1}{4}$, with antimonial wine, fʒj. to fʒij., dissolved in tepid water, fʒj., and repeated every half-hour until vomiting takes place. Some practitioners use **Dover's powder**, or its pharmaceutical imitation, made by triturating together one part each ipecacuan and opium, and eight parts potassium sulphate. Of this expectorant and diaphoretic, horses and cattle take ʒi. to ʒiij.; sheep, grs. xxx. to ʒi.; dogs, grs. x. to grs. xv.; cats, grs. ii. to grs. v., repeated several times daily, the patient supplied with plenty of diluents, and kept comfortably clothed, and in an atmosphere of about 60° Fahr. The **wine** is prepared by macerating an ounce of bruised root in a fluid ounce of acetic acid, adding a pint of water, evaporating to dryness, and macerating the residue with a pint of sherry.

Emetine, when inhaled even in minute amount, irritates the mucous membranes of the air-passages, and induces symptoms analogous to hay fever. Two grains swallowed by a dog caused

violent vomiting, increased mucous secretion from the respiratory and alimentary membranes, inflammation of the stomach and intestines, stupor, and death in twenty-four hours (Magen-die). It is eliminated by the mucous membranes and liver, increasing secretion of bile. Large doses lower temperature, relax voluntary muscles, and kill by cardiac paralysis (Dr A. E. D. Ornellas, *Pharmaceutical Journal*, January 1874).

IRON AND ITS MEDICINAL SALTS.

IRON. Ferrum. Ferrum redactum. Pulvis Ferri. Fe.

Iron is a lustrous grey metal, tenacious, malleable, ductile, the least fusible of the useful metals, but readily welded at a white heat, and with a specific gravity of 7·7. It is attracted by the magnet, and becomes itself magnetic. It is widely diffused in rocks and soils, and is present in the structures of plants and animals. Small quantities occur uncombined, probably of meteoric origin. Its chief ores are the oxides, comprising magnetic ore and hæmatites; the carbonates or clay ironstone, and blackband; and the bisulphide or pyrites.

In the blast furnace, in contact with coal, limestone, and sand, or other suitable flux, the ores are smelted or roasted; clay and other impurities are transferred to the fusible slag, while the metal, retaining from 2 to 5 per cent. each of carbon and silicon, is drawn out as **pig or cast iron**. In the manufacture of **bar or wrought iron** the cast iron is exposed to hot air on the refining hearth, to a high temperature in the puddling furnace, and to squeezing under the steam hammer. Most of the carbon, silicon, sulphur, and phosphorus is thus removed; while, by subsequent pressure under heavy rollers, greater tenacity and more fibrous texture are imparted. The Bessemer process dispenses with the laborious puddling, and secures very similar results, by heating cast iron in large crucibles, and forcing air through the molten mass. **Steel** is made by heating bars of wrought iron in contact with charcoal, of which it takes up 0·2 to 1·2 per cent., the former constituting mild steel, the latter the hardest steel.

Iron forms three compounds with oxygen — FeO , Fe_2O_3 ,

and Fe_3O_4 —the last being a compound of the other two. Iron forms two series of salts—the lower proto or ferrous salts, in which it is diatomic and magnetic; and the higher per or ferric salts, in which it is triatomic and non-magnetic.

The ferrous salts are reducing agents, are chiefly grey or green, and in solution give, with hydrochloric acid and sulphuretted hydrogen, negative results; with ammonium hydro-sulphide, a black precipitate of hydrated sulphide ($\text{FeS}\cdot\text{H}_2\text{O}$); with caustic alkalies, white or grey precipitates of hydrated protoxide, $\text{FeO}(\text{HO})_2$, rapidly becoming green and then brown; with potassium ferrocyanide, a white precipitate (K_2FeFcy), gradually becoming blue by oxidation; with potassium ferricyanide, a precipitate dark-blue from the first ($\text{Fe}_3\text{Fe}_2\text{Cy}_{12}$).

The ferric salts are oxidising agents, are mostly brown or red, and in solution exhibit, with hydrochloric acid, a negative reaction; with sulphuretted hydrogen, give a white precipitate of sulphur; with ammonium hydrosulphide, the black ferrous and ferric sulphides, together with sulphur; with caustic alkalies, a brown-red precipitate of ferric hydrate; with potassium ferrocyanide, a deep-blue precipitate of Prussian blue at once goes down; with potassium ferricyanide, no precipitate, but an olive or brown decoloration; with solution of galls, neutral solutions yield a blue-black precipitate—the basis of writing ink; with potassium sulphocyanide, an intense blood-red colour.

ACTIONS AND USES.—Iron and its salts were the first mineral substances employed in medicine; they have been used for three thousand years; but although anciently and extensively prescribed, a good deal has still to be learned regarding them.

In the economy of nature iron performs the part of a **carrier of oxygen**. The ferrous oxide being a strong base, has great affinity for all acids. In the soil it combines with carbonic acid, and thus becomes soluble and freely diffused. In contact with air it is further oxidised into ferric oxide, when carbonic acid is given off, to be used for plant nutrition and for solution of plant food. But the unstable ferric oxide, in contact with organic matters, again gives up oxygen, forming more carbonic acid, and, reduced to the state of ferrous oxide, is ready again to begin the cycle.

In the bodies of the higher animals iron occurs **chiefly in**

the blood. About fifteen grammes, or nearly half an ounce, is yielded from the blood of a horse or ox of about 1000 lbs. live-weight. In the hæmoglobin and oxyhæmoglobin the iron performs much the same functions as it does in the ferrous and ferric oxides in the soils. In the lungs, hæmoglobin takes up oxygen, and becomes oxyhæmoglobin, which readily parts with oxygen as it circulates through the capillary vessels. Thus maintaining the healthy activity of these blood constituents, iron is said to act as a **hæmatinic or blood tonic**. Its curative effects are specially manifested in anæmia and chlorosis, in which the number of red corpuscles and amount of hæmoglobin are seriously reduced, sometimes to the amount of one-fifth of their normal proportion, impairing tissue oxidation and functional activity. Clinical observation testifies that full doses of iron restore the pallid soft textures to their normal colour and firmness, and improve general health. These curative results have hitherto been supposed to depend upon the medicine being absorbed, and directly furnishing iron to the hæmoglobin, restoring its deficiency, and aiding the formation of red blood corpuscles from leucocytes.

The recent investigations of Professor Bunge, of Basil, discredit this view. Dr Stockman, while Assistant to the Professor of *Materia Medica* in the University of Edinburgh, in an abstract of these researches, published in Part IV. of the *Journal of Comparative Pathology and Therapeutics*, points out—(1) That the normal waste of iron and hæmoglobin in the blood is proved to be small. (2) This waste is more than compensated by the ordinary food, which contains iron in an organic form, probably as hæmatogen. (3) But although this form of iron present in food is soluble in alkaline solutions, and is readily absorbed from the intestines, ordinary iron salts, contrary to the views generally held, do not appear to be absorbed, or are absorbed only in minute quantity, and hence cannot, as has been hitherto supposed, directly restore iron to the blood. Professor Bunge and Dr Stockman believe that the primary factor in the production of anæmia and chlorosis “is great poverty of the gastric juice, with attendant dyspepsia and formation of alkaline sulphides. These alkaline sulphides are capable of decomposing the absorbable albu-

minous iron compounds, and thereby render them, like ordinary iron salts, incapable of absorption. Hence the deficiency of hæmoglobin."

Iron preparations are believed to **cure anæmia by removing the dyspepsia** which interferes with the assimilation of the soluble iron in the food. They are attacked by the excess of alkaline sulphides. "In favour of this view," continues Dr Stockman, "is the fact that such enormous doses of iron require to be given to cure a case of chlorosis, small doses being of no value. In two or three days more iron may be given than is present in the whole body; secondly, good hygienic measures and attention to diet frequently cure chlorosis without iron; thirdly, in a healthy subject continued administration of iron does not raise the red corpuscles and hæmoglobin above the normal standard. In all forms of anæmia which have their origin outside the alimentary canal, iron must therefore be powerless."

Neither ferrous nor ferric salts dissolve or pass through the epidermis. Both coagulate albumin, and exert astringent effects on mucous and denuded skin surfaces, and also coagulate blood. Professor Bunge is very confident that iron salts, like those of manganese, howsoever administered, are **not absorbed from the alimentary canal**. They certainly do not directly increase the percentage of iron in the blood, nor the amount excreted by the urine, or in the secretions poured into the intestines. Soluble iron salts, which do not coagulate albumin, when injected into the circulation produce metallic poisoning, characterised by muscular and nervous depression, cardiac weakness, and renal inflammation. But when iron salts are swallowed no such effects are produced, which would certainly be the case if they were freely absorbed. Professor Bunge further states "that all the iron salts—inorganic, organic, and albuminates—become in the stomach either ferrous or ferric chlorides. In the intestine the sodium carbonate, which is always present, turns the ferric chloride into ferric oxide, which remains dissolved in the organic matters of the alimentary canal. On the other hand, the ferrous chloride is transformed into ferrous carbonate, which also remains dissolved in the carbonic acid and organic matters. Both are finally

converted into sulphide by the alkaline sulphides formed during digestion, and are so excreted in the fæces."

It would thus appear that iron salts are **very partially and slowly absorbed** from the alimentary tract; only infinitesimal proportions of the doses prescribed can be used by the red blood corpuscles; the absorbed portions, as occur with so many other metallic salts, accumulate in the liver, and are again returned to the intestine in the bile.

The numerous salts of iron possess much the same kind of action, but differ considerably in the degree of their activity. Comparing the ferrous with the ferric salts, the latter are darker coloured, more soluble and stable, as well as more irritant and astringent. Small dogs are killed by four or five grains of ferric chloride, but swallow without harm forty grains of ferrous sulphate. The more soluble ferric salts are notably irritant, astringent, and corrosive. In the earlier stages of convalescence, where the stomach is irritable, in young patients, and especially in dogs, ferrous carbonate or iodide, in the conveniently keeping saccharated form, is usually better borne than the ferric chloride, or even the ferrous sulphate. But in order to secure the full tonic effects of iron it is specially essential that the bowels be maintained in a natural state, and an occasional laxative should be given to clear away the excess of alkaline sulphides which characterise most cases of anæmia. Where prompt astringent effects are to be produced, full doses of the chloride or other soluble ferric salts are given.

The Pharmacopœias enumerate nearly forty salts of iron, but those chiefly used in veterinary practice, and hence demanding special notice, are the saccharated carbonate, ferrous sulphate, and iodide, with the ferric oxide and chloride.

Metallic iron, as filings or pulvis ferri, is occasionally given in poisoning with salts of mercury and copper. **Iron arsenite** has been prescribed in squamous and herpetic skin diseases, in about the same doses as arsenic, and is also applied externally. **Citrate of iron and quinine**, conjoining the tonic properties of its components, is occasionally used for dogs, in doses of four to ten grains (p. 378). Dialysed iron and amorphous quinine have been conjoined. The **phosphate** ($\text{Fe}_3\text{P}_2\text{O}_8$), re-

commended as being the form in which iron occurs in the blood, is sometimes prescribed in strumous diseases of the bones, in diabetes, and in nervous exhaustion. It is occasionally given to delicate dogs and thriftless foals, along with other phosphates, in the form of Parrish's chemical food, and in nervous depression with quinine and strychnine in the preparation known as Easton's syrup.

IRON CARBONATE. Ferri Carbonas. Ferrous Carbonate. FeCO_3 .
SACCHARATED CARBONATE OF IRON. Ferri Carbonas Saccharata.

The ferrous carbonate occurs in clay iron ore and in many mineral waters. It is prepared by mixing solutions of iron sulphate and ammonium carbonate. It is greyish-green, has a chalybeate, inky taste, and dissolves with brisk effervescence in hydrochloric acid. Exposed to the air, it rapidly absorbs oxygen, gives off carbonic anhydride, and becomes converted into ferric oxyhydrate—a change constantly taking place along the banks of chalybeate streams.

The **saccharated carbonate** is greatly more stable. It is made by rubbing the freshly-prepared carbonate with sugar in a porcelain mortar. It occurs in small, coherent, grey lumps, has a sweet, feebly chalybeate taste, and should contain at least 37 per cent. of carbonate. It is readily soluble, is a mild chalybeate, especially convenient in canine practice, and administered for the same purposes as the sulphate, in three times the doses.

IRON SULPHATE. Ferri Sulphas. Ferrous Sulphate. Green Vitriol. Copperas. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

Iron sulphate may be got by dissolving iron in sulphuric acid; it is the by-product in the making of hydrogen sulphide; but the large supplies required in the arts and in medicine are chiefly obtained from clay shale or alum schist, which contain iron pyrites (FeS_2). Such schists yield both iron sulphate and alums (p. 228). They are broken into fragments; unless containing sufficient bituminous matter, they are heaped in alternate layers with coal, and slowly roasted. The sulphur

is thus converted into SO_3 , and combines with alumina. The heaps remain for several months exposed to the air, and are frequently wetted, when the FeS is gradually changed into FeOSO_3 or FeSO_4 . The heap is lixiviated with water, and the solution evaporated, when the iron sulphate crystallises out, leaving in solution the more soluble aluminum sulphate.

Iron sulphate occurs in bluish-green, oblique, rhombic prisms, which, exposed to the air, gradually oxidise, becoming opaque, and covered with a brown coating of the normal and basic ferric sulphates; an excess of sulphuric acid retards this oxidation. It has an inky, styptic taste; is insoluble in rectified spirit, but soluble in one-third its weight of boiling water and twice its weight of cold water. Heated, it fuses, readily parts with six molecules of water of crystallisation, retaining, however, the seventh more tenaciously. Its distinguishing tests are those of other ferrous salts (p. 458).

ACTIONS AND USES.—Topically applied, it is astringent and antiseptic. When swallowed it is a hæmatinic tonic, astringent, and, in large doses, irritant. It is twice as active as the oxides and carbonates, but is not so astringent, corrosive, or irritant as the ferric chloride or nitrate. As an antiseptic it is not so powerful as the ferric chloride, but has about the same power as the sulphates of alumina and zinc. Professor Gohier administered $10\frac{1}{2}$ ounces to a horse, 6 ounces to a donkey, and 3 ounces to a six-months fowl. All were nauseated; no appreciable increase of iron appeared in the excretions from either bowels or kidneys. The three subjects died the following day, and their intestines were found to be gangrenous (Kaufmann).

MEDICINAL USES.—Iron sulphate is administered to all veterinary patients in **anæmia**, and especially when it is connected with dyspepsia. It improves the appetite, diminishes exhausting discharges, and abates glandular enlargements. It is specially beneficial in anæmia occurring in young horses, cattle, or sheep, kept throughout the late autumn or winter on grass that has lost its nutritive value, or in young stock that have been reduced by restriction to indigestible, poor straw fodder. Along with concentrated, good food, the iron salt in many such cases is

advantageously conjoined or alternated with bitter tonics, *nux vomica*, acids, and occasionally with arsenic.

In conjunction with nutritive and oleaginous diet, iron is given to horses in the earlier stages of tuberculosis and of farcy. It is said to abate nasal gleet and leucorrhœa. It is prescribed with aloes for **atonic torpidity** of the bowels, and for **removing intestinal worms**. Combined with iodine, it arrests that form of **diabetes insipidus** common in horses. It is one of the remedies given to check the earlier progress of liver-rot in sheep. Chorea and epilepsy, when connected, as they often are, with anæmia, are benefited by iron. In septicæmia, pyæmia, and other forms of **blood-poisoning**, the sulphate or other soluble salt is used. In **hæmorrhagic cases**, as in purpura, it is prescribed with a mineral acid, and alternated with quinine. After the bowels are freely opened, it aids recovery of cattle and sheep from red-water.

In **convalescence** from debilitating disorders it is regarded as a valuable hæmatinic. In the several forms of influenza and bronchitis, Professor Robertson was wont to give iron sulphate and *nux vomica*, of each half a drachm, with four drachms of powdered gentian, in bolus. In irritability, chronic catarrh, or hæmorrhagic conditions of the urinary bladder, such as accompany or follow epizootic disorders in horses, it has been prescribed with sulphuric acid and alternated with salicylic acid. A like prescription, or a course of iron and quinine, is advised in convalescence from nephritis. Although itself devoid of purgative effect, iron sulphate is stated to increase the activity of most cathartics with which it is combined. The sulphate is not much used for external purposes. Mixed with sulphates of lime and alumina, Tuson's disinfectant powder is formed, one pound of which, when moistened, gives off seven gallons of sulphurous anhydride.

Doses, &c.—Horses take ℥ss. to ℥ij.; cattle, ℥i. to ℥iv.; sheep, grs. x. to grs. xxx.; pigs, grs. v. to grs. xx.; dogs, grs. ij. to grs. x. The smaller doses are given as hæmatinics and tonics, the larger as astringents. The drug is administered in bolus, solution in water-gruel or ale, or mixed with soft food, and repeated twice or thrice daily. As a tonic for horses and cattle, one to two drachms iron sulphate, and half an ounce each of

gentian and ginger, are made into bolus, or dissolved in a pint of ale or gruel. Such proportions make three or four doses for sheep and eight or ten for dogs. Preparations of iron intended to act as tonics should be given during or shortly after meals. Full doses introduced into the empty stomach, especially of dogs, are apt to cause dyspepsia. To obviate gastric irritation or constipation, and maintain the continued good effects of iron tonics, after being used for a week or ten days they should for several days be withheld, or replaced by other tonics. Confinement of the bowels, and the dark colour and sulphurous odour communicated to the dejections, are abated by appropriate diet and an occasional laxative.

IRON IODIDE. *Ferri Iodidum.* Ferrous Iodide. $\text{FeI}_2 \cdot 4\text{Aq}$.

When iodine, iron wire, and distilled water are gradually heated together, combination occurs, and the solution, filtered and evaporated, yields tabular green crystals, which are inodorous, have a styptic, metallic taste, and are soluble in about their own weight of water and alcohol. When heated they give off violet-coloured fumes of iodine, and, exposed to the air, deliquesce and acquire a red-brown colour. This oxidation is retarded by keeping the solution secluded from light, in well-stoppered bottles, in contact with fresh iron wire; by boiling the freshly-prepared solution in syrup; or by casting the iodide into small plates or cylinders, and at once dipping it in pure stearin, which can be scraped off when the salt is required for use.

ACTIONS, USES, AND DOSES.—It is a hæmatinic tonic, alterative, and astringent. Poisonous doses are irritant, and produce the effects of iron rather than of iodine. Thus, Dr Cogswell found that three drachms caused in dogs vomiting and purging, while one drachm in concentrated solution killed a rabbit in three hours and a half, with the symptoms and post-mortem appearances of poisoning with other soluble salts of iron.

Besides being used for the same hæmatinic purposes as the sulphate, it is given to promote absorption of glandular enlargements, especially in young and weakly animals; it is serviceable in scrofulous swellings of the joints, and was commended by Mr

Morton for its efficacy in polyuria and nasal gleet in horses. The doses are the same as those of the sulphate. It is used in bolus, saccharated powder, and syrup.

IRON SESQUI-OXIDE. Ferric Oxide. Ferrugo. Rust of Iron.
 $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$.

IRON PEROXIDE MOIST. Ferri Peroxidum humidum. Moist Ferric Oxide, $\text{Fe}_2\text{O}_3 \cdot (\text{H}_2\text{O})$, with about 86 per cent. of uncombined water.

Red or ferric oxide is found native in the several varieties of hæmatite, ochre, red chalk, and specular ore. The hydrate is prepared by boiling a solution of ferrous sulphate with a few drops of nitric acid, and as much sulphuric acid as it already contains; decomposing this ferric sulphate by an alkali (the B.P. orders solution of soda), and washing the soft red-brown magma thrown down. This moist ferric oxide, freshly prepared, is the **best antidote for arsenic**. Twelve parts are stated by Sir Douglas Maclagan to neutralise one part of arsenious acid. It mechanically entangles the particles of the poison, and further converts it into an inert substance, the composition of which has not, however, been determined. In human patients doses of a tablespoonful are given every five or ten minutes. Another arsenic antidote is the ferri oxidum hydratum cum magnesia, made by mixing a solution of magnesia with a solution of iron tersulphate (U.S.P.)

IRON PERCHLORIDE. Ferri Perchloridum. Ferric Chloride.
 Fe_2Cl_6 .

Iron perchloride is prepared by heating the metal in excess of chlorine gas, or dissolving it in hydrochloric acid, with a little nitric acid added to ensure production of the higher chloride. The green crystals, having a great affinity for water, quickly melt. The strong watery solution—the **liquor ferri perchloridi fortior**—is orange-brown, odourless, inky-tasted, has a specific gravity of 1.42, and is miscible in all proportions with water and alcohol. Diluted with three measures of water, it constitutes the **medicinal solution**, which, for ordinary

veterinary purposes, is as effectual, and cheaper, than the **tinctura ferri perchloridi**, known as tincture of steel, or steel drops, and made by mixing one measure each of strong watery solution and rectified spirit with two of distilled water. This tincture has a red-brown colour, an ethereal odour, and an acid, chalybeate taste.

ACTIONS AND USES.—Iron perchloride, whether in watery or alcoholic solution, is one of the most soluble, irritant, and corrosive preparations of iron. It is prescribed as a hæmatinic tonic, antiseptic, astringent, and styptic, and is used topically as an antiseptic, astringent, and caustic.

MEDICINAL USES.—The solutions of the chloride are serviceable in most of the cases in which the sulphate has been recommended. They conjoin, with general tonic effects, marked astringent action. They are prescribed in **atonic dyspepsia**, and for the removal of intestinal worms. In **relaxed and diphtheritic sore throats**, which accompany and follow catarrhal fever in horses, half drachm doses, with equal quantity of glycerine and six or eight ounces of water, are given every two hours, administered slowly, so as to act as a gargle, or applied with an atomiser. They are used in anæmia and the several conditions connected with it. Professor Williams states:—“When debility and anæmia are associated symptoms, I have found the salts of iron, more especially the tincture of the perchloride, to have a marked effect in promoting absorption of inflammatory products, fluid and solid. I have a far higher opinion of the effects of iron salts than of iodine or of iodide of potassium. The practitioner, however, is at liberty to combine the iodine with the iron” (*Principles and Practice of Medicine*). In **influenza** and **purpura** in horses it improves the appetite, and is credited with tonic effects both on the blood and arterioles. In **hæmorrhagic cases** it is sometimes prescribed with turpentine, in purpura with quinine. Professor Robertson was wont to treat purpura with iron chloride and sulphuric acid, alternated with occasional doses of potassium chlorate. In **rheumatism**, especially in weakly subjects, it is useful, and may be alternated with salicylic acid. It is administered as an astringent and stimulant of the urino-genital mucous membranes, the tincture, on account of its

greater tendency to be excreted by the kidneys, in such cases being preferable to the watery solution. After the bowels are opened it is serviceable in red-water in cattle.

It is particularly suitable in most cases of **distemper** and **rheumatic lameness** in weakly dogs, and, with or without arsenic, benefits most attacks of chorea and many of epilepsy. In dogs, as in other animals, it promotes recovery from most exhausting diseases.

Externally, it is used as an **antiseptic** and **astringent**. It coagulates albumin, and hence is a valuable **styptic**. Diluted with six or eight parts of water, the medicinal solution is injected into the uterus in cases of post-partum hæmorrhage. Two drachms to a pint of water, injected into the rectum, destroy and bring away ascarides. Actinomycosis, after scraping, is sometimes dressed with the strong liquor, and subsequently with weaker solutions.

Although not so effectual an **antiseptic** as corrosive sublimate, it readily yields part of its chlorine, and arrests the action of ferments. A solution of five per cent. in water in two days retarded the growth of anthrax bacilli, and in six days effectually destroyed both bacilli and their spores, which was effected, however, in two days by corrosive sublimate (Koch).

Doses, &c.—Of the medicinal liquor and tincture, horses and cattle take $\text{f}\overline{\text{z}}\text{ss.}$ to $\text{f}\overline{\text{z}}\text{j.}$; sheep, $\text{℥}\text{xx.}$ to $\text{℥}\text{xxx.}$; pigs, $\text{℥}\text{x.}$ to $\text{℥}\text{xx.}$; dogs, $\text{℥}\text{j.}$ to $\text{℥}\text{x.}$ The smaller doses suffice for hæmatinic or tonic purposes, are repeated two or three times daily, are diluted with at least ten parts of water, ale, or gruel; are sometimes conjoined with mineral acids, quassia, and other bitters, or with alcohol or ether. They are incompatible with ammonia, alkalies, or their carbonates, and with tannin-containing substances. The larger doses mentioned are given when powerful astringent effects are required. As caustics, the liquor ferri perchloridi fortior and the liquor ferri pernitratris, $\text{Fe}_2(\text{NO}_3)_6$, are sometimes used, the latter being also prescribed in obstinate diarrhœa, dysentery, and bleeding from the bowels.

JABORANDI.

PILOCARPI FOLIOLA. The dried leaflets of *Pilocarpus Pennatifolius* (Lemaire). (B.P.) *Nat. Ord.*—Rutaceæ.

PILOCARPINE NITRATE. *Pilocarpinæ Nitras.* Pilocarpine Hydrochlorate. *Pilocarpinæ Hydrochloras.* Salts of an alkaloid obtained from Jaborandi. (B.P. and U.S.P.)

The shrubs yielding jaborandi are natives of Brazil. The leaves and bark have a slightly aromatic odour and a bitter, pungent taste, and produce when chewed a tingling sensation and increased secretion of saliva. The leaflets are about four inches long, and contain an acrid resin, an essential oil consisting in part of a dextrogyrate terpene ($C_{10}H_{16}$), and an amorphous liquid alkaloid, **pilocarpine** ($C_{11}H_{16}N_2O_2$), which is soluble in alcohol, ether, chloroform, ammonia, and dilute acids, and forms crystallisable salts, the hydrochlorate and nitrate being chiefly used. Another alkaloid, **jaborine**, occurs in much smaller proportion, is stated to be a basic decomposition product of pilocarpine, and is antagonistic to it in its actions.

ACTIONS AND USES.—Pilocarpine and jaborandi leaflets have no notable in-contact effect on the skin or mucous membranes, but when absorbed they stimulate glandular secretion more promptly, energetically, and generally than any other known drugs. The salivary, lachrymal, bronchial, intestinal, urinary, and mammary secretions are increased. The cutaneous perspiratory glands are not so actively stimulated in the lower animals as in man. They, moreover, slightly and temporarily excite and then paralyse the efferent nerves of involuntary muscles, while large doses impair the irritability of voluntary muscles and motor nerves (Brunton). They are prescribed as eliminatives in catarrhal, pneumonic, and rheumatic cases, and in torpidity and obstruction of the bowels—in these being conjoined with physostygmine. Jaborine has actions entirely opposite to those of pilocarpine. It is an anti-secretory and a paralytant of involuntary muscles, thus closely resembling atropine. Its presence in jaborandi and in commercial specimens of pilocarpine hence interferes with their characteristic actions.

GENERAL ACTIONS.—Pilocarpine stimulates the peripheral terminations of efferent nerves going to glands and to involuntary muscles, and also excites the nerve centres presiding over secretion. In the lower animals secretion of saliva is early and prominently increased. Horses subcutaneously injected with three to four grains in two or three minutes are **freely salivated**; within one hour three and a half pints of saliva have been collected; during the next hour about half that quantity, but an hour later the secretion was nearly normal (Kaufmann). The nasal and lachrymal secretions are augmented. So much bronchial mucus is outpoured that a distinct r le is audible, and in poisonous doses the accumulation of fluid and œdema of the membrane cause dyspnoea, which is sometimes fatal. The intestinal glands are stimulated, rendering the dejections more abundant, soft, and shortly semi-fluid. Small and moderate doses increase the secretion of urine, and also of milk. In man pilocarpine produces profuse sweating, but in the lower animals even full doses only render the skin moist. By its stimulation of the skin growth of hair is said to be encouraged (Fr hner).

Pilocarpine temporarily stimulates the peripheral terminations of the efferent nerves distributed to involuntary muscles, and secondarily, and especially in large doses, paralyses them. Injected into the conjunctiva, the circular fibres of the iris are contracted, but frequently the pupil is subsequently dilated. The muscles of the stomach and intestines are in a state of **active peristalsis**, occasionally accompanied by vomiting, colic, and diarrhoea. The bladder contracts, and urine is passed at short intervals. Contractions of the uterus and spleen are also produced. After slight and temporary stimulation, heart action is slowed and blood-pressure lowered. The temperature, which at first rises, subsequently falls several tenths of a degree. Fr hner states that a single dose in from two to four hours will reduce the weight of a horse from forty to sixty pounds.

Mr I. Print, of Clapham, gave **horses** two to four drachms of the leaves infused in hot water, and in fifteen to twenty minutes observed profuse salivation, continuing for three hours, but without notable diaphoresis, altered circulation, or increased temperature. Carriage horses to which I gave two to four

drachms, in fifteen minutes had saliva abundantly outpoured, and the discharge continued for two or three hours; very slight diaphoresis occurred for twenty minutes; no change was noticeable in the pulse, temperature, or quantity of urine excreted. Mr William Dollar, New Bond Street, London, injected hypodermically $1\frac{1}{2}$ grains pilocarpine in ten parts water into the shoulder of an aged horse $15\frac{1}{4}$ hands; in six minutes marked salivation set in, the saliva pouring out of the mouth; the secretion from the buccal glands also appeared to be augmented. These effects continued for fully an hour and a half; the pulse was lowered in force, and was slowed to the amount of two to three beats; the skin, previously dry, became moist, but there was no distinct sweating. Professor Fred. Smith, of the A.V.D., Aldershot, reports that in horses, in about ten minutes after a subcutaneous injection of three grains, there is constant "champing of the jaws, whilst saliva flows from the mouth, sometimes in quite a stream. There is no attempt at sweating; the sweat glands of the horse are perfectly insensible to the action of pilocarpine. The involuntary muscles of the intestinal canal are stimulated, and the rectum is repeatedly emptied. . . . In one case I observed a gulping sound in the throat, resembling the effect produced by aconite" (*The Veterinary Journal*, June 1888).

Horses are poisoned by the subcutaneous injection of five grains (Kaufmann). **Cattle**, however, tolerate much larger quantities. Feser subcutaneously injected a cow and bull with doses ranging from three to eighteen grains. The larger doses produced abundant secretion of viscid saliva, frequent, short, laboured respiration, tympanitic rumen, intestinal irritation, colic, and profuse diarrhoea, but only slight and temporary diaphoresis. Still fuller doses increased the œdema of the lung and paralytic tympany of the rumen, and also weakened heart action. But much larger doses, reaching to forty-five grains, were tolerated when given by the mouth. **Compared with physostygmine**, pilocarpine, although stimulating more powerfully intestinal glandular secretion, had much less effect on intestinal muscular fibre, and two to four times the dose is stated to be required to produce purgation in cattle

(*Thiermed. Rundschau*, March 1889, reported in *Journal of Comparative Pathology and Therapeutics*, June 1889).

Dogs and cats are more sensitive to the drug than horses or cattle. A dog of 25 lbs. weight was prostrated for two days by three-quarters of a grain, and Fröhner records that this dose killed by pulmonary cedema a dog weighing 132 lbs. Half a grain caused profuse salivation, continuing for six hours, and increased action of the bowels and kidneys. Half a drachm to a drachm of the leaves, infused in water, produced in English terriers of 20 to 25 lbs. weight abundant salivation, but no notable diaphoresis. **The physiological opposite** of pilocarpine is atropine, which arrests glandular secretion and paralyzes the nerve endings of involuntary muscles. It is hence the appropriate antidote for poisoning by pilocarpine.

MEDICINAL USES.—The prompt and **general eliminative** action of pilocarpine has suggested its use for the absorption of pleuritic and other effusions, and the removal of products of tissue waste. It has been prescribed for rheumatism, especially affecting muscles, and in chronic eczema. Kaufmann testifies to its value as an **expectorant** in catarrh, pneumonia, and complaints resulting from exposure to cold. In such cases it may be usefully combined with other expectorants. Friedberger and Fröhner advise its subcutaneous injection in acute brain inflammation, hydrocephalus, and laminitis. In nephritis it beneficially removes by other channels the albuminoid waste usually got rid of by the kidneys. In virtue of its increasing alike intestinal secretion and peristalsis, it is serviceable in **torpidity and obstruction of the bowels**, and may even relieve volvulus and invagination. In these gastrointestinal cases it is conjoined with physostygmine, which stimulates muscular contractions more powerfully than pilocarpine (p. 313).

DOSES, &c.—Of the fresh leaves horses or cattle take ℥ij. to ℥iv.; sheep, pigs, or large dogs, ℥ss. to ℥i., given as an infusion. But pilocarpine nitrate or hydrochlorate is more certain and effective, and is prescribed, usually hypodermically, to horses and cattle in doses of gr. ij. to grs. v.; to dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{3}$.

J A L A P.

JALAPA. The dried tubercules of *Ipomœa Purga* (Hayne).
Exogonium Purga (Bentham). (B.P.) *Nat. Ord.*—Convolvulaceæ.

Jalap derives its name from Xalapa or Jalapa, a town in Mexico, whence it was first obtained. The hardy climbers yielding it grow on the Andes 6000 feet above sea-level, are cultivated in Southern India, and in sheltered spots in this country produce their salver-shaped crimson or light-red flowers. The perennial root-stock throws off underground shoots, which at intervals send down roots, gradually thickening, becoming irregularly oblong or ovoid, ranging in size from a walnut to an orange, invested with a thin, brown, furrowed wrinkled cuticle, and presenting within a dirty yellow colour, with dark-brown concentric circles. The larger roots, or tubercules, are divided into halves or quarters, or gashed to facilitate drying. They are tough, and difficult to reduce to powder, which has a pale-brown colour, a faint, disagreeable odour, and a taste at first sweet and mawkish, but afterwards acrid and nauseous. Water dissolves the sugar and mucilage without the cathartic, resinous principles, which are, however, readily soluble in rectified spirit.

Along with starch, cellulose, uncrystallisable sugar, and gum, jalap contains 10 to 12 per cent. of an active **resin**, consisting chiefly of the glucoside convolvulin, which differs from the jalapin of scammony in being insoluble in ether. Before the root is imported the Mexican dealers sometimes, however, extract with alcohol one half the resin.

ACTIONS AND USES.—Jalap is a hydragogue cathartic, a vermifuge, and cholagogue. The ordinary jalap closely resembles the larger rooted male jalap, or orizaba root, the smaller paler tubercules of the tampico root, the dried root of *Convolvulus scammonia*, and the root of *Bryonia alba* and *B. dioica*, as well as the *Kaladana* seeds used roasted as a purgative by the nations of Hindostan. It is more active than senna, the leaves of *Cassia acutifolia*, but less powerful and irritant than gamboge, podophyllum, elaterium, or colocynth.

Jalap has very gentle cathartic action either on horses or cattle. Two or three ounces given to the horse have slight effect on the bowels, but increase the activity of the kidneys (Moiroud). White reports administering half a pound to horses without causing purgation. I have repeatedly given cows four ounces without perceptible effect. For **dogs and pigs** it is, however, a **good purgative**, although full doses occasionally produce nausea and sometimes vomiting. It is prescribed for most purgative purposes, acts tolerably speedily and certainly, produces full watery discharges, and is specially effective when given with a grain or two of calomel. Professors Rutherford and Vignal, experimenting upon dogs, found that jalap stimulates secretion of bile, but still more notably the secretions from the intestinal glands (*Journal of Anatomy and Physiology*, 1876).

Doses, &c.—Dogs take ℥i. to ℥ij.; cats, ℥ss.; pigs, ℥i. to ℥iv. It is best given in combination with calomel. Dogs, if fasted for six hours, are effectively physicked in three or four hours by ℥ss. to ℥i. of jalap, with two or three grains of calomel, made into bolus with any convenient excipient.

JUNIPER TOPS, FRUIT, AND OIL.

JUNIPERI CACUMINA, FRUCTUS, ET OLEUM. Dried tops and fruit of the *J. communis*. Oil distilled from the unripe fruit.
Nat. Ord.—Coniferæ.

The junipers are shrubby evergreen trees, growing in most temperate countries. Their leaves are dark-green, linear, and arranged three in a whorl. Their fruit or berries are bluish-purple, furrowed, of the size and appearance of currants; take two seasons to come to maturity; have an aromatic, terebinthinate odour, and a warm, sweet taste, followed by bitterness. For flavouring gin about two pounds of the berries are added to 100 gallons of spirit. They owe their distinctive properties to about two per cent. of a mixture of two volatile oils, one of which is polymeric with terpene ($C_{10}H_{16}$).

The fresh and dried tops of *Juniperus sabina* constitute savin. From the wood of the *Juniperus oxycedrus*, and

occasionally from that of the communis, the brown empyreumatic oil of cade is got by dry distillation; is used in France and other Continental countries for most of the purposes of oil of tar, and is recommended in scaly skin diseases.

ACTIONS AND USES.—The tops, fruit, and oil of juniper are topical irritants, and when absorbed are mildly stimulant, stomachic, carminative, and diuretic. They resemble the turpentine, and the thuja, or arbor vitæ.

Two ounces of the berries given to horses and cattle have little notable effect; but three or four ounces induce diuresis. The fruit and oil are occasionally given as **stomachics** and **carminatives** in indigestion and flatulence, are stated to diminish the evil effects of bad fodder and marshy pastures, and to aid alike the prevention and cure of liver-rot.

DOSES, &c.—Of the fruit as a stomachic horses and cattle take ℥i. to ℥iij.; sheep, ℥ij. to ℥iv.; dogs, grs. xx. to grs. xl., repeated several times a day, and usually given coarsely powdered and mixed with fodder. They are readily eaten by most animals, especially by sheep. A decoction, made either from the fruit or tops, is occasionally prescribed, and also used as an external stimulant. As a diuretic the oil is the best form. Horses and cattle take ℥i. to ℥ij.; dogs, ℥v. to ℥x., which may be repeated at intervals of three hours till diuresis is induced.

K A M A L A.

A powder which consists of the minute glands and hairs obtained from the surface of the fruits of *Mallotus philippinensis* (*Rottlera tinctoria*). (B.P.) *Nat. Ord.*—Euphorbiaceæ.

The glandular, brick-red, resinous powder, mixed with minute, thick-walled, stellate hairs, which constitute kamala, are obtained from the capsules of an evergreen shrub or small tree indigenous to Australia, India, and Abyssinia. It yields an active yellow crystalline substance—rottlerin.

ACTIONS AND USES.—It is a drastic purgative and vermicide, nearly as effectual for the destruction of tape-worm

but rather more severe than areca-nut and male shield fern. The dose for a dog is ℥ss. to ℥i, administered in thick gruel or treacle.

K E R A T I N.

A mucilaginous solution which, when dry, is a yellow gum-like substance, insoluble in gastric juice, but soluble in the intestinal juices, and used for coating boluses or pills which are required to pass through the stomach without acting upon it, and to undergo solution in the intestines.

Keratin is prepared from horn-turnings by digesting them with artificial gastric juice, so long as they yield any soluble matters. They are then digested for some weeks in solution of ammonia or glacial acetic acid, which gradually dissolves them. The ammonia solution is generally used, but the acetic acid solution is suitable for those drugs which might be decomposed by ammonia. The medicines, made into bolus in the usual way, are generally thinly covered with cocoa butter, and then coated twice with keratin. This method of administration is useful—

(1) For drugs which irritate the gastric mucous membrane—such as anthelmintics, arsenic, creosote, salicylic acid, phosphorus, and the more soluble iron salts.

(2) For such substances as impair digestion in the stomach by precipitating pepsin and peptones—*e.g.*, tannic acid, alum, lead acetate, silver nitrate, corrosive sublimate, &c.

(3) For such substances as are rendered inert by the gastric juice, or are undesirably acted upon by it—*e.g.*, alkalies, soaps, bile, silver nitrate, iodides of iron and mercury, &c.

(4) For medicines which it is desired to introduce into the duodenum in as concentrated a form as possible—*e.g.*, koussou, male shield fern extract, santonin, bile, alkalies, and silver nitrate, lead acetate, or tannin, when their local action is sought to be applied in ulceration or hæmorrhage of the intestines (Dr Lauder Brunton, *Pharmacology*).

K O U S S O .

KOSSO. *Cusso.* *Brayera.* The dried pannicles, chiefly of the female flowers, of *Hagenia abyssinica* (*Brayera anthelmintica*). (B.P.) *Nat. Ord.*—*Roseæ* or *Rosaceæ*.

Koussou consists of bundles, rolls, or complex clusters of pannicles of small reddish-brown flowers, yielded by an aborescent Abyssinian rosacea. Its active principle is kosin—an acid crystalline glucoside, with a bitter, acrid taste, insoluble in water, but soluble in alcohol. It besides contains a bitter resin, tannic acid, and a volatile oil.

ACTIONS AND USES.—It narcotises and kills intestinal worms, and in dogs fasting, two consecutive doses, given at intervals of two hours, and followed by a purgative, frequently bring away tape-worms. Although it scarcely causes catharsis, full doses nauseate dogs and cats, and sometimes excite colic. Dogs, according to their size, take grs. xl. to ℥ij., usually given in infusion, most effectually used unstrained, sweetened with honey or treacle, and the taste veiled by a little peppermint water. Kosin is occasionally given to dogs in grs. v. to grs. xx.

L A N O L I N .

A cholesterin fat obtained from sheep's wool

Sheep's wool, steeped and boiled with water, and exposed to pressure, yields about 11 per cent. of lanolin. It has a firmer consistence than most fats, rapidly takes up 100 parts of water, is of a yellow-brown colour, and has a faint odour. The glycerine present in most fats is replaced by cholesterin, and hence lanolin does not yield soap when boiled with an alkali.

ACTIONS AND USES.—It is stable, little liable to rancidity, and unirritating, and accordingly makes a good, permanent, protecting lubricant. It mixes readily with other fats and oils; is used as a basis for ointments and liniments. For stock ointments a good combination consists of 65 parts lanolin, 30 paraffin oil, and 5 ceresin. It is readily miscible with starch,

bismuth, or zinc oxide; and on account of its bland properties is used in the weeping stages of eczema in dogs. It was introduced with the recommendation that it possessed specially penetrating and absorbent powers; but Dr Jamieson, of Edinburgh, has shown that in this particular it does not materially differ from lard (*The Edinburgh Medical Journal*, August 1887).

LEAD AND ITS MEDICINAL SALTS.

LEAD. Plumbum. Pb.

Lead is chiefly obtained by roasting galena, the sulphide (PbS). It has a blue-grey colour, and a peculiar odour when rubbed; is soft and fusible, melting at 617° Fahr.; is readily cut and rolled into sheets or pipes. It has the specific gravity of 11.4. Exposed to air it oxidises, loses its metallic lustre, and becomes dull and opaque. In contact with air and water a soluble basic carbonate is gradually formed, and water thus contaminated is dangerous. Lead is divalent or diad.

ACTIONS AND USES.—The salts of lead resemble those of tin. Metallic lead is devoid of medicinal or poisonous action. Shot—an alloy of lead, with two per cent. of arsenic—is occasionally used by the lower order of dealers, temporarily and mechanically to relieve the distressed breathing of broken-winded horses. Four ounces of metallic lead were given to a dog at the Veterinary School of Lyons without effect. Introduced into the animal body, in frequently repeated although small quantity, the metal is apt, however, to become oxidised, dissolved, and cause poisoning. Painters, plumbers, and other persons working with lead frequently suffer from lead-poisoning, and such poisoning also occasionally occurs in the domestic animals.

The soluble salts—such as the nitrate and acetate, as well as the peptonates formed in the stomach—**unite with albumin**. Small to moderate diluted doses do not irritate either the skin or mucous membranes, but are **astringent, desiccant, and analgesic**. They have a sweet rather than a corrosive taste. When swallowed they act as gastro-intestinal astringents, are absorbed chiefly as albuminates, permeate the tissues, contract arterioles,

elevate blood-pressure, and slow the heart movements. Fuller or continued doses **irritate and then paralyse voluntary and involuntary muscles, and also the central nervous system.** This twofold irritant and paralyzant action is illustrated by the vomiting induced in dogs and cats, the cramp of the intestinal and other muscles resulting in man and other animals, and the paresis developed subsequently by toxic doses. These effects appear to result from the deposition of the lead in the several textures affected. Hence arise, in chronic cases, degeneration of the implicated muscles and cirrhosis of the kidneys and other internal organs. Certain animals exhibit more prominently some of the actions of lead. Muscular weakness and paralysis are well marked in frogs and rabbits, are less pronounced in cats, and are absent in dogs. **Elimination** is slowly effected in the urine, bile, and intestinal mucus (Brunton).

Lead-poisoning, or plumbism, in the lower animals exhibits symptoms analogous to those in man, and frequently continues, in more or less aggravated form, for several weeks, or even months. Digestion is impaired, appetite becomes capricious and irregular; there are spasms and subsequently torpidity of the bowels. These symptoms simulate those of stomach staggers in horses and impaction of the third stomach of cattle—disorders for which lead-poisoning has been mistaken. Distinctive features shortly, however, present themselves. Along the margins of the gums appears a grey or blue line of lead deposited in the connective tissue, blackened by hydrogen sulphide present in the mouth, or sulphur in the food. Colic and constipation are not so invariably present in the lower animals as in human patients. The extensor muscles of the limbs are cramped and paralysed earlier and more seriously than the flexors. The affected muscles gradually waste. The motor area of the central nervous system is more notably involved than the sensory, and choreic movements and convulsions are succeeded by paresis. In cattle lead-poisoning occasionally proves a cause of abortion.

Mr Shenton, a veterinary surgeon practising in Derbyshire, in the autumn of 1861 had eleven **horses poisoned**, and several cattle, and thus described to me the conditions which

came under his observation :—“There was a rough, staring coat, a tucked-up appearance of the abdomen, and a slightly accelerated pulse; in fact, symptoms of febrile excitement, which usually, however, passed away in about a week. About this time large quantities of grey-coloured matter were discharged from the nostrils, and saliva from the mouth; but at no time was there any enlargement of the sub-maxillary, lymphatic, or salivary glands. Neither was there constipation of the bowels, which appears to be nearly always present in lead-poisoning in man. Fits and partial paralysis came on at intervals, and when the animals got down, they often struggled, for a long time ineffectually, to get up again. The breathing up to this period was pretty tranquil, but now became so difficult and laboured that the patients appeared in danger of suffocation. The pulse was in no case above sixty or seventy, and I ascribed the difficulty of respiration to a paralysed state of the respiratory apparatus. The animals did not live more than two or three days after these symptoms appeared. The post-mortem appearances varied little. The lungs and trachea were inflamed, the lungs engorged with large quantities of black blood, the trachea and bronchi filled with frothy spume. In all cases but two the villous portion of the stomach presented isolated patches of increased vascularity, and in all cases the intestines, and especially the large ones, were inflamed. The blind pouch of the cæcum was nearly gangrenous. There was nothing remarkable about the liver, spleen, or kidneys, except that they were of a singularly blue appearance. The brain and spinal cord were not examined.”

Mr Cartwright, of Whitechurch, Salop, recorded in the *Edinburgh Veterinary Review*, August 1863, three cases of **milk cows poisoned by eating sheet lead**, which had been used for lining tea-chests, had been carelessly thrown on the manure heap, and thence spread on the pastures. Besides failure of milk and appetite, grinding of the teeth, and dulness, several curious symptoms are mentioned. The head was rested against any convenient object, as if the animal were asleep, while the pupils were nearly closed, and were little sensitive to light or to movements of the finger. The gait was weak and tottering, while for an hour or two at a time the cows, although persist-

ently standing on their hind limbs, went down on their knees, propping themselves against the wall. They survived four or five days. From the fourth stomach of one cow a pound of fragments of sheet lead was removed; the lining membrane was thickened, and of a brown colour. The mucous membrane of the stomachs and bowels was unnaturally vascular, and exhibited in places patches of ecchymosis. The liver was pale, clay-coloured, compact, and contained little blood. There was nothing amiss with the urinary organs.

Mr W. Watson, Rugby, records the poisoning of three cows, which languished for several months, and died from eating grass on which **bullet spray** from the Rugby rifle butts had fallen. Fragments of the lead were found adhering to the coats of the stomach, and the poison was also detected in the intestines, liver, and kidneys (*Veterinarian*, May and August 1864). Mr Broad, of Bath (*Veterinarian*, April 1865), also records cases of cattle poisoned by picking up bullet spray. The animals were described as dull and tucked-up, the eyes staring, the gait unsteady, the appetite good, but the bowels constipated; emaciation and œdema under the jaw made rapid progress. Portions of bullet spray were found in the second and third stomachs; both large and small intestines were pale-blue and bloodless. Professor Tuson recorded similar symptoms from **licking red paint**, which he found retained for twenty-eight weeks in a cow's stomach. Mr Cox, of Hendon, had several **sheep** which became emaciated and paralysed from eating the splashes of lead bullets, which were found in the stomachs in thin flakes, readily soluble in the gastric fluids (*Taylor On Poisons*). Birds are occasionally poisoned by eating berries contaminated by the smoke of lead smelters.

Mr Herapath reported in *The Chemist* for 1855 interesting cases of lead-poisoning which followed the erection of **smelting furnaces** on the Mendip hills in 1853. The injury appeared to commence half a mile from the chimney, and to extend for half a mile farther. Lead oxides, carbonate, and sulphate were found on the herbage, hedges, and hay. On the live stock "the effects of the metal were stunted growth, leanness, shortness of breathing, paralysis of the extremities, particularly the hinder ones; the flexor muscles of the fore-legs affected, so that they

stood upon their toes; swelling of the knees; but no constipation or colic, as in the human species; in a few months death followed. If the injured beasts were removed to another farm they never throve. In the young the symptoms were more conspicuous and the mortality greater. Lambs were yeaned paralytic; when three weeks old they could not stand, although they made great efforts to do so; in attempting to feed them from a bottle they were nearly suffocated from paralysis of the glottis; twenty-one died early out of twenty-three. Colts also died, and those that lived could not be trotted 150 yards without distressed breathing. Pigs confined to the sty were not injured, but if allowed to roam were soon affected. The milk of cows and sheep was reduced in quality and quantity, and cheese made from the former had less fat in it. I found in the milk of both minute traces of lead. The dead subjects showed the mucous surfaces to be paler than natural; the lungs had large portions of a dark-red colour, with circumscribed edges, not like ordinary inflammation, but evidently surcharged with fluid. This accounted for the shortness of breathing, as only portions of the lungs were fit to perform their functions. In some parts there appeared bluish spots, where the powder had been stopped by the bifurcation of the air-passages. A blue line appeared in the gum of the lower jaw, which Dr Taylor said in court was not caused by lead poison, as it did not occur, as in the human subject, on the upper edge of the gum, but where the gums first come into contact with the teeth, about three-sixteenths of an inch below the top edge. I therefore dissected out this line, which was about three-quarters of an inch in length, and the thickness of sewing cotton, and, by aid of carbonate of soda and the blow-pipe, reduced a spangle of lead from it, quite visible to the jury without the aid of a microscope. I was agreeably surprised at this result, as I expected the mark arose only from altered blood; but it will now become, in the hands of a good blow-pipe manipulator, the most ready means of detecting lead in the dead subject. It will be observed that of the symptoms, those of emaciation, paralysis, and the blue line are similar to those of the human subject, that constipation and colic are absent, and we get two new ones—shortness of breathing and

swelled knees. I will merely add that the company agreed, without calling witnesses, to pay £500 damages, and to buy the estate at full value."

Lead is readily found in the bodies of animals thus poisoned. It has been detected in the blood, the contents of the stomach and intestines, the brain and spinal cord, the muscles, lungs, spleen, and liver. Lead salts in solution give with hydrochloric acid a white crystalline precipitate (PbCl_2), redissolved partially or wholly when heated, but reappearing on addition of ammonia solution, which throws down the hydrate $\text{Pb}(\text{OH})_2$. Hydrogen sulphide and ammonium hydrosulphide precipitate the black sulphide (PbS). Sulphuric acid and soluble sulphates precipitate the white sulphate (PbSO_4). Potassium iodide and bichromate give yellow precipitates of iodide (PbI_2) and chromate (PbCrO_4).

Lead enters the bodies of animals in their food or water, portions of metal are picked up, or paint is licked. The poison is sometimes brought to the farm in street manure. Water is liable to contamination by conveyance through leaden pipes or storage in leaden cisterns. The hounds at the royal kennels at Ascot some years since suffered from paralysis from drinking water contaminated by passing through new lead pipes. At Claremont the late Louis Philippe and his suite had symptoms of lead-poisoning, although the amount of lead did not reach half a grain to the gallon. But in some of the Yorkshire towns where lead-poisoning recently occurred from new pipes, the contamination does not seem to have exceeded one twenty-fifth of a grain per gallon. On lead pipes or vessels the conjoined action of **air** and **soft water** is liable to produce a crust of carbonate (PbCO_3), with variable proportions of hydrate $\text{Pb}(\text{OH})_2$. This crust crumbles away as a crystalline powder, partly dissolved and partly suspended in the fluid. Leaden vessels, or vessels soldered with lead, must therefore be used with caution for storage, especially for any length of time, of water, saccharine or acetic solutions, or other fluids likely to dissolve the metal. This caution is especially applicable to soft waters, and to those rich in chlorides, nitrites, nitrates, and nitrogenous matters yielding ammonia. Hard waters, abounding in carbonates, sulphates, or phosphates, are less

liable to contamination, as their acid, uniting with the lead, forms an insoluble crust, which protects the metal from further action of air or water. But even such hard waters are not absolutely safe from lead contamination. A piece of iron, a patch of soft solder, or a few carbonaceous or other impurities in the lead, are liable to set up galvanic action, and thus dissolve the metal. Great care should therefore be taken to prevent lime, mortar, nails, or in fact any foreign body, getting into leaden cisterns, which should further be emptied and cleaned out frequently, especially when new.

In acute poisoning an emetic or the stomach-pump is promptly used, followed by the appropriate **antidotes**. In chronic poisoning, the lead, whether deposited in the tissues or lodged in the digestive canal, should be rendered insoluble by administration of sulphur, potassium iodide, or magnesium sulphate. The two latter, which are most to be relied on, are given separately, at intervals of two hours, and repeated thrice daily, while a dose of oil is prescribed every third day to hasten the removal of the lead salts excreted into the bowels.

LEAD OXIDES. Plumbi Oxidi. Litharge. Red Lead.

LEAD CARBONATE. Plumbi Carbonas. White Lead. Ceruse.

There are five **oxides** of lead. The plumbous oxide (Pb_2O) is a black powder, obtained by heating lead oxalate (PbC_2O_4). Litharge (PbO) is a yellow, scaly powder, prepared by thoroughly heating the metal, and which, by further fusion and action of oxidising agents, yields the higher oxides.

Lead carbonate, or white lead, is prepared in various ways. In the Dutch process, lead castings are placed over pots containing vinegar, and covered by alternate layers of stable manure and spent tan. The lead is gradually oxidised, then converted into acetate, which in its turn is decomposed, and the basic carbonate is formed, having generally the formula $PbCO_3 \cdot Pb(OH)_2$.

ACTIONS AND USES.—Litharge and white lead are used topically as desiccants and astringents. Mixed with linseed oil, glycerine, or vaselin, they form antiseptic, astringent, protective coverings, useful in burns, herpes, and moist eczema. Animals,

however, are prone to eat or lick such dressings, and to obviate risk of poisoning, zinc oxide and carbonate are hence usually substituted.

LEAD OLEATE. Lead Plaster. *Emplastrum Plumbi*.

The common sticking or diachylon plaster is prepared by boiling together gently, by the heat of a steam bath, five parts litharge in fine powder, ten olive oil, and five water, keeping them simmering for four or five hours, stirring constantly until the product acquires a proper consistence for a plaster, and adding more water if necessary (B.P.) In this process the oil is decomposed in the same manner as fats are acted upon by steam heat, or by alkalis in the preparation of soap (p. 436); lead oleate rises to the surface, and glycerine remains in solution. Lead plaster is sold in rolls, about a foot in length, of a yellow-white colour, and a faint, sweet, soapy odour. Although brittle when cold, it becomes soft and adhesive when heated.

ACTIONS AND USES.—Lead plaster is adhesive, free from irritant properties, and in this form the lead is not liable to absorption. For bringing together the edges of small incised wounds it is generally used spread on linen or calico, and thus applied it besides affords protection and support. Lead plasters are rendered more adhesive, and consequently better adapted for most veterinary purposes, by melting with every pound four ounces of pitch or resin and two ounces of hard soap.

LEAD IODIDE. *Plumbi Iodium.* PbI_2 .

When equal parts of lead nitrate and potassium iodide are dissolved, and the solutions mixed, double decomposition occurs, potassium nitrate remains in solution, and lead iodide is precipitated in brilliant, golden yellow, crystalline scales, or in a fine, bright yellow heavy powder. It is tasteless, colourless, sparingly soluble in cold water, but readily dissolved by boiling water.

ACTIONS AND USES.—It resembles other lead salts; is occasionally prescribed as a gland stimulant, and applied as a dressing for ring-worm and for indolent tumours, being used in the form of ointment or plaster.

LEAD ACETATE. Plumbi Acetas. Sugar of Lead. Neutral Acetate. $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{Aq.}$

LEAD SUBACETATE. Liquor Plumbi Subacetatis. Goulard's Extract. $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{PbO.Aq.}$

Two lead acetates are used in medicine—the neutral acetate or sugar of lead, and the tribasic, which occurs in Goulard's Extract.

Sugar of lead is obtained by dissolving litharge in excess of acetic acid, or by exposing it to acetic acid vapour; and also by immersing castings or coils of lead in dilute acetic acid, scraping off the crust of subacetate and subcarbonate which accumulates, dissolving it in acetic acid and evaporating. Lead acetate is sold in minute needle-like crystals, which are slightly efflorescent, have an acetous odour, and a sweet astringent taste. It is soluble in about twice its weight of water at 60° Fahr., and in solution unites with different proportions of the oxide, forming subsalts.

The **liquor plumbi subacetatis**, or Goulard's Extract, is prepared by boiling 5 ounces of acetate of lead and $3\frac{1}{2}$ ounces oxide of lead, in powder, in a pint of water, for half an hour, constantly stirring; then filter, and, when the liquid is cold, add to it more distilled water, until the product measures twenty fluid ounces. Keep the clear solution in stoppered bottles (B.P.) It is a colourless, transparent, alkaline liquid, has a sweet, astringent taste, and unless concentrated becomes turbid on exposure. From a solution of the neutral acetate it is distinguished by its alkalinity, by the copious white precipitate thrown down when a stream of carbonic acid gas is passed through it, and by its producing an opaque white jelly when mixed with gum arabic mucilage.

ACTIONS AND USES.—The acetates exhibit the physiological actions of other soluble lead salts. They are prescribed as astringents and styptics, and externally as astringents and analgesics. They are less corrosive and astringent, and more soothing, than zinc or copper acetates. The greater solubility of Goulard's Extract renders it more active than the sugar of lead, and it is preferable for external application on account of its not drying or crystallising.

TOXIC EFFECTS.—Hertwig gave a pound of sugar of lead to horses, and observed nausea, colic, a quick, small, hard pulse, stiffness of the limbs, paralysis of the optic nerve, and sometimes of other parts, insensibility, and often death. Even more energetic effects occur in cattle. Prinz observed that half an ounce given daily for three days produced in cows fever, with a quick, throbbing pulse, colic, and other symptoms of abdominal pain; in one case mania, but in none death. Mecke found that eight ounces, dissolved in water, and given in divided doses during two days, destroyed nine cattle—the first on the second, the last on the fourteenth day after the poison had been given. Early in 1857 a farmer near Glasgow lost eight cows from their boiled food having been stored in a large tub obtained from a chemical manufactory, and impregnated with sugar of lead. The symptoms were similar to those above recorded. **Dogs** receiving half an ounce, retained by tying the œsophagus, suffered intense intestinal irritation, and died, occasionally in nine hours, but sometimes only after two or three days (Orfila). Owing to chemical action the membrane of the stomach is grey, of a macerated appearance, and sometimes vascular, especially in cases that survive long. Similar symptoms and appearances are observed when sugar of lead is absorbed from a wound, or injected into the veins.

MEDICINAL USES.—Lead acetate is administered to check hæmorrhages, especially from the stomach and lungs. It used to be prescribed in purpura in horses and red-water in cattle; but other remedies are more effectual. Half-drachm doses each of sugar of lead and opium, given daily, sometimes check the dangerous diarrhœa and dysentery which attack badly-managed anæmic cattle in autumn and early winter. Scouring lambs are equally benefited by eight or ten grains each of lead acetate and opium. In many of these cases, besides being given by the mouth, it is also added to starch injections.

Externally it is applied to check superficial, circumscribed inflammation; to soothe and heal burns, bruises, and irritable moist ulcers; to cool and relieve strained, inflamed tendons and joints; in conjunction with a dose of physic, to abate the itching of nettle-rash and erythema; to remove the irritation and heal the excoriations of herpes circinatus; to limit the

pimples and surrounding inflammation of acne; to arrest irritation and discharge in the moist stages of eczema, in such cases being advantageously alternated with dilute alkalies, sulphur or citrine ointments, or yellow wash. It is applied in mucous and catarrhal inflammations of the eye, but is unsuitable when there is abrasion or rupture of the cornea, as insoluble lead albuminates and sulphates are formed, causing opacity, which is difficult to remove.

DOSES, &c.—Of the lead acetates, horses and cattle take ℥ss. to ℥i.; calves and sheep, grs. x. to grs. xx.; pigs, grs. ij. to grs. vj.; dogs, grs. j. to grs. iv., given in bolus or solution, repeated once or twice daily. For external application, sugar of lead is used in powder, ointment, or dissolved in twenty to forty parts of water, with a little vinegar to increase its solubility. Goulard's Extract, diluted with four to six parts of linseed or olive oil, is a cooling application for blistered or contused surfaces. An equally serviceable astringent and anodyne is made with one part of extract to six or eight of vaselin or glycerine. Equal parts of extract and spirit, diluted with eight or ten parts of water, make a useful refrigerant astringent. One part of lead acetate and three-quarter parts zinc sulphate, dissolved in thirty or forty of water, constitute the familiar **white lotion**, and although the preparation is not chemically a correct one, every-day experience proves it to be a serviceable astringent, analgesic, and antiseptic.

L I N S E E D .

FLAX OR LINT SEEDS. *Semena Lini.* The dried ripe seeds of *Linum usitatissimum.* (B.P.) *Nat. Ord.*—Lineæ or Linaceæ.

LINSEED OIL. *Oleum Lini.* The oil expressed in Britain, without heat, from linseed. (B.P.)

LINSEED CAKE. The residue left after expression of the oil.

LINSEED MEAL. *Farina Lini.*

The *Linum usitatissimum*, or common flax, cultivated in Britain and other European countries, yields several important articles. The stem affords lint and tow; the seeds, crushed,

ground, and subjected to hydraulic pressure, yield linseed oil; the residual cake is a valuable feeding stuff, and when reduced to powder constitutes linseed meal.

The **fibrous stem** is utilised by steeping in water, generally used hot; starch and cellulose are got rid of by scutching; the fibres are hackled and carded—the shorter, coarser portions forming **tow**; the finer, when bleached, are made into **linen**. Soft, loosely woven linen, when scarified, and the cut fibres scraped into gauzy down, constitutes **surgeons' lint**. Both lint and tow, as well as **jute** (the prepared fibre of hemp), are employed as protectives for wounds. When saturated with hot or cold water they prove cleanly substitutes for poultices. For cleansing wounds they are preferable to sponges, which are apt to retain and distribute septic germs, while the rag, lint, or tow is thrown away after use. These fibrous materials, saturated with carbolic or other antiseptic solutions, are used for antiseptic dressings. **Oakum**, consisting of detached fibres of old ropes, when treated with Stockholm tar, is also a cheap antiseptic dressing.

Lint seeds are about two lines long, smooth, and shining, of a brown colour and oval shape, flattened laterally, and pointed at one extremity. They are inodorous, but have an oily, mucilaginous taste. They consist of about 20 per cent. of mucilage, wholly present in the envelope of the seed, and hence only properly extracted by prolonged steeping or slow boiling; 20 of albuminoids, a little sugar, 25 to 30 of oil, contained in the albumen and embryo; 5 to 6 of mineral matters, chiefly phosphates, mostly stored in the husks; 5 to 8 of fibre, and 8 to 10 of water. The seeds, ground and pressed without the aid of heat, produce about 25 per cent. of oil of the best quality; steam heat extracts 25 to 35 per cent. The residual **linseed cake**, or oilcake, contains 10 to 13 per cent. of oil.

Linseed oil is viscid, has a pale-yellow colour, a faint odour, a mild but nauseous taste, and a specific gravity of about 939. It consists largely of olein, or of a variety recognised as linolein. Although it does not solidify until cooled to -15° or -20° Fahr., at ordinary temperatures it oxidises and becomes viscous, hence receiving the title of a drying oil. This drying property is much increased by boiling, or heating it with litharge or

black oxide of manganese. It is insoluble in water, soluble in five times its weight of boiling alcohol, in forty parts of cold alcohol, and in one and a half of ether. Boiled with alkaline solutions it forms soaps. Mixed with an equal quantity of lime water it forms **Carron oil**, a useful dressing for burns and scalds. Exposed for some hours to a high temperature it becomes a dark, tenacious mass, which, when mixed with lamp-black, constitutes **printers' ink**. It is sometimes adulterated with rapeseed oil, but is more commonly of inferior quality from rancidity, from preparation at a high temperature, or from presence of impurities.

ACTIONS AND USES.—**Linseed and linseed cakes** are valuable feeding stuffs for cattle and sheep, and, in restricted amount, for horses. As fat producers they represent about two and a half times the value of starch or sugar. They are emulsified mainly by the pancreatic and biliary fluids; they are absorbed chiefly by the lacteals, and their combustion develops heat and force. In moderate amount they favour assimilation alike of carbohydrates and proteids, with which they are generally given.

Well-boiled linseed gruel, or bruised linseed cake digested in hot water, is a **palatable, digestible nutrient** for horses, cattle, and sheep, not only in health, but notably in catarrhal and other inflammatory attacks, in tuberculosis, rheumatism, chronic skin complaints, and during convalescence from reducing disorders. In such cases it proves both food and medicine. In febrile cases many horses will sip cold linseed tea when they will scarcely eat or drink anything else. Where the patient is exhausted, the linseed tea is given with milk, eggs, or beef-tea, or with alcoholic or other stimulants. Horses that are bad feeders, have harsh, scurfy skins, or are affected with roaring or thick wind, are usually much benefited, especially while living mostly on oats and hay, by about a pound daily of bruised linseed cake. For healthy hunters and carriage horses the continued use of linseed cake proves, however, too feeding, and often causes itching. Young herbivora reared on skim milk frequently have linseed gruel mixed with it to furnish requisite fatty matters, and also to prevent the formation of tough, indigestible clots. A mess of linseed

gruel, or a few ounces of bruised cake given daily to calves or lambs, as soon as they will eat it, not only economically favours growth and early maturity, but is tolerably effectual in warding off attacks of diarrhœa, dysentery, and anæmia.

A mucilaginous, demulcent decoction, made with about one part of steeped seed to fifteen or twenty parts water, is useful in irritable conditions of the throat, alimentary canal, kidneys, and bladder; in poisoning with irritants and corrosives; and as a convenient vehicle for the administration of nauseous or acrid medicines.

Ground linseed makes **good poultices**, especially when mixed with an equal quantity of bran or oatmeal; but the bruised linseed cake is cheaper, less apt to become rancid, and equally effectual in retaining heat and moisture. The **common mass** employed for making up balls and pills usually consists of equal quantities of linseed flour and treacle.

LINSEED OIL has been used **dietetically**; but neither for cattle nor sheep does it answer so well as properly prepared linseed or linseed cake. It has the disadvantage of being too laxative, and it increases rather than diminishes the quantity of ordinary food consumed. As an adjuvant feeding stuff for animals in health, I have found it inferior to linseed cake, beans, or oats. One or two ounce doses repeated daily are, however, often beneficial in sore-throat and bronchitis in horses, and especially for subjects that will not take linseed gruel or mashes.

Linseed oil, in amounts too large to be digested, acts as a **cathartic**; it is also **emollient**. It closely resembles rapeseed, almond, and other fixed oils; but is scarcely so actively cathartic as castor oil.

As a laxative it usually produces tolerably full and softened evacuations, without nausea, griping, or super-purgation. It is prescribed for young and delicate horses, and pregnant mares, and for all subjects in influenza, purpura, and other debilitating disorders; in diarrhœa, hernia, and irritable states of the intestine, as well as in overloaded, torpid bowels, where aloes and other active purgatives, especially if repeated, might cause dangerous irritation. It is usually serviceable in warding off attacks of weed, hæmoglobinuria, or fulness and

itching of the limbs, which are liable to occur when hard-worked horses have several days' rest. In the treatment of colic it is generally combined with a stimulant and anodyne. A draught in common use consists of one pint of linseed oil with an ounce each of ether and laudanum, both being doubled in acute cases and in large horses. For colic, aloes, however, generally answers better than linseed oil; but for laxative enemata the oil is preferable.

Two or three ounces of linseed oil, or of a mixture of equal parts of linseed and olive oils, given daily in mash, often suffice, with the use of enemata, to maintain the bowels of horses in a sufficiently relaxed state throughout catarrhal and other febrile attacks. This treatment is also specially suitable in inflammation of the kidneys and bladder, where it is desirable to keep these organs quiescent, and have their excretory work in great part done by the bowels and skin. An ounce or two of oil given daily to broken-winded subjects often relieves them; and Mr Anderson, Glasgow, advantageously combined it with lime-water.

In cattle and canine practice linseed oil is much used as a purgative, especially for young and weakly patients, in advanced pregnancy, in gastro-intestinal derangements, in irritant poisoning, where saline or other active purgatives have been given, and their repetition is inexpedient, and as a convenient menstruum for the administration of croton and oil of turpentine. For calves and lambs it is more gentle and safe than salts. For dogs, especially when young, when the digestive organs are in an irritable state, and exhausting disease has reduced strength, it is a suitable laxative, and more effectual when mixed with an equal amount of castor oil. **As a lubricant and emollient** linseed oil relieves choking; mixed with well-boiled starch gruel, and injected into the rectum, it allays irritation; softening the hard, cracked, or scaly skin, it is applied, often with an alkaline solution, in psoriasis, impetigo, and eczema. Its analgesic effects are increased by admixture with lead acetate solution. For emollient dressings to be used for a considerable time vaselin or benzoated almond or cocoa-nut oils are, however, preferable, as they are not drying or prone to rancidity. The drying properties, possessed

in common with poppy, walnut, and cod-liver oils, render linseed oil less suitable than olive, almond, rape, or colza oils, or than lard for making ointments or liniments. Smart friction with oil often reduces fulness of joints and bursæ. Flannel, soaked in hot linseed oil, is sometimes applied for the relief of rheumatism. The "**black oil**" used in many parts of England for bruises, strains, and wounds, is made with a pint of linseed or other cheap oil, two ounces oil of turpentine, adding six drachms oil of vitriol, and leaving the bottle without the stopper until the heat evolved by admixture of the acid has passed away.

DOSES, &c.—As a cathartic, horses take Oss. to Oj.; cattle, Oi. to Oij.; sheep and pigs, fʒvj. to fʒx.; dogs, fʒi. to fʒij.; cats, fʒi., administered shaken up with linseed gruel, mucilage, milk, treacle, and tepid water, or spirit and water. For horses or cattle it is sometimes mixed with a well-made bran mash.

LIQUORICE ROOT.

GLYCYRRHIZÆ RADIX. The root and subterranean stems or stolons, fresh and dried, of *Glycyrrhiza glabra*. (B.P.)
Nat. Ord.—Leguminosæ.

The perennial herbaceous plants yielding liquorice grow in the temperate countries of Continental Europe. Their roots and underground stems arrive at perfection about the third year, and produce a yellow powder having a sweet taste, and soluble in water, and, to a less extent, in alcohol. Besides starch, sugar, and a resinous oil, to which it owes its sub-acrid taste, liquorice contains about six per cent. of a sweet, yellow, uncrystallisable, unfermentable sugar termed glycyrrhizin. The natural juice or watery infusion, concentrated until it becomes solid, forms the extract or black sugar.

ACTIONS AND USES.—Liquorice resembles sugar and treacle in its dietetic and medicinal uses. It is occasionally used as a demulcent in irritation of the pulmonary mucous membrane, for making up boluses, and covering the disagreeable taste and odour of various drugs.

MAGNESIUM AND ITS MEDICINAL SALTS.

Magnesium salts are obtained from dolomite or magnesian limestone, magnesite, a native carbonate, talc, meerschaum, and other silicates, and from sea-water.

Magnesium salts give negative results with hydrogen sulphide and ammonium hydro-sulphide. Like other salts of the alkaline earths, they produce, with potassium or sodium carbonate, white precipitates, which are basic carbonates. They give gelatinous white precipitates of hydrate with caustic potash and soda, insoluble in excess, but soluble in solution of ammonium chloride, owing to the property which magnesium salts have to form double soluble salts with ammonium salts; while the characteristic reaction is the precipitation of the crystalline white ammonia magnesium phosphate ($Mg(NH_4)PO_4$), when a magnesium salt in solution is treated with ammonia and sodium phosphate. A solution of iodine in caustic potash gives a reddish-brown precipitate, decolorised by excess of caustic potash.

Magnesium salts when swallowed are not rapidly absorbed, and do not cause any toxic effects. The oxides and carbonates are antacids and laxatives; the sulphate is purgative and febrifuge.

MAGNESIUM OXIDES. Magnesia. Calcined Magnesia. MgO .

LIGHT CALCINED MAGNESIA. Magnesia levis.

HEAVY CALCINED MAGNESIA. Magnesia ponderosa. (B.P.)

Magnesia is usually prepared by heating the carbonate to redness, in partially covered crucibles, until water and carbonic acid are expelled. It is also got by mixing solutions of caustic potash and of any magnesian salt.

It is a white odourless powder, with a slightly earthy taste; is very sparingly soluble in water; has much affinity for moisture, but little for carbonic acid. Two varieties occur, differing only in their density: the lighter **magnesia levis**, prepared from the light carbonate; the heavy **magnesia ponderosa**, three and a half times the weight of the other, and prepared from the heavy carbonate.

ACTIONS AND USES.—Magnesia is antacid and laxative. The oxide and carbonate are sparingly absorbed, chiefly as chlorides. They resemble potash, soda, and their carbonates, but lack their stimulating effect upon the mucous membrane, and their diffusible, solvent, and diuretic properties. Their laxative effect and absence of causticity distinguish them from corresponding lime salts.

Magnesia does not purge either horses or cattle, but is a **gentle laxative for dogs and cats**, to which it is occasionally prescribed with calomel, jalap, or buckthorn. Its laxative effects are increased when the bowels contain acid secretions. For foals and calves suffering from acidity and flatulence, acids and bitters are usually the appropriate treatment; magnesia, however, is sometimes prescribed, but must not be too freely or continuously used, as it is apt to congregate and accumulate in the bowels. It is an antidote for poisoning by oxalic and the mineral acids. It removes arsenic from solution, and for this purpose is most effective in the form of the gelatinous hydrate made by adding caustic potash to a solution of the sulphate. It is occasionally applied as a desiccant.

DOSES, &c.—Foals and calves three or four months old take, as an antacid, ℥ss. to ℥i.; dogs and cats, grs. v. to ℥ss. It is given suspended in milk or gruel, and conjoined with carminatives.

MAGNESIUM CARBONATES. $(\text{MgCO}_3)_3\text{Mg}(\text{HO})_2\cdot 4\text{H}_2\text{O}$.

LIGHT CARBONATE OF MAGNESIUM. *Magnesia alba.*

HEAVY CARBONATE OF MAGNESIUM.

When sodium carbonate is mixed with a solution of magnesium sulphate, magnesium carbonate and magnesium hydrate are precipitated. The manner of preparation affects the weight, but not the other properties. Diluted solutions, boiled, yield the light carbonate. Tolerably concentrated solutions, mixed without heat, yield the carbonate, which is three and a half times heavier than the other, more dense, loose, and granular; more starchy, and, under the microscope, is found to be partly amorphous, with intermixture of numerous slender prisms. Both varieties are white, odourless, and tasteless, sparingly soluble in water, but more easily dissolved in hot than in

cold water. **Fluid magnesia** usually contains in every ounce thirteen grains of carbonate, dissolved in water charged with carbonic acid gas.

THE ACTIONS, USES, AND DOSES of the carbonates are similar to those of the oxides.

MAGNESIUM SULPHATE. Magnesii Sulphas. Epsom Salt.
 $MgSO_4 \cdot 7H_2O$.

Magnesium sulphate is present in various rocks and soils, in the proportion of fifteen to twenty grains in the pint of sea-water, and in some mineral springs. It derives its vernacular name from the mineral springs of Epsom. It is obtained **from the following sources** :—

(1) **Dolomite**, a double carbonate of lime and magnesia, is calcined, washed to remove part of the lime, treated with diluted sulphuric acid, when calcium and magnesium sulphates are formed. The calcium salt being insoluble is precipitated; the magnesium sulphate in solution is syphoned off, evaporated, and crystallised.

(2) **Bittern**, the mother-liquor, left when sea-water is concentrated for separation of common salt by treatment with sulphuric acid, also yields magnesium sulphate.

(3) **Kieserite** ($MgSO_4 \cdot H_2O$), from the Saffurt salt beds, when digested with water is gradually converted into $MgSO_4 \cdot H_2O \cdot 6 Aq$.

PROPERTIES.—Epsom salt is usually sold in transparent, colourless, minute, right rhombic prisms, but by slow crystallisation it is got in large prisms. It has a cooling, saline, nauseous, bitter taste; is insoluble in alcohol, but soluble in its own weight of temperate water, and in three-fourths of boiling water. When heated it fuses in its water of crystallisation; but as the temperature is raised the water volatilises, and a colourless glass remains. It **resembles** zinc sulphate, from which, however, it is distinguished by its saline, bitter taste, by absence of metallic astringency, and by its neutral solution giving no precipitate with hydrogen sulphide. Epsom salt is distinguished from Glauber salt by its neither efflorescing when exposed to air, nor communicating any yellow colour to the flame of alcohol. From oxalic acid (for which it has been

sometimes mistaken) it is distinguished by its finer and more needle-like crystals, its bitter taste, devoid of acidity, and its precipitating alkaline carbonates without effervescence.

ACTIONS AND USES.—Epsom salt is purgative, alterative, and febrifuge, and is also feebly diuretic and diaphoretic. As a purgative it resembles common and Glauber salts, and is more active than potassium bitartrate or sodium phosphate.

GENERAL ACTIONS.—When swallowed, it causes outpouring of **secretion from the walls of the small intestines**, most quickly produced, and most abundant where the bowels are partially emptied by several hours' fasting. Neither pancreatic fluid nor bile is materially increased. But Epsom salt has a low diffusing power. It is slowly absorbed, and, moreover, retards diffusion and absorption of fluid present in the canal. In this twofold manner—by (1) **increased secretion**, and (2) **retarded absorption**—the fluid contents of the bowels are increased, producing more or less mechanical distention, and provoking, like other salines, some slight amount of peristalsis. The retarded removal of accumulating liquid is apt to induce flatulence, which is relieved by conjoining carminatives; while effectual removal of the intestinal fluids is attained by using with the saline some aloes, oil, or calomel.

In the small intestine some of the magnesium sulphate is decomposed; its acid portion is more readily absorbed than its basic; part is returned into the intestine, but the greater part is excreted in the urine. Meanwhile, unchanged portions of the salt also undergo slow and gradual absorption; but this is checked when purgation occurs. After a few hours the free acid and undecomposed salt are excreted by the kidneys, and more or less diuresis ensues. A smaller amount is also removed by the skin, notably in men and horses, and when the saline is determined to this excretory channel by warmly clothing the body.

Free secretion from the intestinal walls, and the subsequent more limited excretion from the kidneys, necessarily **removes both fluid and saline matters from the blood**, and within a few hours this loss is in great part made good by **absorption of lymph and fluid from the tissues**. Mainly in this manner result the febrifuge and alterative effects of salines, their lower-

ing abnormal temperature, and their abatement of dropsical effusions.

Dr Lauder Brunton demonstrated, experimentally, the effect of Epsom salt in causing **outpouring of mucous fluid** from the intestinal walls. He placed four ligatures round the intestines of a cat, so as to make three separate closed sacs from five to seven inches long. Into the two outside sacs water alone was introduced; into the centre one were injected seven grains Epsom salt, dissolved in 105 minims of water. The cat was killed four hours later, and although the two outside sacs were quite empty, the middle one, into which the purgative had been injected, contained 320 minims of pale amber fluid, of the nature of a secretion rather than an albuminous exudation. In two similar experiments, 425 and 250 minims of fluid were found, four and five hours after injection of 85 and 90 minims of saturated solution of Epsom salt. No congestion or inflammation was noticed. The loops on either side, which had been filled with the same quantity of water, were empty. Croton oil, elaterium, and gamboge, tested by like experiment, all caused similar secretion, but none so abundant as Epsom salt, which yielded 42 to 56 minims per square inch of intestine acted on by the purgative (*Practitioner*, May and June 1874).

Professor Rutherford's experiments on dogs demonstrate that magnesium sulphate, unlike sodium and potassium sulphates, has no stimulant action on the liver (*British Medical and Surgical Journal*, November 1875). It nevertheless notably **counteracts "biliousness,"** alike in men and animals, by sweeping away unabsorbed bile, generally present in the duodenum, and which, unless removed, becomes reabsorbed.

Epsom salt injected into the circulation does not produce intestinal secretion, but five grains to the pound of body-weight were proved by Dr Matthew Hay to produce powerful **toxic effects** in cats and other animals, paralysing first the respiration and afterwards the heart, abolishing sensation, or paralysing the sensori-motor reflex centres (*Journal of Anatomy and Physiology*, vol. xiv.; *Lancet*, 21st April 1883).

The several domesticated animals are differently affected by Epsom salt. On **horses**, unless given in combination, it acts uncertainly. Full doses sometimes cause violent catharsis, and

occasionally produce considerable diuresis; but two to three ounces, repeated daily, are convenient alteratives and febrifuges. On **dogs** the purgative effect is irregular, and often accompanied by vomiting. For **cattle and sheep** it is a convenient and effectual cathartic, inducing copious fluid evacuations, usually in twelve or fifteen hours.

MEDICINAL USES.—For ruminants it is the purgative in most frequent and general use. In indigestion, constipation, and in the earlier stages of many cases of diarrhoea, it clears the bowels of undigested, fermenting food, of irritant matters, and occasionally of worms. Horses liberally fed on cut, dry food, or tough, over-ripened green fodder, are subject to overloaded bowels, and in such cases, with restriction to fluid food, and in conjunction with one or two doses of linseed oil and copious clysters, two ounces Epsom salt, repeated twice daily, help to moisten, soften, and expel the dry, impacted intestinal contents. Emptying the bowels, and removing excrementitious products from the blood, it lowers abnormal temperature and blood-pressure, and relieves febrile and inflammatory conditions.

Although not a desirable purgative for horses, it is a useful febrifuge. One to three ounces given in influenza, pneumonia, and indeed in most febrile and inflammatory disorders, improve the appetite, abate noisome clamminess of the mouth, lessen fever, and help to establish and maintain a healthy and regular action of the bowels. For such febrifuge purposes, whether in horses or cattle, it is given once or twice daily, but should be withheld or diminished in amount whenever the bowels become unduly relaxed, or where flatulence or spasm follows its use. It acts more certainly and regularly when given in solution than in bolus. It is often conjoined with nitre and other salines, and during convalescence from acute disorders with powdered gentian and other carminatives. Epsom salt is one of the best antidotes for poisoning by salts of lead and barium; it converts them into insoluble sulphates, and further evokes the action of the bowels, which in lead-poisoning is apt to be impaired and tardy. In smaller and repeated doses it acts as a diuretic, but is seldom specially used for that purpose. It is frequently added to laxative clysters.

Doses, &c.—As a cathartic, adult cattle take lbj. to lbjss.; calves of two to three months, ℥ij. to ℥iv.; sheep and pigs, ℥iv. to ℥vi.; dogs, ℥ii. to ℥iv. One-fifth or one-eighth of these doses are often effectual in removing indigestion, keeping up the action of other cathartics, and as febrifuges and alteratives. Epsom salt is given dissolved in ten or fifteen parts of water. To conceal its nauseous, bitter taste, it is administered with treacle, or with sulphuric acid, in the proportion of about five drops to every ounce of salt. To expedite its purgative action and prevent nausea and griping, there is usually added some carminative, such as a drachm of ginger to the ounce of salt. To ensure prompt and full purgation in cattle or sheep, equal weights of Epsom and common salt are preferable to either given alone; treacle and a full dose of ginger are added, and solution is effected in a liberal amount of tepid water. In impaction of the third stomach and obstinate constipation among cattle, it is sometimes requisite to add to such saline purges twelve or fifteen croton beans, a drachm of calomel, or half an ounce of gamboge, and to follow this up with repeated doses of treacle and ginger. In atonic torpidity of the bowels it is conjoined with half a dose of aloes and thirty grains of nux vomica. For febrifuge and alterative purposes, in any class of patients, Epsom salt is conjoined with nitre, mineral acids, gentian, and other bitters.

MARSH MALLOW ROOT.

ALTHÆA RADIX. Dried root of *Althæa officinalis*. *Nat.*
Ord.—Malvaceæ.

The Malvaceæ are rich in mucilage, and several yield tenacious fibres, from which cordage is obtained. The species *Gossypium* have their seeds surrounded by delicate, flattened, twisted hairs, which constitute **raw cotton**, and the seeds by expression yield the bland **cotton seed oil** often substituted for olive oil. The **marsh mallow grows** both in this country and on the Continent, generally in the neighbourhood of rivers and salt marshes. Mucilage is yielded by most parts of the plant, notably by the two and three year old roots, which con-

tain about 35 per cent. each of mucin and starch, and a little uncrystallisable sugar.

ACTIONS AND USES.—Marsh, and also common mallow roots, are digested with boiling water, and the mucilage thus extracted, and resembling that of linseed, is used as a demulcent.

MERCURY AND ITS MEDICINAL COMPOUNDS.

MERCURY. Hydrargyrum. Quicksilver. Hg.

From its mobility and volatility this metal is named mercury; to its silvery appearance it owes its synonym hydrargyrum; to its mobility and metallic lustre such appellations as aqua argentum, aqua metallica, and quicksilver. Although occasionally found in metallic globules, its most important source is the sulphide or cinnabar (HgS). When the ore is roasted or heated with iron or lime, sulphur is got rid of and mercury distils over.

Mercury is easily distinguished by its mobility, liquidity, and silver-white lustre. It is tasteless and odourless; freezes at -40° Fahr., forming octahedral crystals; slowly volatilises at all temperatures, and boils at 662° Fahr., forming a dense, colourless gas. Its specific gravity at 60° is 13.6, its atomic weight 200. It is diatomic, forming, like copper, two series of salts—the lower, or mercurous; the higher, or mercuric. When pure its globules roll over a sheet of white paper without losing their spherical shape or leaving a stain. It forms amalgams with other metals; with about four parts of tin the silvering is made for looking-glasses. Triturated with fatty or saccharine substances, as in the preparation of mercurial ointments, liniments, and pills, the metal loses its fluidity and globular structure, is reduced to the condition of a dark-grey powder, while a small portion is oxidised.

CHEMICAL TESTS.—Metallic mercury is identified by the characters already mentioned. Its several salts are distinguishable by the following tests:—(1) Slightly heated in a quarter-inch test-tube with dry sodium carbonate, they undergo decomposition, the metal volatilising, and condensing in the cool part of the tube in minute globules. (2) When a neutral

solution, whether organic or inorganic, whether containing a mercurous or mercuric salt, has a slip of clean copper placed in it and heat applied, metallic mercury condenses on the copper. (3) A drop of a solution of a mercury salt placed upon a sovereign, and a key or piece of iron placed in contact with the gold and the solution, evolves a current of electricity, which decomposes the salt and precipitates its mercury on the gold as a dark-grey stain, easily removable by heat.

Mercury forms **two series of salts**—(1) the mercurous, which are univalent; (2) the mercuric, which are bivalent.

Mercurous salts in solution (*a*) treated with hydrochloric acid, produce a white precipitate of calomel (HgCl). Silver and lead have similar white, insoluble chlorides; and these three are distinguished by their reaction with ammonia solution, which blackens the mercurous chloride, dissolves the silver chloride, but leaves the lead chloride unaltered. (*b*) Hydrogen sulphide gives a black precipitate of HgS and Hg . (*c*) Potassium iodide in diluted solution yields a yellow precipitate of HgI . (*d*) Potassium chromate gives a light-red precipitate of Hg_2CrO_4 .

Mercuric salts (*a*) treated with hydrochloric acid give negative results. (*b*) To this acidulated solution hydrogen sulphide, cautiously added, throws down a white precipitate ($\text{HgCl}_2 + 2\text{HgS}$), which, on further addition of the precipitant, becomes brown and then black (HgS), and is insoluble in dilute acids and ammonium sulphide. (*c*) Caustic potash yields a yellow precipitate of oxide (HgO), insoluble in excess. (*d*) Potassium iodide gives a precipitate yellow at first, but rapidly becoming red (HgI_2), soluble in excess either of the mercury or potassium salt. (*e*) Stannous chloride produces a precipitate at first white, consisting of calomel, which, as the tin salt is added, becomes decomposed, and darkens, leaving metallic mercury.

ACTIONS AND USES.—Mercury, mercurous salts, and mercuric salts differ in their local effects. Metallic mercury has no topical irritant action, and is slowly absorbed, unless in the state of vapour. **Mercurous salts** have a very slight topical stimulant action, and are slowly absorbed. But the more soluble **mercuric salts** readily unite with albumin, are corro-

sive, act as irritant poisons, and are quickly absorbed. **When absorbed**, all mercurials produce, however, the distinctive condition of mercurialism. Calomel, grey powder, or blue pill, are prescribed to develop mild mercurialism, which modifies the course of localised inflammations, and aids the removal of recent fibrinous deposits. They are cathartics, increasing both secretion and peristalsis, and especially when conjoined with a small amount of any cathartic. They are cholagogue, and also diuretic. Corrosive sublimate, the biniodide, and the double cyanide of mercury and zinc are effectual germicides. Ointments of mercury and of mercuric iodide are applied as anti-parasitics, absorbents, and counter-irritants. Mercurials are **excreted** in the saliva, bile, intestinal mucus, urine, and sweat. They pass into the milk of nursing females; and Gasparin has seen lambs die from mercurialism when the ewes had been freely dressed with ointment. Elimination is tolerably rapid, even when repeated doses have been given; it is completed in about four days after administration has ceased.

Mercury, so long as it remains uncombined, like other metals is devoid of physiological action. Several pounds, which were formerly given to human and veterinary patients for the removal of obstruction of the bowels, produce only mechanical effects. In a state of fine division it is, however, oxidised and dissolved, and hence acquires activity. **Mercurial vapours** thus speedily become **poisonous**, as was strikingly illustrated in the case of the *Triumph* man-of-war and the *Phipps* schooner, which received on board several tons of quicksilver, saved from the wreck of a vessel near Cadiz in 1809. From the rotten bags the mercury escaped, and within three weeks two hundred men were salivated, two died, and all the animals—cats, dogs, sheep, fowls, a canary bird, nay, even the rats, mice, and cockroaches—were destroyed (Pereira). Men working with the metal frequently suffer from mercurial poisoning. Out of 516 workmen employed at the quicksilver works at Idria, 122 were, in 1856, affected with dyspepsia, scrofula, anæmia, neuralgia, mercurial gout, tremor, and caries. The finely-divided mercury so pervaded the atmosphere that cows feeding in the neighbourhood of the furnaces suffered from excessive secretion of saliva, became unthrifty, and aborted: the calves were also often

ailing; while trout in adjacent reservoirs, contaminated by the waste products of the furnaces, lost their red spots and became sickly.

Mercurialism in all animals consists in a chronic condition of anæmia, prostration, and wasting; secretion and excretion are increased. The abundant flow of saliva so notable in man is not, however, observed to the same extent amongst the lower animals. The mouth becomes tender; the gums red, soft, and swollen; the breath fœtid. There is impaired appetite, nausea, gradual loss of condition, œdema, and general weakness. The heart action is enfeebled and respiration impaired. The fæces are increased in quantity, are largely mixed with mucus, and bad-smelling. The functions of the kidneys and skin are exalted. The joints are often stiff and painful. The blood is deficient in fibrin, albumin, and globules; forms a soft, friable clot, and is loaded with a fœtid oil. In man there occur peculiar tremors, passing into paralysis, and affecting certain muscles and groups of muscles. Mr Percivall and Professor Williams describe a form of eczema resembling red-mange, and occurring especially in cattle and dogs. Professor Williams gives woodcuts of cancer-like deposits found in the shafts of the long bones of a dog which had been in the habit of lapping vermilion paint (*Principles of Veterinary Surgery*).

Different species of animals show a diminishing susceptibility to mercurialism in the following order: birds, cats, sheep, cattle, dogs, pigs, and solipeds (Kaufmann). Although generally less susceptible, individual horses exhibit different degrees of susceptibility. Mr Percivall, in his *Effects of Medicines*, mentions that ten grains of calomel given daily to a four-year-old horse made the mouth so sore by the fifth day that he "cuddled" his hay; while a mare had six drachms of calomel, two ounces of blue pill, and mercurial ointment well rubbed into her thighs, without suffering either from sore mouth or salivation. Mercurialism occasionally results from one large dose, when it is apt to be violent and difficult to control, but is induced more certainly and safely by small and repeated doses of calomel, or any mild mercurial, and its production is hastened by using the medicine both externally and internally.

The patient under the effects of mercury must be protected from cold and wet. To arrest excessive action the drug must be withheld; its excretion hastened by administration of potassium iodide, followed by a saline purge; the mouth, if sore, washed repeatedly with solution of chlorinated lime or alum; anæmia and wasting combated by good food, iron salts, and quinine. In poisoning by irritant mercurial salts, the preliminary treatment consists in repeated full doses of albumin and other demulcents.

MERCURIAL OINTMENT. Unguentum Hydrargyri.

Mercurial or blue ointment of good quality cannot be made on the small scale without immense labour and loss of time. The wholesale manufacturer generally uses equal weights of mercury and hog's lard, with one-sixteenth part of suet to impart suitable consistence. The materials are kept in the fluid state by a temperature of about 100° Fahr., and are driven with rapidity round a circular trough by two spherical iron balls propelled by a steam-engine, and in this way extinction of the globules is accomplished in the course of twelve hours. The process is facilitated by addition of one-sixteenth part of old ointment, or a small quantity of potassium nitrate or sulphate. It has a bluish-grey colour, and a specific gravity of 1.78. A good ointment contains about one per cent. of its mercury in the state of oxide, and infriiction and exposure during application increase this more active oxidised portion, which is dissolved by the salts and fatty acids of the skin. This strong ointment is usually diluted with two or three parts of hog's lard or soft soap.

ACTIONS AND USES.—Mercurial ointment, when merely laid on the surface of the skin, exerts slight topical effect, and is only very gradually absorbed. When applied with smart friction it is more quickly absorbed, and, in considerable amount, **irritates, vesicates,** and induces constitutional effects. Two ounces of the strong ointment, rubbed daily into the skin of a horse, salivates in four or five days; but according to Professor H. Bouley, three ounces may, without fatal effects, be thus applied daily for a week. Lafosse produced, however, grave constitutional effects in cattle by rubbing three ounces into

the throat (Kaufmann). When constitutional effects are desired, the external and internal use of the drug is sometimes concurrently adopted.

Mild dressings encourage the healing of indolent ulcers, and promote a healthier action in psoriasis and other persistent scaly skin disorders. For the successful treatment of psoriasis and allied complaints, Professor Williams recommends the internal as well as the external use of liquor arsenii et hydrargyri iodidi. Although not superior to many safer remedies, it is sometimes used for destroying tinea and favus, and killing the acari of mange and scab, lice, and other skin parasites, and for such purposes is frequently conjoined with tar oils, sulphur, or iodine. As a **counter-irritant and absorbent** the strong ointment is employed in reducing swelling of joints and tendons.

Mercurial ointments are apt, however, to be used too freely and indiscriminately. Professor John Gamgee states that a druggist in Boston, Lincolnshire, sold in one year twenty-five tons of mercurial ointment, mostly to farmers. When incautiously used they not only cause undue irritation, but are apt to become absorbed. I have known many cattle and sheep, dressed for skin complaints and skin parasites, suffer from mercurial poisoning, and seen some of these cases terminate fatally. In Lincolnshire a lot of scabby sheep were treated with blue ointment, and forty died, with symptoms of short breathing, a peculiar grunt indicative of pain, and drooping heads (Taylor *On Poisons*). The maximum amount of the strong ointment to be used for horses is two ounces, for cattle an ounce, for sheep half an ounce, for dogs thirty grains to a drachm. For topical purposes a second dressing, if required, should not be applied for two days.

MERCURIAL LINIMENT. Linimentum Hydrargyri.

MERCURIAL OLEATE. Oleatum Hydrargyri.

One part each of mercurial ointment, ammonia solution, and camphor liniment, thoroughly mixed, constitutes the B.P. liniment. Its effects are similar to those of the ointment. Two liniments suitable for persistent scaly skin diseases, enlarged glands, and chronic indurations are subjoined:—

Mercurial ointment, 2 ounces.	Mercurial ointment, 2 ounces.
Camphor, . . . 1 drachm.	Creosote, . . . 1 drachm.
Oil of tar, . . . 4 ounces.	Liquor ammonia, . 2 ounces.
Linseed oil, . . . 4 ounces.	Linseed oil, . . . 6 ounces.

An oleate is prepared by mixing in a mortar, with stirring, oleic acid, and ten to twenty per cent. of mercuric oxide, which should be added gradually. Such a preparation is diffusible and penetrating. It promotes absorption, and, used repeatedly, acts as a counter-irritant. It is applied in articular inflammation, exostoses, indurations of the udder, and other glandular and indolent swellings. Diluted solutions destroy tinea and favus, and are also fatal to animal parasites. Morphine is added to the oleate when anodyne is to be conjoined with absorbent effects.

MERCURIAL PLASTER. Emplastrum Hydrargyri.

Seven parts olive oil is heated, and one part of sulphur gradually added until they unite. With this mixture triturate 164 parts mercury until globules are no longer visible; then add 328 parts lead plaster, previously liquefied, and mix thoroughly. This plaster is occasionally used as a stimulant for glandular and chronic enlargements, wind-galls, and other bursal swellings.

MERCURY WITH CHALK OR MAGNESIA. Hydrargyrum cum Creta vel Magnesia.

These mixtures are made by triturating together one part mercury with two of chalk or magnesia until globules disappear, and a uniform grey colour is acquired. The mercury with chalk, constituting **grey powder**, should be free from grittiness, and insoluble in water; but its chalk dissolves in hydrochloric acid, leaving the mercury in a finely-divided state.

Both preparations are **antacid, laxative, and alterative**. Grey powder is given with good effect to young calves and foals suffering from bilious indigestion and diarrhoea, in doses of five to fifteen grains, repeated once or twice a day, conveniently placed on the patient's tongue, or administered with a drachm of ginger, either in spirit and water, milk, or gruel. To allay gastric irritation, and as an alterative for dogs, one to

three grains are prescribed two or three times daily. In the earlier stages of distemper, Mr Mayhew recommends grs. v. to grs. xv. of grey powder, conjoined with gr. i. to grs. v. of ipecacuan; but such treatment is only applicable in robust patients.

MERCURIAL OR BLUE PILLS. *Pilula Hydrargyri.*

These pills, so much used in human medicine, are seldom employed in veterinary practice. They consist of two parts mercury, three of confection of roses, and one of liquorice root. The addition to this of about one part of ferric oxide produces a pill mass, which Mr Morton used to prescribe as an alterative for horses, in doses of half a drachm to a drachm. Mr Mayhew recommends, as a cathartic for a medium-sized dog, five grains blue pill, six grains powdered colchicum, and ten grains colocynth extract. Five grains blue pill and eight grains compound extract of colocynth, flavoured with a few drops of oil of peppermint or of cloves, make a convenient laxative for a large dog, or two or three doses for a smaller. The activity of mercurial pills in part results from their containing a small proportion of oxide, which is readily dissolved by the acid gastric juice.

MERCUROUS OXIDE. *Hydrargyri Suboxidum. Hg₂O.*

Mercurous, black, grey, or lower oxide is prepared by decomposing calomel (HgCl) with caustic potash solution, and washing with water. It is a heavy black powder, devoid of taste or odour, insoluble in water and alkalies, but soluble in nitric and acetic acids. It is unstable, and on exposure to light or gentle heat decomposes into mercuric oxide and metallic mercury. It is less active than the mercuric oxide, and is frequently used as a **stimulant** for unhealthy wounds and ulcers, in the form of the black wash (the **lotio hydrargyri nigra**), made by mixing thirty grains calomel with ten fluid ounces lime water.

MERCURIC OXIDE. *Hydrargyri Oxidum rubrum. Red Precipitate. HgO.*

Mercuric, red, or yellow oxide is prepared by decomposing

a solution of corrosive sublimate with caustic potash, soda, or lime water; or by heating equal weights of mercuric nitrate and metallic mercury so long as acid fumes are evolved. Prepared by precipitation, it constitutes the yellow wash, or **lotio hydrargyri flava**. The modified form, prepared by heating the nitrate, occurs in orange-red crystals, which become yellow when powdered and brownish-black when heated, recovering, however, their original colour on cooling. It dissolves sparingly in water, but readily in hydrochloric acid.

Mercuric oxide is nearly as active and irritant as corrosive sublimate. Two or three grains given to dogs cause fatal gastro-enteritis. Eight to fifteen grains caused colic in horses, and one or two drachms enteritis and death (Hertwig). It is applied externally as a **stimulant** and caustic for indolent ulcers, over-luxuriant granulations, chronic scaly eruptions, and glandular enlargements, being used in the several forms of powder, lotion, or ointment.

MERCURY SULPHIDES. Hydrargyri Sulphuretum.

Cinnabar, a red-brown native mercuric sulphide (HgS), found in Carniola and Spain, is the most abundant ore of mercury. A black, amorphous, mercuric sulphide is thrown down when hydrogen sulphide is added to corrosive sublimate, and this black sulphide, when sublimed, is converted into the bright scarlet **vermilion**. **Ethiops mineral** is a black, unstable, mercurous sulphide (Hg_2S). These sulphides are insoluble, and nearly inert. Ethiops mineral used to be given to horses as an anthelmintic and supposed specific for glanders, in doses of $\mathfrak{z}\text{i}$ to $\mathfrak{z}\text{ij}$, but has deservedly fallen into discredit.

MERCURY SULPHATE. Hydrargyri Sulphas. Turbith or Turpeth Mineral.

The mercuric sulphate (HgSO_4) is the usual source both of calomel and corrosive sublimate. The insoluble, yellow, basic, mercuric sulphate known as **turpeth mineral** ($\text{HgSO}_4 \cdot 2\text{HgO}$) is an active irritant and errhine; half a drachm to a drachm poisons dogs; smaller doses are emetic; but it is not now used in regular practice.

MERCUROUS CHLORIDE. Mercury Sub or Lower Chloride.
Hydrargyri Subchloridum. Calomel. HgCl or Hg_2Cl_2 .

Calomel is found native in Carniola and Spain, but in too small amount to be of commercial value. It is obtained (1) by decomposing a solution of mercurous nitrate with a hot solution of common salt; and (2) more commonly by subliming a mixture of mercurous sulphate with common salt. The calomel, rising in vapour, may be condensed in fibrous cakes on the cool part of the vessel, or conducted into a large chamber, where it falls in fine powder, its minute subdivision being sometimes still further secured by introduction of steam. Traces of corrosive sublimate, which are apt to sublime over, are got rid of by washing with boiling distilled water until the washings cease to be darkened by a drop of ammonium hydrosulphide. The powder is dried at a temperature not exceeding 212° Fahr.

As usually sold, calomel is an amorphous powder, dull-white, with a faint yellow tinge. Its specific gravity is 7.18. It is inodorous, nearly tasteless, insoluble in cold water, alcohol, and ether. It is slowly decomposed by light; volatilises unchanged when heated; yields mercurous oxide when acted on by alkalis or lime water; and is converted into corrosive sublimate by boiling hydrochloric acid.

ACTIONS AND USES.—Calomel, being insoluble in water, has no in-contact effect on the skin, but it is in part dissolved by the gastric secretions. It irritates the gastric membrane and glands, full doses producing emesis in man and carnivora. Similar irritation is exerted on the mucous membrane of the small intestines, and it is consequently a cathartic. It does not increase secretion of bile, but removes bile lodged in the duodenum. Like other mercurials, repeated doses cause mercurialism, and increase secretion of the salivary, pancreatic, and intestinal glands, and also of the kidneys. The earlier stages of mercurialism are produced with the view of altering metabolism and nutrition, and promoting especially absorption of fibrinous exudation. Externally, it is used as a desiccant, stimulant, and antiparasitic.

GENERAL ACTIONS.—Professor Tuson showed that calomel and

distilled water, digested in a glass vessel at 100·2° Fahr. (the temperature of the stomach), when mixed with either pepsin or a two per cent. solution of hydrochloric acid, remained unaltered, even after twenty-four hours; but when both pepsin and hydrochloric acid were used, solution speedily occurred, and a black precipitate of mercury sulphide was formed (*Veterinarian*, January 1872). The mucus and fats of the canal, and also the bile, further aid solution. It is chiefly absorbed as an albuminate, which, although insoluble in water, dissolves in excess of albumin and in sodium chloride solution. In the blood all mercurials probably circulate as mercuric oxide (Brunton). Small proportions even of small doses of calomel are absorbed, and most of that absorbed, as well as that unabsorbed, is excreted by the bowels in the state of metallic sulphide and sulphate, exerting an antiseptic effect, and usually imparting a green colour to the fæces. The opinion that calomel undergoes partial conversion into the higher chloride appears disproved by the fact that the chlorides in the canal are insufficient to effect such a change, while, moreover, each mercury chloride has distinctive actions (*Monthly Journal of Medical Science*, 1851).

TOXIC EFFECTS.—Calomel is less irritant than mercuric chloride or nitrate, but irritant effects, usually followed by constitutional effects, are produced in horses by three or four drachms; in cattle by two or three drachms; in sheep by fifteen to thirty grains; in dogs by six to thirty grains. Hertwig found that these doses, within twenty-four or thirty-six hours, and in dogs in less time, caused occasional colic and copious excretion of fæces, which contained bile, and were greyish-green in cattle, but darker in dogs. Such doses, especially if repeated daily for three or four days, further induce fluid and stinking evacuations, fœtid breath, soreness of the mouth, rapid impairment of appetite and condition, and fatal low fever and dysentery.

At the Edinburgh Veterinary College, in June 1853, a healthy **donkey** got a drachm of calomel daily in three separate doses. About the sixth day the animal became excitable, and the pulse rose to 85. By the eighth day secretion of saliva was augmented, the breath was fœtid, the gums red and tender,

and appetite impaired; but nothing abnormal was observed about the fæces or urine. By the twelfth day these symptoms became more aggravated, the pulse softer and less frequent, the strength much reduced. On the fourteenth day administration of the calomel was suspended, but death occurred two days later. The animal had received fourteen drachms in fourteen days. Post-mortem examination discovered the teeth loose, the mucous membrane of the mouth and air-passages blanched, while that of the stomach and intestines was softened, easily torn, and in many places thickly covered with mucus and epithelium. The liver was rather friable, but the kidneys, spleen, and lungs were healthy.

Dogs weighing 30 lbs. to 40 lbs. receiving three or four grains night and morning were salivated in a week, and died in nine days. The most notable appearances were inflammation of the large intestines, and of the sympathetic ganglia of the abdomen. Hertwig considers that dogs and swine, on account of their often getting rid of the drug by vomiting, are less easily affected than the other domesticated animals, and that horses are less susceptible than cattle.

The action of calomel **on the liver** was investigated by the Committee of the British Medical Association, who experimented chiefly on dogs with fistulous openings into the duodenum, and arrived at the conclusion that **neither calomel nor blue pill affect secretion of bile**, unless they purge or impair health, when the quantity of bile is diminished (*Medical Times and Gazette*, vol. ii., 1869). Dr A. Röhrig curarised dogs, maintained life by artificial respiration, and placed a glass tube in the gall duct. Croton oil, in doses of eighteen drops, introduced into the duodenum, increased or re-established the biliary secretion. Colocynth, jalap, aloes, rhubarb, and senna acted with a power decreasing in the order named. Castor oil and bitter salts had little effect. Calomel, even in twenty-grain doses, did not re-establish the secretion when it had ceased, but had a marked power in increasing and maintaining it beyond the natural time for its cessation (Stricken's *Medicinische Jahrbucher*, 1873).

Professors Rutherford and Vignal, also experimenting on curarised dogs, found that doses of ten, five, or even two grains

of calomel, placed in the duodenum of fasting subjects, produced purging; they did not, however, increase secretion of bile, but actually diminished it. Similar results occurred even when calomel was introduced into the intestine, mixed with bile or hydrochloric acid. These repeated experiments justify the conclusion that calomel and the milder mercurials have no special cholagogue action; they do not stimulate secretion of bile, as they notably do of saliva and pancreatic fluid. The small intestines, irritated by the mercurial, reflexly stimulate the liver and contract the gall bladder and hepatic ducts, in the same way as do resinous purgatives, croton, and acid chyme. The increased intestinal action sweeps out bile lodged in the duodenum, as well as in the hepatic ducts, and thus prevents its reabsorption, and, moreover, abates congestion of the portal system. Calomel, therefore, **although not increasing secretion of bile, notably hastens its expulsion.**

MEDICINAL USES.—Few remedies have been applied to so many and diversified uses, but neither in veterinary nor in human medicine is it as much used as formerly. **Gastric irritation**, intestinal catarrh, as well as bilious diarrhoea, are frequently treated with small doses, either used alone or conjoined with chalk or opium. For foals and calves calomel may be substituted for grey powder (p. 507), when the bowels are irregular and the discharges malodorous. In such cases, like other mercurials it owes its good effects to its combination of antiseptic and eliminative properties. Although useful in biliousness and congestion of the liver, and, along with laxatives, removing waste bile from the duodenum, it has no special remedial effect in jaundice, arrested secretion of bile, or chronic liver complaints. Such cases are fittingly treated by nitro-hydrochloric acid and other liver stimulants. That type of influenza in horses complicated with gastric derangement and yellow mucous membranes is often well treated in the early stages with calomel grs. xx., and opium ℥ss., with or without oil, repeated twice or thrice, at intervals of twelve hours, and alternated with or followed by salines.

It is a useful **adjuvant cathartic**. Four drachms of aloes, with half a drachm of calomel, purge most horses as effectually as eight drachms of aloes. Such a combination is advan-

tageously used in weed and other cases where prompt and full catharsis is desired. But as an adjuvant purgative it is more serviceable amongst cattle than in horses. As an **anthelmintic**, combined sometimes with santonin, and followed by a laxative, it removes lumbrici. In acute rheumatism calomel is given with a purgative; in chronic cases, and also in malarial disorders, small doses are sometimes used with quinine sulphate. Dogs and pigs frequently have calomel conjoined with jalap or with oils as a cathartic and febrifuge, and occasionally with ipecacuanha as an emetic.

As an **alterative** and **febrifuge** it is not as much used as formerly, but some practitioners still prescribe it in acute localised inflammation, particularly in pneumonia, pleurisy, peritonitis, laminitis, and iritis. It is most effectual when such cases are complicated with gastric derangement, and its curative action probably depends upon its combination of antiseptic, cathartic, and diuretic effects, these latter being increased by the laxatives and salines with which it is usually conjoined. In chronic inflammation it reduces enlarged glands, liquefies recently formed deposits, and prevents adhesions, as in iritis, pleurisy, or peritonitis. For such objects, small, frequently repeated doses are used, conjoined with opium to delay excretion, while constitutional effects may be hastened by in-rubbing of the ointment. In enteritis, whether in horses or cattle, Mr Barlow sometimes used half a drachm of calomel with an ounce of laudanum, repeated at intervals of one or two hours, until three or four doses were taken. Metritis and peritonitis, affecting cows three or four days after calving, are usually relieved by a drachm of calomel, two ounces laudanum, and one pound castor oil, mixed with hot water and treacle. Calomel, chalk, and opium are frequently prescribed in dysentery.

Calomel has **diuretic** effects; it notably increases the diuresis caused by resinous or saline drugs. This action is stated to result from its being in part converted into mercuric chloride, which, unlike mercurous chloride, stimulates the liver, and increases the amount of urea in the blood (Brunton).

Externally, calomel destroys the acari of scab and mange, kills lice, abates the itching of those eczematous eruptions which affect the hairy limbs of underbred cart horses, and are

also common in dogs. Although of small benefit in soothing the itching of urticaria, it relieves the irritation of prurigo, removes the scales, and heals the cracks of psoriasis, hastens removal of warts, and is one of the best remedies for thrush in the horses' frog, while in the form of ointment it relieves piles in dogs. It must be used discreetly, for if freely applied it may be absorbed, and cause untoward constitutional effects.

DOSES, &c.—As an **alterative** and **febrifuge**, horses and cattle take grs. x. to ℥i.; sheep and pigs, grs. v. to grs. xxx.; dogs, gr. i. to grs. iij., usually given two or three times a day, frequently with an equal weight of opium, to prevent too rapid removal by the bowels. As a **cathartic**, calomel is not used alone, and the dose is consequently regulated by that of the drug with which it is combined. For the horse a full purgative consists of calomel ℥i., with aloes ℥iv.; for cattle, ℥i. to ℥ij., with Epsom or common salt, lb. 1, or oil, Oj.; for dogs, grs. ij. to grs. iv., with jalap, grs. xx. to grs. xl. As a **vermifuge** for the horse, the following combination is given before feeding for three or four consecutive mornings:—One drachm each of calomel, oil of male shield fern, and aloes, with four drachms of ginger, made into bolus with linseed meal and treacle. As an **emetic** for dogs or pigs, two or three grains are given, with an equal quantity of tartar emetic, or with grs. xv. to grs. xx. of ipecacuan. To allay skin irritation, promote healthy skin action, or destroy skin parasites, calomel is used in powder, solution, or ointment, conjoined sometimes with iodine, boric acid, or wood-tar oils.

MERCURIC CHLORIDE. Hydrargyri Perchloridum. Hydrargyrum Corrosivum Sublimatum. Corrosive Sublimate. HgCl_2 .

Corrosive sublimate and calomel are both chlorides of mercury; corrosive sublimate contains twice as much chlorine as calomel, is the higher per or mercuric chloride (HgCl_2), and is a soluble and actively corrosive poison; while calomel, the lower or mercurous chloride (HgCl), is an insoluble, comparatively mild medicine. By using, in speaking or writing, the vernacular names, risk of mistaking these chlorides is diminished.

Corrosive sublimate may be **prepared** by heating metallic mercury in chlorine gas, or dissolving it in aqua regia. The most common process, however, consists in subliming a mixture of twenty parts of mercuric sulphate and sixteen of sodium chloride with one of manganese black oxide, which secures oxidation of the sulphate, facilitates liberation of the chlorine, and thus prevents formation of calomel.

It occurs in heavy, colourless masses of prisms, or as a dense white powder of broken crystals. It has a specific gravity of 5.4, is devoid of odour, but has an acrid, disagreeable, metallic taste. When heated it fuses, boils, and emits an exceedingly acrid, poisonous vapour. It is soluble in about two parts of alcohol, still less of ether, three of boiling water, and sixteen of cold water, or nearly four grains to the ounce. Its solubility is increased by the presence of salts, such as the chlorides of sodium or ammonium, the latter being used in the B.P. liquor hydrargyri perchloridi. It has an acid reaction on colouring matter, and forms, with albumin and fibrin, flaky precipitates, soluble in solution of common salt. It is decomposed by most vegetable solutions, especially when exposed to light. Its antiseptic properties recommend it for preserving wood, cordage, and anatomical preparations. Its tests have been detailed (p. 502). It is not subject to intentional adulteration.

ACTIONS AND USES.—It is a corrosive and irritant poison; is occasionally prescribed as an alterative, antiseptic, and cholagogue; repeated doses cause mercurialism. Externally, it is used as an antiseptic, astringent, caustic, and parasiticide.

Corrosive sublimate **precipitates albumin**, and hence in powder or concentrated solution is **irritant** and **corrosive**. Dissolved in water, it is the most powerful **liquid antiseptic**; one part in 25.250 prevents the development of bacteria taken from meat infusion; one part in 10.250 prevents the development of spores in boiled meat infusion; one part in 6.500 prevents reproduction of spores. Spores placed in one per cent. solution in water were effectually destroyed in one to two days (Koch). Solution of one to two grains to the ounce of water effectually destroys vegetable and animal parasites infesting the skin. It must, however, be used with caution, for it not only irritates and corrodes locally, but is

readily absorbed, and hence liable to produce constitutional effects.

Toxic Effects.—Swallowed in strong solution it is an **irritant corrosive poison**, producing **gastro-enteritis** and **collapse**. Smaller or more diluted doses **produce mercurialism**. Seven or eight grains destroyed dogs in seven to thirty hours; four drachms dissolved in three pounds of water killed a horse in twelve hours; two drachms caused in cattle great emaciation, and death in fourteen days; one drachm proved fatal to a sheep within twelve hours (Hertwig). Larger quantities, however, appear to be tolerated when the poison is first given in small doses. Thus, Mr Percivall, experimenting upon a horse, commenced with ten grains, and gradually increased the dose to five drachms before the appetite or pulse became affected. Injurious effects occur whatever the channel by which poisonous doses enter the body. Shepherds using strong solutions for foot-rot or for scab have suffered from its irritant and also from its constitutional effects. Dogs dressed with it for mange have occasionally died from gastro-enteritis and collapse.

Compared with arsenical poisoning, the symptoms come on more rapidly; there is more chemical and corrosive action, whilst in chronic cases salivation usually ensues.

Post-mortem examination discovers the mucous lining of the alimentary canal softened and bluish-grey; where large doses have been given it is disorganised by chemical action; where death is postponed for a day, patches of inflammation and sloughing are found; the kidneys and other urinary organs are congested; the lungs are usually spotted with effused blood.

The treatment consists in the free use of albumin, which forms an insoluble mercuric albuminate. One egg suffices to neutralise four grains of sublimate. When eggs cannot be had, wheat or barley flour, milk, or other albuminoids should be given, followed by astringent solutions. Unless the drug has itself caused vomiting, the stomach must be emptied either by emetics, the stomach pump, or syphon.

MEDICINAL USES.—For internal use, milder mercurials are preferred, and it is dangerous to use it for the production of

mercurialism. For horses it has been prescribed in farcy, chronic skin eruptions, and swollen, œdematous legs resulting from repeated attacks of weed. Half or even a quarter of a grain, repeated every three hours, sometimes arrests the slimy, bloody, reducing discharges of persistent diarrhœa and dysentery in cattle. Professors Rutherford and Vignal found that $\frac{1}{16}$ to $\frac{1}{8}$ grain given to dogs, although not stimulating the duodenal glands, notably **excite secretion of bile**. Conjoined with opium, hemlock, and salines, it has been advised in rheumatism.

As an effectual **antiseptic** it is used for many surgical purposes. Foul wounds washed with one part dissolved in 500 to 1000 of water are rendered aseptic. Knives and other infected instruments, as well as the hands of the practitioner, are disinfected by washing in a one-thousandth solution. Such solutions **destroy** the cryptogamic growths of **ring-worm**, kill **lice and acari**, and also their spores, and **allay the itching** of pruritus, prurigo, and urticaria. In the latter disease Professor Robertson recommended mercuric chloride, grs. xii., dilute hydrocyanic acid fʒiv., glycerine fʒii., water fʒx. In diphtheritic sore throats, a spray of half a grain to an ounce of water is sometimes used. The one-thousandth solution is injected into the uterus in puerperal metritis and in cases of abortion. The spread of infective abortion germs is further prevented by washing with the solution, twice daily, the external organs of generation and the stump of the tail. A similar washing of the in-calvers on premises where abortion has appeared usually protects them from the mishap. In **ophthalmic cases** watery solutions are applied, containing gr. $\frac{1}{30}$ to gr. $\frac{1}{10}$. It is a prompt but not a deeply acting caustic. Solutions of one five-hundredth are used for checking caries of bone and cartilage. Four or five grains rolled in tissue paper and introduced deeply into the sinuses of quittor and other fistulæ, in six or eight days slough out the fibrous secreting walls.

With suitable precautions, watery solutions are used for **disinfecting** infected premises, and the carcasses of animals which have died of anthrax or other contagious diseases.

DOSES, &c.—Horses and cattle take grs. v. to grs. viij.; sheep and large pigs, gr. j.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{3}$. It is best given

freely dissolved in water or other simple fluid. For most external purposes a **solution** of sufficient strength is made with a half to two grains to the ounce of water. To relieve itching, especially amongst dogs, one grain corrosive sublimate and one minim prussic acid are dissolved in an ounce of water. An **ointment** containing one part of sublimate to twenty or thirty parts of fatty matters is sometimes used cautiously for skin complaints, and for destroying skin parasites.

Ammoniated mercury, or white precipitate, is an opaque, white, insoluble powder, made by mixing corrosive sublimate solution with excess of ammonia solution, and washing and drying the precipitate (NH_2HgCl). It is devoid of irritant action. An ointment made of one part precipitate to ten of simple ointment is used as a parasiticide and as a mild mercurial in skin diseases.

MERCUROUS IODIDE. Green or Lower Iodide. Hydrargyri Iodidum viride. HgI .

MERCURIC IODIDE. Red or Higher Iodide. Hydrargyri Iodidum rubrum. HgI_2 .

Mercurous iodide is an unstable salt, prepared by triturating together iodine and an excess of mercury with a little alcohol, or by mixing solutions of mercurous nitrate and potassium iodide. Although not so active as the higher iodide, twenty grains destroyed a rabbit within twenty-four hours, and a drachm a pointer dog in five days (Cogswell).

Mercuric or red iodide is a vermilion coloured, heavy, crystalline powder, with a disagreeable metallic taste. It is insoluble in water, sparingly soluble in cold alcohol, but soluble in ether, acids, solution of potassium iodide, and most saline fluids. It is prepared by mixing corrosive sublimate and potassium iodide solutions, when mutual decomposition ensues; the precipitate, at first yellow, then fawn, becomes red; the clear supernatant fluid is decanted away, and the precipitate washed with distilled water and dried.

ACTIONS AND USES.—Mercuric iodide is as irritant as mercuric chloride or nitrate. But the presence of iodine increases the solubility of albuminates, and, compared with the chloride, the iodide is hence more quickly absorbed and excreted.

Twenty grains given to a rabbit induced gastro-enteritis, collapse, and death in twenty-four hours. It is not used internally, but solutions are applied externally as antiseptics, and ointments as stimulants, counter-irritants, and caustics.

The periodide, dissolved in water, is used for the same antiseptic and stimulant purposes as the perchloride. The B.P. ointment, of sixteen grains iodide to the ounce of lard, is not sufficiently strong for most veterinary purposes, and a more effective preparation is made by mixing one part iodide with eight of lard. But Mr William Dollar, of New Bond Street, assures me that one part iodide dissolved in ten of vaselin makes an equally efficacious ointment, which has the further advantage, even when long kept, of neither changing colour nor becoming rancid. This "**red ointment**" is very effectual for **condensing** and **reducing** splints, spavins, ring-bones, and other **bony deposits**. It penetrates deeply, arrests chronic inflammation, and aids absorption of chronic enlargements and indurations of strained tendons, bursæ, and joints. It is occasionally used as a **counter-irritant** in sore-throat, chronic cough, and roaring, relieving cases that have resisted milder blisters. When effusion has occurred in pneumonia in horses, and other irritants are ineffectual, an ounce of iodide ointment rubbed (if need be) into each side is stated sometimes to give relief. It is frequently applied with advantage to the rheumatic joints of cattle. Repeated dressings are serviceable in arresting induration of the absorbent glands and vessels in the earlier stages of **farcy**, and in such cases it is more reliable than mercurial or citrine ointments, sometimes substituted for it. When absorbent and counter-irritant effects are to be produced, it is sometimes used diluted with iodine ointment. The strong red iodide ointments require to be used with care, otherwise they destroy the hair-roots, cause sloughing and blemishing, and produce constitutional effects.

MERCURIC NITRATE. Mercury Nitrate. $2\text{Hg}(\text{NO}_3)_2$
 UNGUENTUM HYDRARGYRI NITRATIS. Citrine Ointment.

When mercury is dissolved in diluted nitric acid, and the solution boiled gently for fifteen minutes, there is produced the

B.P. liquor hydrargyri nitratis acidus, a colourless, strongly acid, caustic solution.

The **unguentum hydrargyri nitratis**, or citrine ointment (the pharmaceutical imitation of the empirical golden eye ointment), is prepared by mixing a hot solution of mercury in nitric acid with lard or olive oil. It has a lemon-yellow colour, a nitrous acid odour, and is apt to spoil unless well made and kept in earthenware vessels secluded from light.

ACTIONS AND USES.—The stronger mercuric nitrate solutions are caustics. They and the ointments are applicable for many of the purposes of corrosive sublimate, and used for reducing and destroying glandular and malignant growths, and stimulating such specific ulcerations as canker in the feet of horses and foot-rot in sheep. Milder solutions and citrine ointment are good remedies for eczema, especially after heat and pain have been subdued and desquamation has set in, and are usefully alternated with tar preparations. Along with good feeding and alkaline washes, they are applied in those cases of pityriasis not uncommon amongst cattle in poor condition. They destroy lice and other skin parasites, and the cryptogamic growths of ring-worm. Being easily absorbed, if too freely applied they induce the usual specific effects of mercury. Diluted with olive or almond oil, or lard, citrine ointment relieves irritable, swollen, discharging conditions of the eyelids.

M U S T A R D.

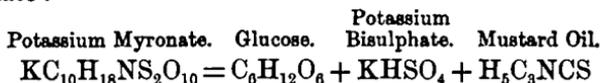
SINAPIS. A mixture of the powdered seeds of white mustard—*Brassica* or *Sinapis alba*; and of black mustard—*Brassica* or *Sinapis nigra*. *Nat. Ord.*—*Cruciferae*.

The *Brassicæ*, or *Sinapes*, are annuals, one to two feet high, with yellow cruciform flowers, and pods containing several brown seeds. They are indigenous in most parts of Europe, and extensively cultivated in Durham, Yorkshire, and Lincolnshire. An abundant wild variety, familiarly known as charlock and kellocks, is sometimes used for adulterating the better sorts. The **black mustard** seeds are red or greyish-brown, about the size of millet; the greenish-yellow powder has a pungent, oily taste, and when triturated with water exhales the

pungent, irritant, volatile oil of mustard. The **white mustard** seeds are double the size of the black, lighter in colour, and when triturated also produce a pungent, yellow, oily emulsion.

The **mustard flour** of the shops is generally made as follows:—“Two bushels of black and three of white seed yield, when ground, 145 lbs. of flour, which, to diminish the pungency and improve the colour, is mixed with 56 lbs. wheat flour and 2 lbs. turmeric; and the acrimony is restored, without the pungency, by the addition of 1 lb. Chili pods and $\frac{1}{2}$ lb. ginger. Black seed alone, it is stated, would be much too pungent for use at table. Wild mustard seed is sometimes substituted for the black species if the latter be scarce” (Christison’s *Dispensatory*).

Black and white mustard seeds contain about 25 per cent. of a yellow, tasteless, non-drying fixed oil, similar to that of rape, and consisting of olein, stearin, and glyceride of erucic or brassic acid; 20 per cent. of mucilage, chiefly found in the epidermis; 4 of inorganic matters, and 10 to 15 of **myrosin**, a ferment similar to diastase or the emulsin of bitter almonds, usually more abundant in white than in black mustard seeds, and coagulated and rendered inactive when heated above 140° Fahr. Black mustard, besides, contains about 2 $\frac{1}{2}$ per cent. of the crystalline **potassium myronate** or sinigrin; white mustard contains an allied principle, sinalbin. When dissolved in water, as in making mustard flour into paste, the ferment-escible myrosin decomposes the chrysaloid bodies, and there are produced two acrid, irritant oils—the pungent **volatile oil of mustard** (H_5C_3NCS) from the black mustard, and the fixed oil—acrinyl sulphocyanate—(C_8H_7NSO) from the white mustard (Flückiger and Hanbury). The oil of mustard, regarded as allyl isosulphocyanate, is thus formed from potassium myronate:—



ACTIONS AND USES.—Unbruised mustard-seeds, being only partially and gradually digested, have little effect when swallowed. When the ground seeds are mixed with water the

pungent, acrid oils are evolved; large doses of the flour are accordingly **irritant**; medicinal doses are **stomachic, carminative, and stimulant**. It is, however, rarely used internally, excepting as a local acting **emetic** for the dog, cat, or pig. For this purpose a dessert-spoonful of mustard flour is given, dissolved in several ounces of water. It is **slightly laxative and diuretic**.

As an external irritant, mustard is much used as a **rubefacient, vesicant, and suppurant**. The paste made with water, and rubbed into the skin of the horse, within twenty minutes causes redness, heat, and tenderness, with subsequent swelling. Reflexly, the activity of conterminous and subjacent parts is roused (p. 44). In two to six hours vesication occurs; twenty-four hours later some of the vesicles will have run together, others are broken; where the dressing has been strong or repeated, or the parts have been rubbed, pustules may have formed; but healing is generally effected in a week. From repeated, prolonged, or injudicious use in irritable states of the skin, there occasionally ensue active inflammation, sloughing, and destruction of the hair-roots.

Compared with cantharides, mustard acts more promptly, but unless used freely or repeatedly it is less permanent. It is used to control functional disturbance rather than to repair structural damage; it causes more swelling of surrounding parts, but less exudation of serum; applied repeatedly, especially to the extremities of the horse, it is more apt to affect the skin deeply, and hence produce sloughing; unlike cantharides, it has no tendency to act upon the kidneys. It is almost as prompt, and is more manageable than very hot water. For horses it is less irritating and burning than oil of turpentine. It is not so severe or so apt to cause suppuration as euphorbium or croton oil. For cattle it is an excellent blister, often acting promptly on their thick and insensible hides when other agents have slight or tardy effect, and seldom causing injury or blemishing. On dogs and sheep it acts powerfully, and must be used with caution.

MEDICINAL USES.—In all veterinary patients suffering from catarrh, sore-throat, laryngitis, bronchitis, pneumonia, and pleurisy, mustard, applied in the early congestive stage, **lessens**

pain and relieves difficult breathing. It is more serviceable in chronic than acute bronchitis. It often answers where the inflammation affects the lesser bronchi, and there is considerable exudation. In pleurisy, mustard liniments alternated with fomentations are often applied at intervals throughout the attack, but are specially indicated after the tenth day, when such counter-irritation aids absorption of exudate. During the hepatisation stage of pneumonia mustard is of little use; but, after five or six days, occasional dressings are again serviceable in sustaining the action of the heart and promoting absorption. It is frequently rubbed over a considerable area immediately external to the congested, painful, or inflamed parts; after about fifteen minutes washed off, and in an hour or two, if required, again reapplied.

Mustard dressings are serviceable in acute indigestion, colic, and enteritis, especially amongst horses. In phlebitis a smart blister reduces inflammation, and hastens absorption of exudate. Mustard is of service in chronic rheumatism, especially amongst cattle, in the second stages of inflammation of joints and tendons, in enlargements of glands, and occasionally as a stimulant in chronic scurfy skin diseases. Flying blisters, applied over the chest or abdomen, or below the knees and hocks, especially when the limbs are cold, arouse vitality and overcome congestion in the later stages of pneumonia, in parturient apoplexy of cattle, and in poisoning by narcotics. With stimulants administered internally, mustard is rubbed over the region of the heart to counteract syncope. Applied over the kidneys, it promotes diuresis. It is occasionally used for maintaining or increasing the effects of cantharides, but in horses considerable caution is necessary in applying the one irritant soon after the other.

Mustard is **specially indicated** where extensive counter-irritation has to be speedily produced and stimulation of the kidneys avoided. Cantharides or mercuric iodide ointment is preferable in chronic diseases of joints, and where structural changes have occurred in bone, cartilage, or tendon. Neither mustard, nor indeed any blisters, can be directly applied to parts extensively or deeply inflamed without causing much irritation, and probably sloughing

Doses, &c.—If used as a stomachic, carminative, or mild stimulant, horses take ℥iv. to ℥vj.; cattle, ℥ss. to ℥j.; sheep and pigs, ℥j. to ℥ij; dogs, grs. x. to grs. xx. To prevent irritation of the fauces, it is given in the form of pill or electuary. Larger doses, especially in solution, act as emetics in dogs, cats, and pigs.

Externally, it is used generally as a paste made as for table purposes, with water at a temperature of about 100° Fahr. Hot water or admixture of spirits, acids, or alkalies coagulate the ferment, or impair its action. A paste made with water alone produced, in six minutes, effects similar to those which it required fifty minutes to produce with the same mustard made up with vinegar. Extra activity is secured by using black and white mustard seeds, in about equal amount, ground unmixed with bland ingredients, or by adding to the paste made from the mustard of the shops a little oil of turpentine. The freshly-made paste is usually applied directly to the skin, with smart friction; after fifteen or twenty minutes it may be washed off with tepid water, and, if required, again applied three or four times. Such repeated moderate external warming is usually more serviceable than one violent dressing, whether for diminution of congestion, relief of pain, or even for removal of exudate.

For veterinary patients little use is made of **plasters** prepared by spreading mustard upon calico or paper; of **leaves** consisting of powdered mustard seeds and guttapercha solution spread upon cartridge paper and dried; or of **poultices** usually made with equal parts of mustard and linseed meal, well stirred with four parts of hot water.

A tincture of the essence, in the form of **Savary's liquid sinapism**, has been used **hypodermically** in France. In chest affections, 15 to 30 drops are injected at three or four points on each side of the chest. The resulting œdema appears within ten minutes, but is said to be less painful, and to cause the patient less disturbance than mustard in the usual form. No untoward local or general effects are observed. Such injections have also been used in the neck, in vertigo, and ophthalmia; under the belly in the gastro-intestinal forms of influenza; and also in colic, enteritis, and umbilical hernia

(*Journal of Comparative Pathology and Therapeutics*, March 1888).

Volatile oil of mustard, got by distilling black mustard seeds with water, is antiseptic and antipyretic, and one of the most poisonous of the volatile oils. Rabbits are killed in two hours by a drachm, in fifteen minutes by half an ounce, with symptoms of gastro-enteritis, loss of sensation and muscular power, difficult breathing, and collapse. Applied externally, it is a prompt and powerful vesicant.

M Y R R H.

MYRRHA. A gum resinous exudation from the stem of *Balsamodendron Myrrha*. (B.P.) *Nat. Ord.*—*Burseraceæ* or *Amyridaceæ*.

Myrrh is imported from the coasts of the Red Sea. With oil-banum or frankincense it has long been used in making incense, perfumes, holy oils, and unguents for embalming. It exudes spontaneously, as a yellow-white oily substance, from perforations or cracks in the cortical layer of the trunk or branches of several species of the shrubby thorn-like balsamodendrons. The best sorts are in irregular-shaped, semi-translucent, red-brown tears, or masses of tears, which deepen in colour when breathed on. They are brittle, and easily powdered; their fracture is irregular, shining, oily, and occasionally dotted with opaque white markings. Myrrh has a slightly bitter, acrid taste, and an agreeable aromatic odour. When heated, it softens, froths up, and burns, leaving a dark spongy ash. Powdered with water, it forms an emulsion, but it readily dissolves in rectified spirit. It consists of 50 to 60 per cent. of soluble gum, chiefly arabin; 30 to 40 of several resins soluble in alcohol, ether, and acetic acid, and 7 to 8 per cent. of a pale yellow volatile oil, myrrhol ($C_{10}H_{14}O$), isomeric with thymol and carrol.

ACTIONS AND USES.—Its antiseptic volatile oil and slightly irritant resins render myrrh a topical stimulant. When swallowed it increases the secretions of the gastro-intestinal glands, producing stomachic and mild laxative effects. During

elimination it stimulates the mucous lining of the respiratory and urinary tracts, and is hence prescribed as an adjuvant, expectorant, and diuretic. It is sometimes used as an antiseptic, mildly astringent vulnerary, and a flavouring agent. It resembles the fragrant gum resin olibanum, produced by several species of *Boswellia*, and the concrete resin of the Elemi tree imported from Manilla. It is less stimulant than the balsams and fetid gum resins.

Doses, &c.—Horses and cattle take ℥ij.; sheep and pigs, ℥ss. to ℥i.; dogs, grs. x. to grs. xx., repeated several times daily, in bolus, decoction, or tincture, used with vegetable tonics, or with aloes, sometimes in the form of the compound tincture of aloes and myrrh, which is thus prepared:—Macerate one ounce each of myrrh and aloes, coarsely powdered, in a mixture of methylated spirit f℥xiv., and water f℥vi., for fourteen days in a closed vessel; shake frequently, filter, and add proof spirit to make one pint.

NUX VOMICA.

NUCES VOMICÆ. The seeds of *Strychnos Nux Vomica*. *Nat.*

Ord.—Loganiaceæ.

STRYCHNINE. *Strychnia*. An alkaloid prepared from *Nux Vomica*, from the *Strychnos Nux Vomica* or false *Angustura* bark, from *St Ignatius' bean*, and occurring in other plants of the natural order *Loganiaceæ*.

The *Strychnos nux vomica* grows on the southern coasts of India, in many islands of the Indian Archipelago, and in the northern parts of Australia. It is a moderate-sized tree, with crooked stem, irregular branches, tough white wood, known in commerce as snake-wood; grey or yellow bark—the poisonous false *Angustura* bark; a globular berry, about the size of an apple, containing, amid soft gelatinous pulp (which birds are said to eat with impunity), five round, flat, yellow-grey seeds, about an inch in diameter. These seeds have a central scar or hilum on one surface, are covered with short satiny hairs, have an intensely bitter taste, and are tough, horny, and require to be steamed and dried before they can be powdered.

and vaso-motor centres, and hence increase the rapidity and depth of the respirations, the number and force of the heart-beat, and raise temperature. Larger doses cause muscular twitching, hyperæsthesia, heightened acuteness of the special senses, and clonic convulsions. The extensor usually overcome the flexor muscles, producing opisthotonos. **Death results from asphyxia**, occurring during a spasm, or from paralysis and collapse, occurring during a period of relaxation. Strychnine is **absorbed** more rapidly from the rectum than from the stomach, and still more rapidly from the bronchi and cellular tissues. It has been detected in the blood, the spinal cord, and the brain. It appears to be **tardily excreted** unchanged in the urine, in which it has been found an hour after administration, and has also been detected forty-eight hours later.

Toxic Actions.—Poisonous doses within a few minutes produce in all animals trembling and twitching of voluntary and also of involuntary muscles, and violent clonic spasms, usually lasting one to two minutes, gradually becoming more frequent and severe; and from their involving the glottis, diaphragm, and other muscles of respiration, causing death, usually by asphyxia. The symptoms and mode of death **resemble** those of **tetanus**, but are more suddenly developed, more intermittent, and more rapidly fatal. The muscular rigidity does not, as in tetanus, first affect the muscles of the jaws, and the spasms are clonic, while in tetanus they are tonic.

The several classes of **animals differ in their susceptibility** to the actions of strychnine. Horses and cattle are not so readily affected as men and dogs. Poultry are said to be less easily affected than other birds; while guinea-pigs and some monkeys seem almost entirely to resist its action, at least so long as it is given by the mouth (Dr H. C. Wood, *Treatise on Therapeutics*).

Horses had twitching of the muscles after swallowing six grains of strychnine, and were poisoned by twelve grains in about twelve minutes (Tabourin). Five grains in bolus produced, after six hours, abdominal pain, laboured breathing, acceleration of the pulse from 42 to 60, starting when touched, and tetanic spasms. Twelve hours later the pulse was 96, and

subsequently rose to 120. Blood-letting and fomentations gave no relief, and in a convulsive paroxysm the horse died. The membranes of the brain and cord were injected, the lungs engorged (*Veterinarian*, March 1856). Given hypodermically, the toxic dose is stated by Fröhner and Kaufmann to be three to six grains. Half a grain, given hypodermically, induced in half an hour general muscular rigidity. Ten drachms of **nux vomica** in powder caused muscular tremors, but in solution proved fatal in ten hours (Hertwig). Professor Coleman gave a mare two ounces in a drench; within an hour, and after the animal had drunk some water, she had violent tetanic symptoms, and died half an hour later. Ounce doses, given a glandered horse, caused tetanic spasms, but were not fatal. Moiroud states that the fatal dose for a horse is one to two ounces.

Cattle stand larger doses than horses when the poison is given by the mouth, whether in solution or bolus. Mr Macgillivray, Banff, gave an old cow thirty grains strychnine, and shortly after sixty grains, both doses in solution, with the result of a few spasmodic tremors, which continued for about twenty minutes (*Veterinarian*, November 1870). I gave a small red cow, affected with pleuro-pneumonia, grs. xv. strychnine, suspended in two ounces of oil, at 12 o'clock. At 12.30 the pulse had risen from 70 to 78, regurgitation was observable in the jugular veins, quivering and twitching affected the facial muscles, particularly during inspiration. At 12.45 the pulse numbered 84, and the symptoms were aggravated. Grs. ij. were given, dissolved in diluted acetic acid; and in a quarter of an hour the animal was very uneasy, and attempted to vomit; the pulse was 94, full and strong; the pupils much dilated. At 1.30 the nausea and efforts to vomit were much increased, the breathing more laboured; the animal lay down, and the pulse shortly fell to 58. At 2.15 the nausea was diminished, and the pulse 92. Grs. xxx. were then given in acetic acid and water. At 2.20 the pulse was 100, sharp and distinct. The muscles were affected by frequent spasms. At 2.25 the pulse was 140, and the animal very sensitive to light, sound, and external impressions. It reeled and fell. At 2.30 the pulse had risen to 160, the limbs were very rigid, the eyes

protruding, involuntary spasms more general, frequent, and severe. Two minutes later she died quietly. Much smaller doses are fatal when strychnine is quickly absorbed. When given hypodermically, Kaufmann states that the toxic dose for cattle is five or six grains. Tabourin records the death of a cow in twenty minutes from four grains placed in the areolar tissues.

Sheep are destroyed by half an ounce nux vomica in about thirty minutes, but goats appear to be less susceptible. **Pigs** were violently convulsed by fifty grains of nux vomica (Tabourin), and poisoned by one-sixth to three-fourths of a grain of strychnine (Kaufmann).

Dogs are destroyed in two minutes by gr. $\frac{1}{8}$ strychnine, and in twelve minutes by gr. $\frac{1}{8}$ (Christison). An English terrier was poisoned in twenty-four minutes by gr. $\frac{1}{2}$; a greyhound in one hour and a half by grs. iij.; another greyhound in thirty-three minutes by gr. ss. (Dr S. Macadam). Kaufmann fixes the toxic dose at one-sixth to one-third of a grain. Professor Christison poisoned dogs with grs. viij. of nux vomica, and cats with grs. v. Dogs moan and whine, are uneasy, nauseated, sometimes vomit, tremble, have muscular twitchings and general spasms, during which the head is drawn upwards and backwards, and the rectal temperature is raised 4° to 6° Fahr. The tetanic convulsions continue one to two minutes, cease for several minutes, but recur with increased force until death results.

Post-mortem appearances vary with the severity and duration of the case. Asphyxia renders the blood dark-coloured and unusually fluid; there is venous engorgement; congestion of the lungs and of the cerebral and spinal meninges; dilatation of the vessels of the medulla, and sanguineous extravasation into the grey matter. When the patient has survived for several hours, the intestines occasionally present patches of redness and congestion. Where spasms have been severe and rapidly fatal, the left side of the heart is firmly contracted, and contains little, if any, blood. The tetanised muscles quickly undergo *rigor mortis*, which sometimes continues longer than usual. In dogs destroyed with one-fifth grain of strychnine, I found the buccal mucous membrane blanched, the left auricle,

as also the intestines, continued to contract for nearly an hour after death, while the cerebral and intestinal vessels were congested with dark venous blood.

ANTIDOTES.—The stomach should be emptied with as little delay as possible; if convulsions have begun, the patient should be anæsthised, the stomach well washed out, and chloral hydrate given. Professor Hughes Bennett first shewed the antidotal power of chloral hydrate. He found that the minimum fatal dose of strychnine for rabbits was $\frac{1}{288}$ gr. per pound of body-weight. Twenty rabbits received more than this poisonous dose; fifteen of these, to whom chloral was given, recovered. But a few days later, on receiving the dose previously given, without the chloral, all died. French authorities advise the chloral to be given intravenously. Strychnine tetanus is also antagonised, although less effectually, by such motor paralyzers as curare, conium, tobacco, opium, and calabar bean.

MEDICINAL USES.—As bitter tonics, nux vomica and strychnine are prescribed in atonic dyspepsia. Their good effects probably depend upon their checking irregular fermentation, diminishing excessive secretion, as in catarrhal conditions, and perfecting co-ordination between the several functions of digestion and assimilation (Brunton). It is probably mainly in this way that they relieve many cases of broken-wind.

Small doses, especially when combined with acids, are often effectual in checking chronic **relaxed and hypersecreting conditions of the bowels**, where these are not complicated with irritation. Larger doses, increasing peristalsis, overcome **chronic constipation**, whether connected with acute indigestion, inflammation, or febrile attacks, and are usually prescribed with aloes or salines. They **give tone** in weak, dilated conditions of the heart; during their excretion exert tonic action on the urinary organs, while aphrodisias is occasionally produced. In convalescence from acute disease they improve appetite and general tone. Strychnine, subcutaneously injected, is sometimes serviceable in maintaining activity of the respiratory and heart centres in collapse and narcotic poisoning.

Nux vomica and strychnine are prescribed in **paralysis**, whether of the limbs, intestines, or bladder. They are most beneficial in chronic motor paralysis, but are unsuitable in

cases accompanied by irritation and congestion. They frequently relieve paresis resulting from falls or other injuries, from lead-poisoning, influenza, stomach-staggers, or rheumatism. Brown-Séguard, moreover, believes that paraplegia, even when depending upon softening or wasting of nervous textures, may sometimes be arrested by strychnine dilating the capillaries, determining a fuller stream of blood, and promoting nutrition. Mr F. Mavor, Park Street, London, found strychnine, subcutaneously injected, successful in several cases of roaring when used in the earlier stages, and before muscular wasting occurred. French veterinarians prescribe it in amaurosis.

Cerebro-spinal meningitis, probably from climatic peculiarities, is greatly more common in America than in Great Britain. Often it occurs as an epizootic. Mr Alex. Lockhart, of New York, informed me that he has seen two hundred horses almost simultaneously affected in one tram-car stud, and has had eighty patients in slings at one time. It attacks horses of all sorts, and under every description of management. Blood-letting and physic, he believes, hasten and increase mortality; under such reducing treatment half the cases die. It is unsafe to give more than half a dose of physic; oil is preferred to aloes. Although the cerebral form is very hopeless, Mr Lockhart assures me that 95 per cent. of the patients able to stand recover if at once treated with a grain of strychnine, repeated twice or thrice a day. In these cases Professor Robertson recommended Easton's syrup (p. 462).

In cattle practice, nux vomica and its alkaloids are used, especially in chronic paralysis. The late Mr David Aitken, Loughborough, who prescribed them with success since 1853, informed me of several typical cases. Two bullocks suffered from **chronic paralysis**, one so entirely that it had to be carted home from the grass field. He was dull; his pulse 55, and rather weak; his hind extremities and tail had lost their power of movement, their sensation was impaired; the sphincter ani was relaxed, and both fæces and urine were passed involuntarily. Purgative medicine was given, and operated next day, without, however, any abatement of the paralysis. Two drachms nux vomica were prescribed night and morning for ten days; but little improvement being notable, the dose was

increased to three drachms thrice a day. This treatment being persisted with for ten days, the patient was able to walk round the house in which he was confined, and rapidly recovered. The other bullock exhibited similar symptoms, was treated in the same manner, and with like satisfactory results.

A week or two before parturition, cows, especially if in low condition, occasionally lose the power of their hind limbs, and are unable to stand. Little can then be done besides propping the patient in a suitable position, turning her several times daily, and allowing laxative, nutritive diet. Within two or three days after parturition, most of these cases gradually regain the use of their limbs; but when **defective nervous power** continues, *nux vomica* or strychnine is used with success.

In canine practice, strychnine is a valuable tonic in atonic indigestion, in some cases of asthma and chronic bronchitis, in convalescence from exhausting disease, in chorea, and in paralysis resulting from distemper or other causes. It is frequently conjoined or alternated with iron salts, or prescribed in the form of Easton's syrup.

Strychnine is used for the destruction of rats, mice, and other vermin, and for the poisoning of wolves and other wild animals. It constitutes the active ingredient of various "infallible" insect and vermin destroyers, which are usually made up with starch, sugar, and about ten per cent. of strychnine.

Doses, &c.—Of the powdered *nux vomica*, horses take ℥ss. to ℥j.; cattle, ℥i. to ℥ij.; sheep, grs. x. to grs. xl.; pigs, grs. x. to grs. xx.; dogs, gr. ss. to gr. ij. The powder has the disadvantage of not being very soluble. The extract is eight or ten times as active as the powder. A tincture is sometimes used.

Strychnine is greatly more uniform and more readily absorbed than the crude drug, and is fifty times more powerful. The hydrochlorate and sulphate, on account of their solubility, are preferable to the alkaloid. The dose for the horse is gr. i. to grs. ij.; for cattle, grs. ij. to grs. v.; for sheep, gr. $\frac{1}{2}$ to gr. i.; for dogs, gr. $\frac{1}{30}$ to gr. $\frac{1}{20}$.

Strychnine, although conveniently given by the mouth, is

more prompt and active when administered hypodermically or intravenously, and when thus used the minimum doses should first be tried. *Nux vomica* and strychnine are generally given twice a day, and as anti-paralysants the doses may be cautiously and gradually increased, until slight muscular twitchings are produced. The strychnine salts are conveniently kept in tabloids, and for hypodermic purposes one part is dissolved in about 100 parts of a mixture of equal parts of rectified spirit and water. **Strychnine arsenite** has been recommended in some of the Continental veterinary schools for the treatment of persistent nasal discharges.

O A K B A R K.

QUERCUS CORTEX. The dried bark of the smaller branches and young stems of *Quercus robur* (*Q. pedunculata*). Collected in early spring from trees growing in Britain. (B.P.) *Nat. Ord.*—Cupuliferae.

Bark from smaller branches of young trees is more astringent than thicker pieces of older growth; the interior finer fibrous portions than the external rougher cortical. Oak bark contains a bitter crystalline substance, **quercin**, and owes its astringency to ten or fifteen per cent. of **querci-tannic acid**, which differs somewhat from gallo-tannic acid, and does not, by oxidation, yield gallic acid. The infusion has a powerful astringent taste, reddens litmus, gives a blue-black precipitate with ferric salts; and with gelatin solution a white flocculent precipitate, which resists putrefaction better than that of gallo-tannic acid. **Acorns**—the fruit of the oak—are collected in many parts of England for feeding sheep and pigs, are credited with a nutritive value approaching that of beans, but on account of their astringency require to be used sparingly.

ACTIONS AND USES.—Oak bark is **astringent**, resembling galls and catechu. It is prescribed to check chronic diarrhoea, dysentery, and other excessive mucous discharges. For weakly, scouring calves the decoction is given once or twice daily as required, with warm starch gruel, to which may be added aromatics, gentian, spirit, ether, or chloroform, or where there

is griping, laudanum. It lacks the tonic properties of cinchona and gentian, and constipates when given too frequently or freely. Decoctions are applied to dry and constrict hyper-secreting and relaxed surfaces, and to relieve piles in dogs.

Doses, &c.—Horses take ℥ij. to ℥iv.; cattle, ℥ss. to ℥ij.; sheep and pigs, ℥ss. to ℥ij.; dogs, grs. x. to grs. xxx., administered in infusion or decoction, made with one or two ounces of bark to the pint of water.

OLIVE OIL.

OLEUM OLIVÆ. The oil expressed from the ripe fruit of *Olea Europæa*. (B.P.) *Nat. Ord.*—*Oleaceæ*.

Several varieties of the evergreen *Olea Europæa* grow abundantly in the countries bordering the Levant and Mediterranean. From the stem a resinous juice once used in medicine can be got; the leaves are bitter, astringent, and tonic; the olives are oval, succulent, purple drupes, about the size of damsons, and containing a single seed. The ripe pericarp yields about seventy per cent. of oil, of which the finest, imported from Provence and Florence, is obtained by moderate pressure of the freshly-gathered fruit. Inferior qualities are got from stale or damaged fruit, or by extra pressure of the pulp.

PROPERTIES.—Olive oil is one of the fixed, fatty, or expressed oils which produce on paper or linen a greasy stain, not removed by heat, and are glycerides of an acidulous radical, oleic, palmitic, or stearic acid, and the basylous glyceryl or propenyl. Olive oil contains about 72 per cent. of fluid olein or tri-olein, $C_3H_5(C_{18}H_{33}O_2)_3$, holding in solution about 28 of palmitin and allied fatty matters. It is of the consistence of syrup, unctuous, transparent, odourless, and bland tasted. When pure it is pale greenish-yellow; when impure, yellow or brown. Its specific gravity at 77° Fahr. is .920. At 38° Fahr. its solid fats begin to crystallise; at 32° Fahr. it is completely solidified. It is not miscible with water, is scarcely soluble in alcohol, but dissolves in one and a half parts of ether. It is a capital solvent for cantharidin, atropine, and morphine. Exposed to air, it oxidises, thickens, and slowly becomes rancid, but does not dry up.

ACTIONS AND USES.—Olive oil is **nutrient, laxative, and emollient.** Like other bland oils, small quantities are easily digested and assimilated, aid cell development, and by oxidation support animal heat. Larger quantities, such as one or two pints for horses or cattle, and two or three ounces for dogs, are laxative. An ounce each of olive and castor oil makes a mild laxative for the dog. Like other fluid fats, when injected into the veins, it fatally obstructs capillary circulation. Half an ounce injected into the jugular speedily destroys a dog. As a demulcent and emollient, it is used in poisoning by irritants and corrosives; it antagonises the action of alkalis by forming soaps, and retards solution and absorption of arsenic. Small doses are occasionally given to horses and other animals to soothe the irritable mucous membrane in chronic catarrh and bronchitis. Not drying or readily becoming rancid, it is a soothing protective for irritable or abraded surfaces, but for such purposes the cheaper rape, lard, or linseed oils, or vaselin, are usually substituted.

O P I U M.

The juice obtained in Asia Minor by incision from the unripe capsules of *Papaver Somniferum*, inspissated by spontaneous evaporation. (B.P.) *Nat. Ord.*—*Papaveraceæ.*

MORPHINE. *Morphia. Morphina.* An alkaloid prepared from opium. (B.P.)

MORPHINE HYDROCHLORATE. *Morphinæ Hydrochloras.* (B.P.)

MORPHINE ACETATE. *Morphinæ Acetas.* (B.P.)

CODEINE. *Codeina.* An alkaloid contained in opium. (B.P.)

APOMORPHINE HYDROCHLORATE. *Apomorphinæ Hydrochloras.* (B.P.)

Opium, one of the most ancient articles of the *Materia Medica*, derives its name from the Greek word *ὀπός* (*opos*), signifying juice. The stem, unripe capsules, and other succulent parts of any species of poppy contain a milk-white narcotic juice, which, as it dries, becomes darker in colour, and constitutes opium. The fresh purple petals of the **Papaver rhœas**, or corn rose, contain no morphine, and only minute

traces of rhœadine, which are used as colouring agents, but not medicinally. The roots of some species contain a cathartic principle. The nearly ripened **poppy heads**, or capsules, gathered about twelve days after the petals fall, when digested in hot water produce a mucilage used for anodyne purposes; when dried they yield less morphine and codeine than when green, and besides contain the feebly alkaline crystalline rhœadine. Within the capsules are numerous white or brown reniform seeds, devoid of narcotism, but yielding a bland drying oil, similar to that of flax or rape. The cake or residue left after expression of this oil is used for cattle food.

The *Papaver somniferum*—the common white or garden poppy—is a native of the warmer parts of Asia, but it also thrives in this country. It flowers from May to July, and the capsules ripen about two months later. It is two to four feet high; has a round, smooth, erect stem, with a few hairs on the extremities and peduncles; large sessile, glaucous green leaves, with cut and wavy margins; large terminal white, red, or purple flowers, drooping before they open; and globose capsules about the size of a duck's egg, and containing numerous kidney-shaped white or brown seeds. Of the several varieties the white-flowered have hitherto been preferred, but the darker-flowered, especially the purple, are now stated to yield a larger quantity and better quality of opium.

In collecting the juice, transverse or spiral superficial incisions are made towards sunset into the nearly ripened capsules, a few days after the fall of the petals, and when their blue-green colour is changing to golden yellow. There exudes a thick milk-white juice, which concretes and deepens in colour, until, in twelve or fifteen hours, it forms semi-solid, red-brown adhesive tears. These are collected, formed into larger masses, dried, and packed for exportation in poppy leaves, in the leaves and winged seeds of a species of rumex, or in tobacco leaves and poppy petals. In Persia and India the tears collected from the capsules are rubbed in a mortar, and hence the amygdaloid structure is lost. Upwards of thirty tons of opium are annually consumed in this country.

The several varieties—of which the most notable are Turkey, East Indian, Egyptian, and European—owe their

characteristics to differences in soil and climate, and also to the time and manner of collecting and making up the juice.

Turkey or Smyrna opium, mostly of fine quality, and highly prized in the English market, is chiefly collected in the north-western districts of Asia Minor. It occurs in round, flattened pieces, usually weighing from half a pound to two pounds, is covered with poppy leaves and the chaffy seeds of the rumex. It is soft, moist, and ductile, and when minutely examined is seen to be made up of small tears. Its odour is peculiar, but not disagreeable; its taste bitter; its recent fracture pale liver-brown. It readily yields its active principles to water, forming a red-brown solution, and to alcohol of all strengths, forming darker-coloured tinctures. Good samples in a fresh state contain an average of ten per cent. of morphine.

East Indian opium, a large proportion of which is imported to China, is of uniform and good quality.

Egyptian opium, being generally grown on moist soils and collected before the capsules are ripe, is inferior to the best Turkey opium, and contains on an average about six per cent. of morphine.

European opium. Opium has been cultivated in France and Germany, and also in Great Britain. In 1818 Dr Young grew poppies near Edinburgh, and obtained nearly six ounces of excellent opium from a fall of ground, being at the rate of $57\frac{1}{2}$ pounds per acre. A still more extensive trial was made in 1823 in Buckinghamshire, where twelve acres of poppies were grown with a return of 16 pounds per acre of opium, which realised the highest price in the London market. From the high price of Turkey opium at that time, and the low value of land and labour, the speculation proved tolerably satisfactory. Unless, however, returns could be realised like those got in India, where the acreable yield is 30 pounds, the production of opium could not pay in this country. But under favourable circumstances, poppies might be cultivated, and morphine at once extracted.

PROPERTIES.—Opium occurs in irregular red-brown or red-black lumps, which weigh from four ounces to two pounds: usually indicate their being made up from agglutinated tears; break with an irregular, moist, chestnut-red fracture; shine

when rubbed with the finger; and have a specific gravity of about 3.36, a strong, peculiar, aromatic odour, and a disagreeable, persistent, bitter taste. Turkey opium recently imported contains 10 to 15 per cent. of water, and is moist and plastic; when long kept, or artificially dried, it is hard, and easily reduced to a brown powder, which is apt, unless carefully preserved, to absorb moisture. Under the microscope it exhibits various crystalline forms. When heated it softens, and at high temperatures burns with a strong, peculiar odour. Cold water dissolves about 60 per cent. of a good dried specimen, and forms a red-brown solution, including most of the active constituents. Rectified spirit dissolves about 80 per cent., and forms a dark-brown tincture, which includes all the active principles. Acids, when strong, disorganise opium; but when diluted are excellent solvents for it. The watery solution reddens litmus, owing to the presence of meconic and other acids, and is precipitated by vegetable astringents, salts of calcium, lead, copper, and other metals.

IMPURITIES.—As the best Turkey opium usually brings about 15s. per pound, there is great temptation to substitute inferior qualities and add foreign matters. Inferior specimens are distinguished by narrowly examining their consistence, texture, colour, odour, and taste. They are sometimes dry, hard, and resinous, or oleaginous and waxy; their fresh fracture devoid of the characteristic red tint and agreeable aromatic odour; while water and alcohol dissolve them imperfectly. Of the several substances used for adulterating, the most common are starch and molasses, the bruised leaves and chips of the poppy, the juice, pulp, or extract of the prickly pear, and opium from which the morphine has been extracted. Inorganic matters, such as sand, clay, and mud, may be detected by inspection, especially if the specimen be dried. Excess of moisture is discovered by drying a weighed quantity in a water bath, and ascertaining the loss—which should not, even in recent specimens, exceed 20 per cent. Specimens mixed with vegetable extracts, when drawn along a sheet of white paper, make a light-brown continuous mark, while that caused by pure opium is interrupted. But the most certain test of quality or purity is the proportion of morphine. 100 grains of good opium yield

9.5 to 10.5 per cent. of morphine; but picked specimens have produced 22 per cent.

Composition.—Opium is a complex substance. Besides 15 to 25 per cent. of water, it contains 50 of gum, pectine, wax, and albumin; 2 to 6 of ash; traces of an aromatic volatile oil; while combined with meconic, lactic, phosphoric, and sulphuric acids are a number of alkaloids in variable proportions, together amounting to 20 per cent. The most important are morphine, codeine, and thebaine. There are also two neutral bodies.

Subjoined is a list of these opium alkaloids, arranged according to their chemical composition:—

Hydrocotarnine, $C_{12}H_{15}NO_3$	Papaverine, . $C_{21}H_{21}NO_4$
Morphine, . . $C_{17}H_{19}NO_3$	Meconidine, . $C_{21}H_{23}NO_4$
Oxymorphine, . $C_{17}H_{19}NO_4$	Laudanosine, . $C_{21}H_{27}NO_4$
Codeine, . . . $C_{18}H_{21}NO_3$	Cryptopine, . $C_{21}H_{23}NO_5$
Thebaine, . . . $C_{19}H_{21}NO_3$	Narcotine, . $C_{22}H_{23}NO_7$
Laudanine, . . $C_{20}H_{25}NO_4$	Lanthopine, . $C_{23}H_{25}NO_4$
Protopine, . . . $C_{20}H_{19}NO_5$	Narceine, . . $C_{23}H_{29}NO_9$

Some of these alkaloids, such as codeine and oxymorphine, are derivatives of morphine. (1) The codeine series is prepared from morphine by the addition of alcohol radicles; others are got by (2) oxidation; (3) others by dehydration.

Opium alkaloids differ greatly in their action. Morphine is analgesic, and more or less hypnotic. Thebaine is stimulant and convulsant, and allied to strychnine. The best known of the others—oxydimorphine, papaverine, codeine, and narcotine—form a series, in which the first resembles the narcotic morphine, and the last the tetanising thebaine.

Morphine and its salts are got by macerating opium in successive portions of water, which dissolve the morphine meconate; calcium chloride is added to the solution; calcium meconate precipitates, and morphine hydrochlorate remains in solution, which, when concentrated, the morphine salt crystallises, is subjected to pressure in flannel or stout calico, thus removing narcotine and colouring matter, and is redissolved in hot water, and repeatedly crystallised. By the use of animal charcoal colouring matter is removed; while, to get rid of

codeine, ammonia is added to the watery solution, when pure morphine is precipitated.

Morphine crystallises in minute transparent right rhombic prisms, usually arranged in tufts. It has an intensely bitter taste and an alkaline reaction. It is soluble in ether, benzol, and chloroform; dissolves in 1000 times its weight of cold water, in 400 of boiling water, and still more readily in oils, caustic alkalies, and weak acids, with which it forms crystallisable and usually soluble salts. With a neutral solution of ferric chloride, it produces a purple-blue solution, which gradually becomes green; with nitric acid, an orange-red solution; with iodic acid, a red-brown liquid containing free iodine. Warmed with strong sulphuric acid and a little sodium arsenate, a blue-green tinge is produced.

Morphine hydrochlorate ($C_{17}H_{19}NO_3 \cdot HCl \cdot 3H_2O$) is preferable to the alkaloid on account of its solubility, is the salt in most common use, and is prepared by diffusing the morphine (obtained as above) in hot distilled water, gradually adding hydrochloric acid, and setting aside the solution to crystallise. It is a snow-white powder, consisting of broken-down crystals, which, when entire, are needle-like prisms clustering in radiated groups. It is without odour, but has the intensely bitter taste of morphine. It is soluble in its own weight of water at 212° Fahr., in 24 parts at 50° Fahr., and still more so in spirit.

Morphine acetate and sulphate are sometimes used, and are prepared in a similar manner to the hydrochlorate. The acetate is a white powder, almost entirely soluble in $2\frac{1}{2}$ parts of water at 50° Fahr., and readily soluble in spirit.

CODINE is methyl-morphine. Morphine = $C_{17}H_{19}NO_3(OH)$; codeine = $C_{17}H_{19}NO_3(OCH_3)$. It is present in opium in the proportion of $\frac{1}{4}$ to 1 per cent. It is a colourless bitter alkaloid, crystallising in rhombic octahedra, soluble in 80 parts water at 60° Fahr., in less than 2 parts of alcohol and chloroform, in ammonia, and dilute acids. Unlike morphine, it is insoluble in cold, weak caustic potash, and is unaffected by ferric chloride. Like the other opium alkaloids, it exhibits the twofold stimulant and hypnotic action, but its hypnotic power is slight, and, like methyl compounds of the alkaloids, it notably stimulates the motor centres, and full doses cause tetanic convulsions similar to those produced by strychnine or picrotoxin. It lessens irritability of the digestive tract. When given for several days to dogs, cats, or rabbits, arsenic or other irritants administered cause neither vomiting nor purging. It also diminishes the production of hepatic sugar, and is hence prescribed in diabetes mellitus in human patients (Brunton). Professor Thomas Fraser, as the result of

various observations, states, however, that while it is more expensive, it is not so effectual as morphine. The dose is twelve to fifteen times greater than that of morphine.

APOMORPHINE ($C_{17}H_{17}NO_2$) is prepared by heating morphine and concentrated hydrochloric acid for several hours in a hermetically closed tube, when an atom of water is abstracted. Codeine similarly treated yields apocodeine, which is not so active as apomorphine. Dr Lauder Brunton suggests that morphine, by long keeping, may be changed into apomorphine. It is amorphous, slightly bitter, moderately soluble in water, more so in alcohol; exposed to the air it gradually becomes green. It is used in the form of hydrochlorate. It is a prompt and effectual emetic in animals that vomit, acting both reflexly and directly. When gr. $\frac{1}{4}$, dissolved in water, is swallowed either by men or dogs, repeated vomiting occurs, but is not followed by so much nausea as tartar emetic. In dogs and cats, freshly prepared solutions have the advantage of producing immediate emesis, when used hypodermically in doses of gr. $\frac{1}{4}$ to gr. $\frac{1}{10}$. It increases bronchial, intestinal, and pancreatic secretions. It appears to act specially on the basal ganglia, cerebellum, and corpus quadrigemina, first stimulating, and then paralyzing them; large doses in dogs, cats, as well as in rabbits producing, besides vomiting, inco-ordinate manège movements, and subsequently difficult breathing, and muscular paralysis. It does not, like morphine, affect sensory or motor nerves (Brunton). Professor Fred. Smith, of the Army Veterinary Department, informs me that two grain doses given to horses stimulate the cerebro-medullary centres, producing intense delirium and nervousness, constant movement of the limbs, sweating, and every appearance of approaching dissolution. Friedberger states that sucking lambs suffering from gastric obstruction produced by swallowing wool are reported to have been promptly relieved by $1\frac{1}{2}$ to 3 grains, given hypodermically.

THEBAINE or **PARAMORPHINE** is present to the extent of $\frac{1}{2}$ per cent., is obtained in minute, colourless, rectangular prisms, melting at 380° Fahr., has an alkaline taste and reaction, is almost insoluble in water, but soluble in 45 parts of rectified spirit, and still more so in ether and chloroform. With cold sulphuric acid it forms a blood-red solution. It has very slight hypnotic action, prominently exhibits the excitant effects of opium, stimulates the motor tract of the spinal cord, and causes, like strychnine, muscular rigidity and convulsions. One to two grains, injected hypodermically, produce fatal tetanus in dogs (Dr J. Harley).

PAPAVERINE is stated by Dr Brunton to have little physiological action. It is present to the extent of about 1 per cent., is separable in shining prisms, which melt at 297° Fahr., is tasteless, sparingly soluble in water, soluble in dilute acetic and hydrochloric acids, and forms with cold nitric acid an orange colour. It is a feeble hypnotic.

CRYPTOPINE or **CRYPTOPIA**, an alkaloid discovered by Messrs T. & H. Smith, of Edinburgh, is probably a derivative rather than a natural constituent of opium, of which a ton yields only an ounce. It occurs in colourless six-sided prisms, is more bitter than morphine, and soluble in water acidulated with hydrochloric or acetic acids. One grain, injected subcutaneously, caused in dogs excitement, dilatation of the pupil, illusion of vision, agitation, and frenzy. Its hypnotic action is about one-fourth that of morphine. Poisonous doses destroy life by arresting respiratory movements (Dr J. Harley).

NARCOPTINE exists in opium in quantities varying from 2 to 8 per cent., and is got by treating the insoluble residue left in the preparation of morphine with diluted acetic acid, precipitating the solution with ammonia, and purifying with hot alcohol and animal charcoal. Its colourless rhom-

bic prisms melt at 350° Fahr., have an insipid taste, and are soluble in ether, alcohol, and weak acids; notably in chloroform, but not in cold water. It is a feeble base, and is distinguished from morphine by having no bitter taste, no reaction on vegetable colouring matter, and no effect on ferric-chloride. Inappropriately named, it is devoid of narcotism; is tonic and antiperiodic; and has been used in India as a substitute for quinine in the treatment of malarial fevers. Large doses are convulsant.

NARCEINE constitutes 0·1 to 0·7 per cent. of opium; occurs as a light, colourless, bitter, asbestos-like body, made up of soft, needle-like crystals, melting at 293° Fahr., soluble in 100 parts of boiling water, 400 of cold, and rather more soluble in glycerine and diluted hydrochloric acid. Somewhat contradictory opinions are expressed regarding its actions. In dogs grs. v., subcutaneously injected, produce calmative and hypnotic effects, similar, it is said, to those induced by a grain of morphine. Poisonous doses arrest respiratory movements, but do not cause convulsions (Dr J. Harley). It resembles morphine in its anexoosmotic actions.

MECONIC ACID, $C_8H_6O_4$, occurs in opium to the amount of 3 to 6 per cent., and, along with sulphuric acid, forms the solvents for the alkaloids. The calcium meconate precipitated in the preparation of morphine is treated with hot diluted hydrochloric acid, when meconic acid is obtained in transparent, snow-white plates, which are sparingly soluble in water, but readily in alcohol; heated above 150° Fahr., they are decomposed. It is tribasic; forms, with neutral solution of ferric-chloride, a blood-red solution, the colour being discharged by strong but not by diluted hydrochloric acid; and with copper ammonia sulphate, a green precipitate. No effect is produced by eight grains given to dogs, or by four and five grains administered to men (Pereira).

ACTIONS AND USES.—Opium has a complex and somewhat variable composition, and its alkaloids have different, and some of them opposite, effects; hence its actions are liable to variation. Opium, morphine, and its salts, temporarily stimulate and subsequently paralyse the cutaneous and mucous structures and endings of sensory nerves with which they are brought into contact, and this twofold stimulation and paralysis are repeated when the drugs are absorbed. The effects differ in the same individual according to the dose, and in man and the lower animals according to the relative development of the several parts of the central nervous system. In man the higher brain centres on which the drug acts primarily and prominently are paralysed, and the patient is usually calmed, sleeps, and, where large doses are given, becomes comatose. In the lower animals opiates stimulate the locomotor centres of the brain and the reflex centres of the cord, and instead of being quieted and hypnotised, the subject is excited, and exhibits irregular, involuntary movements, tetanic convulsions, and, only as death approaches, coma, from which, however, it can be readily roused. Opiates kill

by respiratory arrest. Medicinal doses are analgesic and antispasmodic, diminish the several secretions, excepting those of the skin, and, in combination with other drugs, are sometimes used as calmatives for dogs. They are applied locally to relieve irritability and pain.

GENERAL ACTIONS.—Opium, morphine, and its salts, applied to thin or denuded skin surfaces or mucous membranes, **temporarily stimulate** or irritate, and **subsequently paralyse**, diminishing sensibility and motility. These twofold actions of stimulation and depression characterise in greater or less degree opium and morphine, howsoever administered. Sensory, and to a less extent motor, nerves have their irritability first increased and then diminished. The in-contact paralyzant effects, with relief of irritation and pain, are directly and quickly produced by hypodermic injection of morphine. When administered by the mouth, opiates slightly augment the secretion of the salivary and gastro-intestinal glands with which they are brought into contact. Full doses cause some amount of gastric irritation, occasionally producing vomiting in man and dogs, but shortly, and more notably and permanently, they diminish gastro-intestinal secretions and movements.

After absorption, full doses induce primary, usually brief, stimulation, followed by **disorder and paresis of the central nervous system**. In veterinary patients the prominent phenomena are agitation, unrest, inco-ordinate, generally manège, movements, diminished sensibility to pain, indisposition for voluntary movement, and in toxic doses convulsions, coma, and death by respiratory arrest. Moderate doses dilate the blood-vessels and quicken heart action, and this is more notable in horses than in man. But repeated full doses slow heart action in all animals. Moderate doses slow respiration and render it irregular. The rectal temperature is temporarily raised; skin temperature from increased transpiration is reduced; but lethal doses, depressing the heat-producing centres, eventually lower the general temperature. Opium, morphine, and narceine diminish all secretions excepting those of the skin and kidneys, their effect on the latter organs being variable. By lessening reflex activity, and paralyzing both striped and unstriped muscles, they are notable antispasmodics. Full doses contract

the pupil, owing to paralysis of the brain centres, but the pupil is not affected by topical applications. Opiates are discoverable a few hours after administration in the secretions of the skin and intestines, and still more notably in the urine, and when full doses have been given they continue to be excreted for several days.

Different animals are somewhat **differently affected** by opiates, depending upon the relative development of different parts of their central nervous system. The higher the development, the greater is the susceptibility of an organ to the operation of the drugs which act upon it. Compared with the lower animals, the cerebrum of man is relatively heavier and more highly organised than the mesencephalon, the cerebellum, and the spinal cord; and this explains why opiates given to man in relatively small doses quickly and without marked stimulation paralyse the human cerebral centres, inducing sleep, and, in large doses, coma. **Horses**, with less development of these higher brain centres, have relatively more development of the locomotor centres and of the reflex centres of the spinal cord, and upon these lower centres opiates in equine subjects exert their primary stimulant effects. Instead of sleep there are produced restless, involuntary movements of the head and limbs, pawing with one foot sometimes for half an hour, or walking continuously round the box; while large doses cause tetanic convulsions.

Ruminants, like horses, are usually excited and restless. Cattle bellow, digestion is deranged, and tympanitis frequently supervenes. Sleep is not quickly or readily induced, excepting by full and repeated doses.

Dogs exhibit effects intermediate between those observed in man and in horses. Relatively to their body-weight, they take eight or ten times the doses prescribed for man. They show more preliminary excitement than man, but less involuntary muscular movement than the horse, but during drowsiness and sleep muscular twitchings occur. Sleep, however, is never very profound; the dogs are easily awakened; they dream, and have hallucinations, and after full doses remain stupid for a day. Although the skin is congested and hot, there is no notable increase of secretion such as occurs in man and occa

sionally in horses. Cats are as much excited as horses or cattle, more so than dogs, and hypnosis is produced with difficulty.

Rabbits also have their motor and spinal centres prominently affected, and convulsions are more common than hypnosis. Mice receiving a fraction of a grain of morphine are restless, have spasms, breathe irregularly, but sleep only when dangerous doses are given. Birds are curiously insusceptible; relatively to their weight they take three hundred times the dose given to man, do not sleep, or show any alteration of the pupil. Pigeons swallowing ten grains, or hypodermically injected with three grains, have inco-ordinate movements, laboured breathing, lowering of the temperature, sometimes to the amount of 5° or 6° Fahr., convulsions, and usually die. Mixed with the food of poultry, opium retards digestion, the crop remaining full for three times the normal period. Cold-blooded animals are even less susceptible than birds. In proportion to their weight, frogs take with impunity a thousand times the dose that would poison a man, and one or two grains cause convulsions, paralysis, and respiratory arrest.

Toxic Effects.—Opium and its preparations annually destroy in Great Britain upwards of one hundred human lives, three-fourths being children under five years. In the domesticated animals accidental poisoning with opiates occurs occasionally, intentional poisoning very rarely.

Horses with impunity take by the mouth about one hundred times as much opium as would poison a man. Hertwig mentions that two to four drachms produce slight stimulation, and that an ounce in solution caused first increased liveliness, and, after two hours, dulness, diminished sensibility, slower circulation, less frequent evacuations, and stupor—symptoms which continued for twelve hours, but entirely disappeared the following day. Two ounces and a half induced similar effects, with convulsions and death in about twenty hours. Dr John Harley found that four drachms powdered opium caused little effect for seven hours, and then only acceleration of the pulse. Even four ounces of laudanum are stated to have had little effect (*Old Vegetable Neurotics*).

I gave a strong, healthy cart horse one ounce powdered opium dissolved in water; the pulse in eight minutes fell from

forty-four to thirty-four beats per minute; the superficial muscles were relaxed, the nasal mucous membrane blanched, and the animal was dull and dejected. After half an hour four drachms were given, increasing the dulness and lowering the pulse to thirty-two. Half an hour later the animal, continuing in the same state, was destroyed by cutting the carotid artery. A mare, aged and rather feeble, had drachm doses in solution thrice a day. She exhibited dulness, loss of appetite, torpidity of the bowels, diminished force of the pulse, and died on the fourth day, after the exhibition of nine doses. One drachm given thrice a day to a healthy donkey, after six doses induced acceleration of the pulse to eighty-eight, restlessness, vertigo, nausea, champing of the teeth, and death on the third day.

Dr John Harley and Messrs Mavor hypodermically injected four grains of morphine acetate, and recorded acceleration of the pulse by twenty to twenty-eight beats, increase alike of its force and volume, restlessness, pawing, augmented moisture of mouth and skin, elevation of temperature, and slight dilatation of the pupils. Twelve grains, dissolved in three drachms of water, injected by three punctures, produced light drowsiness, after three hours followed by excitement, restlessness, and slight delirium, continuing about six hours. Thirty-six grains, in seven drachms of water, introduced by three punctures into a seven-year-old hunter in good condition, caused drowsiness and stupor, coming on in fifteen minutes, and continuing for three hours, slight muscular tremors, awkward, staggering gait, leaning against the sides of his box, dilated and fixed pupils, blindness and insensibility to light; the respiration, at first slow and sighing, gradually became accelerated. The dilatation of the pupil is opposed to the contraction so constantly seen in man. After the third hour restlessness and delirium set in, continuing for seven hours; he walked rapidly, and even ran round his box; his pulse was 96, full and thrilling; the skin damp with perspiration; the membrane of the eyes, nose, and mouth intensely injected. For twenty-four hours the effects continued; the secretions were, however, unaffected, but the horse was left exhausted (*Old Vegetable Neurotics*).

Mr F. Mavor, experimenting with a well-bred three-year-old colt, injected subcutaneously four grains morphine; in two hours the pulse had risen from 36 to 64; the temperature advanced fully one degree, to 101° Fahr.; two hours later the pulse was 57, the temperature remained the same, the pupils were dilated, the patient restless, the tongue moist; the effects gradually abated, and disappeared in twenty-four hours (*Veterinarian*, January 1874).

Mr A. E. Macgillivray, Banff, who has used morphine hydrochlorate hypodermically for years, states that in susceptible horses he has repeatedly found grs. iv. or grs. v. induce staring eyes, restlessness, prancing round the box, increased rapidity and threadiness of the pulse—symptoms which sometimes continue three to five hours (*Veterinarian*, March 1881).

Mr Fred. Smith and Mr C. Rutherford, of the A.V.D., made a series of experiments with alkaloids at Aldershot, and obligingly furnish me with the following notes:—A bay gelding had three grains morphine injected hypodermically, and in fifteen minutes had shaking of the head, which continued more or less for a couple of hours; but there were no other appreciable symptoms. A bay gelding, fed on hay and grass in October 1887—during warm weather—with a pulse of 38, respirations 12, and pupil half an inch vertical diameter, had five grains morphine injected. In forty minutes the pulse was 42, respirations and pupils unchanged. He walked occasionally round his box, threw back his ears; a patch of perspiration appeared on the breast, around the seat of injection; the head was frequently shaken; the animal was easily startled. The effects wore off in about an hour and a half.

In experiments where **morphine and atropine** were injected together, Mr C. Rutherford records that the horses were more readily excited than when morphine was given alone. They moved almost constantly round the box, had rhythmical movements of the head, and dilated pupils. Morphine 5 grs., injected with 15 ℥. B.P. atropine solution, caused in fifteen minutes uneasiness, walking round the box, throwing up and shaking of the head, slight pawing, dilated pupils, nervousness, and excitability. These symptoms continued for one

and a half hours, when they gradually abated; but the animal for six hours still remained easily excited, and a "little on the move."

Twelve grains morphine acetate, dissolved in a pint of water and swallowed by a horse, had no effect beyond increasing the pulsations eight beats (*Old Vegetable Neurotics*). One hundred grains acetate, swallowed in solution, killed a horse with convulsions in three hours (Dr H. C. Wood's *Treatise on Therapeutics*). Kaufmann states that 45 to 75 grains of the hydrochlorate, given hypodermically, poison horses.

Ruminants are not so susceptible, especially of opiates given by the mouth. Cows to which I gave an ounce of opium, and sheep four drachms, exhibited dryness of the mouth, occasional nausea and restlessness, acceleration, and subsequently slight slowing of the pulse. Fröhner hypodermically injected a cow with 15 grains morphine hydrochlorate; she became excited, lowed hoarsely, was tympanitic; but the effects passed off in an hour. Kaufmann states one to two drachms as the toxic dose for cattle, and 15 to 30 grains for sheep and goats. **Swine** receiving one or two drachms of opium become first lively and then dull and sleepy, their bowels constipated, and their skins hot.

Dogs swallowing moderate doses usually become stupid and drowsy, but occasionally are rendered delirious, especially by large doses. The pupil is not dilated, as is frequent in the horse or cat, nor continuously contracted, as in man, but is contracted while the dog is asleep or narcotised. Two to three drachms of opium cause, within a few minutes, increased force and frequency of the circulation; there is nausea, a staggering, unsteady gait, twitching of the limbs, clonic spasms, stertorous breathing, drowsiness, stupor, and usually death. The symptoms continue from three to fifteen hours, and most animals surviving the latter period recover. Dr Harley injected 20 minims laudanum under the skin of a bitch about 25 lbs. weight; she was nauseated; in fifteen minutes she vomited; had spasms of the diaphragm, the bowels acted, mucus ran from the mouth; within an hour the pulse had fallen from 120 to 78, and was irregular; the animal lay quiet, but did not sleep or show narcotism. Twenty minims more were

injected; the pulse fell to 72, and was regular; respiration 16, and regular; half an hour later she closed her eyes and was drowsy, continued so for an hour, but did not actually sleep.

Morphine acetate, half a grain, subcutaneously injected by Dr Harley into a bitch weighing 25 lbs., in a few minutes caused vomiting and urination. She lay motionless, her nose on the rug, her fore and hind limbs fully extended. For upwards of three hours she was so completely narcotised that the eyes were insensible to light, the pupils much contracted; the pulse fell from 120 to 50, and became irregular; the respirations went down from 20 to 14, and were shallow; the muscles were flaccid. Two to three grains, subcutaneously injected, killed dogs of 12 lbs. to 16 lbs. in ten or twelve hours; doses insufficient to kill develop in most dogs excitant instead of soporific effects. The spinal cord is more notably acted on than the brain; vomiting, nausea, restlessness, and delirium are the usual symptoms.

Post-mortem discovers the results of asphyxia. The blood is fluid and dark-coloured, but it does not yield on analysis any indications of the poison. There is general venous engorgement; the lungs and brain are specially congested. The ventricles of the brain and subarachnoid spaces contain more serum than usual.

ANTIDOTES.—Opium is not very quickly absorbed; when a poisonous dose has been swallowed, the stomach should be emptied as soon as possible, preferably by the **stomach pump**, and washed out. A little ammonia added to the solution, used beneficially, promotes cardiac and respiratory action. Administration of nitrites, and of small doses of **atropine hypodermically**, maintain cardiac action; but the atropine must be used cautiously, as full doses are apt to intensify paralysis both of the heart and cord. The lethal tendency is further combated by strychnine, used hypodermically, and by artificial respiration. Coma is prevented by giving strong coffee and stimulant enemata, and keeping the patient moving. Tincture of galls and other chemical antidotes are of little avail.

MEDICINAL USES.—Opium and morphine are used to relieve

symptoms rather than to remove the conditions on which they depend. Small doses are nerve stimulants, and retard digestion and metabolism. The Cutch horsemen share their opium with their jaded steeds, and increased capability of endurance is observed alike in man and beast. In the lower animals, as already indicated, they do not produce the general calmative and hypnotic effects which characterise their use in man, but applied topically they effectually **allay pain and spasm**. In human patients opiates cause notable vascular dilatation, and hence relieve congestion and inflammation (Brunton). But in the lower animals vascular dilatation occurs only when toxic doses are used (Fröhner), and accordingly the antipyretic and anti-inflammatory power of opiates must be considerably less than in man. Moreover, owing to the greater excitant action in veterinary patients, the administration of opium does not blunt the perception of pain as effectually as it does in human patients. When, however, a morphine salt is injected hypodermically twenty to thirty minutes previous to the inhalation of chloroform or ether, the anæsthesia is intensified and prolonged.

In **gastritis** and gastro-enteritis, whether produced from disease or from swallowing acrid poisons, opiates relieve irritability, pain, and spasm. Obstinate chronic **vomiting**, either in dogs or pigs, whether depending upon irritation of the stomach or of the vomiting centre, is generally relieved by a few grains of opium, given with chloroform or chloral hydrate. In gastric irritability it is sometimes prescribed with bismuth. When, in weakly, young, growing animals, food is hurried too rapidly through the digestive canal, opium checks excessive secretion and peristalsis, and, conjoined with mineral acids or arsenic, should be given shortly before feeding.

Diarrhoea, whether occurring from congestion of the alimentary mucous membrane, or as a symptom of other ailments, is often removed by a laxative, which carries away offending matters. Occasionally, however, the intestines continue irritable and relaxed; opium in such cases abates irritability, diminishes excessive secretion, and is administered with well-boiled starch gruel, sometimes conjoined with an antacid, sometimes with acids, bitters, or vegetable astringents. For such purposes the following recipes are used, alike in horses or cattle:—A drachm

each of powdered opium, kino, gentian, and sodium carbonate; or a drachm of opium, a drachm of powdered galls, or half a drachm of tannin, with half an ounce of chalk. These drugs may be made into bolus with treacle or meal and water, or dissolved in ale or gruel, and given twice daily, or as required. An ounce of laudanum, thirty drops sulphuric acid, two drachms powdered catechu, with an ounce of ginger, aniseed, or fenugreek, make an astringent anodyne drench for diarrhoea in cattle, and may be given in gruel, ale, or spirits and water. Another useful prescription for relaxed bowels consists of an ounce each of laudanum, decoction of oak bark, ginger, and sodium carbonate, given several times daily in starch gruel. One-third of this dose suffices for calves of six months. For dogs, Stonehenge mixes three to eight drachms laudanum, two to three drachms chalk, one drachm aromatic confection, and two drachms gum arabic, dissolved in seven ounces of water, and of this mixture orders one or two tablespoonfuls every time the bowels are relaxed.

In **dysentery**, whether in horses, cattle, or dogs, opium is of service in allaying pain and straining, and may usually be freely given, along with antiseptics, both by the mouth and rectum. A drachm each of powdered opium and galls, with half a drachm copper sulphate, may be repeated twice a day, either for horses or cattle. Whilst febrile symptoms continue, any such opium mixture must be used cautiously, and an occasional laxative may be necessary. In gastro-intestinal cases, opium is generally contra-indicated when secretion is impaired, or the liver or kidneys act imperfectly.

In **enteritis** in horses, Professor Robertson used half a drachm each of powdered opium and camphor, with five minims Fleming's tincture of aconite, in a pint of gruel, with or without a dose of oil. In the rapidly fatal **muco-enteritis** amongst the heavier descriptions of hard-worked horses, opium and calomel were wont to be prescribed in the earlier stages, and opium, belladonna, chloral hydrate, and ether in the second stages; but more prompt measures are needful to avert the deadly passive hæmorrhage, and morphine and atropine, sometimes used with ergotin, are hypodermically injected, and repeated every two hours.

In **peritonitis**, whether common or puerperal, full doses of opium are administered, and opium and camphor liniment is rubbed into the abdominal walls. **Obstruction of the bowels** from dust-ball, strangulation of the intestine, or intussusception, are usually hopeless, but the most promising treatment consists in full doses of opiates, which combat spasm, irritation, and pain, and in displacement of the bowels may facilitate restoration of the parts to their normal position.

Antagonising muscular spasm, opium and morphine are valuable in **spasmodic colic** in horses, being usually conjoined with such stimulants as ether, sweet spirit of nitre, chloral hydrate, chloroform, spirit of ammonia, or oil of turpentine, and with such laxatives as aloes and linseed or castor oils. For general service four or five drachms of aloes are rubbed down in a quart of tepid water, and when the solution is nearly cold, an ounce each of laudanum and ether is added; while in large horses the dose of the anodyne and stimulant may be doubled. If more convenient, the aloes may be given in bolus, the laudanum and ether in draught.

As an antispasmodic for the dog, Stonehenge advises half a drachm to a drachm each of laudanum and ether, given in an ounce of camphor mixture. Professor Fred. Smith, A.V.D., informs me of the following case, illustrating the powerful antispasmodic effect of morphine on the dog:—A collie poisoned with strychnine, and so convulsed that recovery seemed impossible, had five grains morphine injected hypodermically; the muscular spasms ceased, he slept for twenty-four hours, and recovered.

Diseases of the respiratory organs, with shallow, embarrassed breathing, are unsuitable cases for full doses of either opium or morphine, which are apt still further to depress respiratory function, and lead to death by apnoea. **Pleurisy**, however, may be treated by larger and more frequently repeated doses than bronchitis or pneumonia. Besides topical analgesic effects produced when slowly swallowed, opiates, when absorbed, diminish excitability of the respiratory centre, and thus **relieve cough**, and pain of the throat and chest. Belladonna and opium, although in large doses opposed in their effects on the respiratory centre—the former acting as an excitant, the latter

as a depressant—in medicinal doses are sometimes advantageously conjoined in allaying bronchial irritability. In the **catarrhal epizootics** of horses, after a few doses of salines, half a drachm each of opium and belladonna extract, conjoined with an ounce of spirit of chloroform, ether, or sweet spirit of nitre, and repeated two or three times daily, frequently abates vascular congestion and cough. A similar prescription answers in **asthma**—a common complaint in dogs; but in this, as in other diseases, more prompt and certain effects are obtained by the hypodermic injection of morphine and atropine.

Rheumatism is sometimes advantageously treated with opium, prescribed in the earlier and more acute stages with calomel and salines; and in more chronic cases used both locally and generally, and along with turpentine and other stimulants, smart friction and warm clothing. Neuralgic pains occurring in horses, and causing puzzling—sometimes frequently shifting—lameness, are relieved, and occasionally cured, by morphine injected deeply into the affected muscles.

American practitioners prescribe opium and also morphine, given by the mouth and hypodermically, for combating the rigidity and pain of **spinal meningitis**. **Tetanus**, occurring in young animals from exposure to cold, is often successfully treated by opium, especially when conjoined with chloral hydrate or conium; while in the more serious cases amongst adults, spasms and morbidly acute sensibility have been removed for several hours by the hypodermic injection of morphine, deeply inserted into the tetanised muscles. In **hysteria** it is prescribed with potassium bromide and camphor.

Opiates are of service alike in mares, cows, and bitches, in allaying the **post-partum irritability** and **straining** which occur in such cases, being sometimes conjoined with chloral or chloroform. Morphine, used either by the mouth or hypodermically, alone, or, better still, conjoined with atropine, is often effectual in arresting **premature labour pains**. Some practitioners recommend opiates in rabies and chorea, but they are of little use in either. They were formerly used in polyuria amongst horses, but are not so effectual as iodine. Although powerless to arrest phthisis pulmonalis, they are often serviceable in relieving the accompanying cough and diarrhoea.

Opiates are **contra-indicated** in acute fever, in congestive and inflammatory diseases of the brain, in obstinate constipation, and in subjects in an excitable state. Full doses, depressing respiratory functions, prove injurious where there is tendency to death by apnœa.

Externally, opium is used to relieve the pain of wounds, bruises, boils, blistered and cauterised surfaces, and superficial inflammation of the eye, skin, or joints. For such purposes five to ten drops each of laudanum and Goulard's extract may be mixed with an ounce of water. As a topical anodyne its efficacy is often increased by combination with belladonna, chloral hydrate, or aconite. A dressing of soap liniment, mixed with opium tincture, often allays irritability and pain in bronchitis, pleurisy, and arthritis; or in such cases a flannel wrung out of hot water may be applied, moistened with the anodyne solution. Along with borax or alkaline carbonate, it is useful in abating the irritation of prurigo and acute eczema. Boils and carbuncles may sometimes be dispersed by freely saturating them with a strong opiate solution or ointment covering with a piece of oiled silk, and applying a large poultice. For hæmorrhoids, opium is conjoined with gall ointment. It is the anodyne chiefly relied on for injections and suppositories in enteritis and dysentery, as well as in irritation and inflammation of the uterus, kidneys, bladder, and rectum. The uterus vagina and urinary bladder, when everted, should be washed with tepid water, moistened with a solution of opium and belladonna, carefully returned, and retained in position by appropriate measures. As a clyster, opium is used in about the same quantities as are given by the mouth. When the skin is tender or abraded, especially in small and young animals, opiates must be applied cautiously, lest they become absorbed, and produce undue constitutional effects.

Doses, &c.—Of **solid opium**, horses take ℥i. to ℥ij.; cattle, ℥ij. to ℥iv.; sheep, grs. x. to grs. lx.; pigs, grs. v. to grs. xx.; dogs, gr. i. to grs. vj.; cats, gr. ss. to grs. ij. Of **morphine and its salts**, horses and cattle take grs. iii. to grs. x.; sheep gr. ss. to grs. ii.; pigs, gr. $\frac{1}{10}$ to gr. ss.; dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{4}$, given in pill or dissolved in diluted spirit, slightly acidulated either with hydrochloric or acetic acid. **For hypodermic in-**

jection not more than the minimum doses mentioned should in the first instance be used. Morphine, hydrochlorate acetate and sulphate are used, dissolved in forty to fifty parts of water, and thus administered act very promptly and effectually, especially in rheumatic and neuralgic cases. Tabloids containing one or more grains or fractions of grains of morphine salts are convenient, especially for hypodermic use.

Tolerance alike of opium and morphine is as quickly acquired in the lower animals as in man. It is increased not only by frequent use but by acute pain. Special **susceptibility** is observable in young animals, in which, accordingly, reduced doses must be used. Although opium and morphine salts resemble each other, the crude drug is more apt to cause gastric disturbance and constipation, while the alkaloid is more effectual in arresting pain, especially when applied directly to the affected part or used hypodermically.

The several actions are altered, intensified, or repressed by **combination with other drugs**. Hypnosis and quieting of nervous excitability are determined by combining the opiate with cannabis indica, chloral hydrate, and bromides; anti-spasmodic effects, by conjunction with ethers or volatile oils; the checking of intestinal secretion, by prescription with lead acetate, tannic or sulphuric acids; sudorific action is promoted by ipecacuanha, ammonium acetate solution, diluents, and warm clothing; anodyne properties are increased by combination with atropine, and occasionally with aconite or prussic acid; while in malarial fevers, Indian and American practitioners prescribe opiates with quinine.

Veterinarians do not use so many preparations as are employed in human medicine. **Crude opium** is given to horses and dogs made into bolus or pill, and no other solid form is necessary. To reduce it to powder, it is first dried in a vapour bath, and its trituration is facilitated by mixture with potassium sulphate, or other hard salt. The **extract**, though somewhat less bulky than crude opium, has the disadvantage of being frequently made at a high temperature, at which the resinous matters unite with the alkaloids, forming compounds which are insoluble and of diminished activity. **Dover's powder**, the pulvis ipecacuanhæ compositus, consists of one part each of

powdered opium and ipecacuan, and eight parts potassium sulphate, added to facilitate trituration and intermixture of the vegetable matters. It is given to dogs as a febrifuge, in doses of grs. iij. to grs. x. (p. 456). A **watery solution**, made by rubbing down opium in hot water, and giving both dissolved matters and residue, has the merit of being cheaper than the tincture, and is more prompt and effectual than the solid drug.

Tincture of opium, popularly known as laudanum, is thus prepared by the B.P. process:—"Take of opium, in coarse powder, an ounce and a half; proof spirit, one pint; macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient proof spirit to make one pint." This brown-red tincture has the odour and taste of opium, and the specific gravity .942. It contains the alkaloids, resinous and odorous matters in a convenient and soluble form. An ounce contains the soluble matters of nearly 33 grains of opium, or about 3.3 grains of morphine. Evaporation of a known quantity, and weighing the residuum, are the best safeguards against adulteration. An ounce of good laudanum leaves 17 to 22 grains of residue. For immediate effects laudanum is usually preferable to solid opium. The dose for horses and cattle is ℥i. to ℥iij.; for sheep and pigs, ℥ii. to ℥vi.; for dogs, ℥xv. to ℥xl.

The **vinegar** and **wine** of opium are seldom used in veterinary practice. An **ammoniated tincture**, known as Scotch paregoric, is prepared by macerating for seven days 100 grains opium with 4 fluid ounces strong ammonia solution and 16 ounces of rectified spirit; to which the B.P. adds saffron, benzoic acid, and oil of anise. A **camphorated tincture**, known as English paregoric, is made with opium 40 grains, benzoic acid 40 grains, camphor 30 grains, oil of anise $\frac{1}{2}$ fluid drachm, proof spirit 1 pint. Laudanum and soap liniment, mixed, make an excellent anodyne, much used externally.

OXYGEN.

Oxygen is a colourless, odourless gas, slightly heavier than atmospheric air, and forming about one-fifth of its volume.

Twenty-five volumes of water dissolve one volume of oxygen. It has a wide range of chemical affinities.

ACTIONS AND USES.—Oxygen has slight effect on the unbroken skin, but stimulates denuded skin and mucous surfaces. Oxygenated solutions have been applied to atonic wounds and ulcers. Such solutions, when swallowed, aid oxidation of waste products in the alimentary canal. The breathing of the gas has been recommended in asthma, asphyxia, and various respiratory difficulties. Six gallons inhaled by human patients have, however, no notable effect. Only limited quantities can be retained by the blood; the serum, when saturated, retains one-fifteenth of the amount the red globules can take up, and hence it is very doubtful whether tissue oxidation can be effected by inhalation of oxygen. Dr Lauder Brunton states that small animals confined in jars of oxygen become excited, tetanised, and die (*Pharmacology*).

OZONE.

When electric sparks are passed through air, the molecules of oxygen, represented by two atoms (O_2), are split up and rearranged in triad atoms, constituting ozone (O_3). It is also produced by the slow oxidation of phosphorus in the presence of water, and by the action of protoplasm. It is unstable, being readily converted into oxygen. It is distinguished by its peculiar smell, and by its decomposing potassium iodide solution, and when mixed with damp starch, producing the blue starch iodide.

ACTIONS AND USES.—It oxidises more actively than oxygen, destroys the coagulability of albumin, decomposes many organic substances, and kills micro-organisms. In virtue of its chemical actions it is a powerful irritant. When inhaled it induces excitement, succeeded by exhaustion and sometimes by convulsions. It has been used for most of the cases in which oxygen has been given, notably for the destruction of micro-parasites in diphtheria and other such diseases (Brunton).

PARALDEHYDE.

A polymeric modification of Aldehyde. $C_6H_{12}O_3$

Paraldehyde is a body intermediate between an alcohol and an ether. It is a colourless fluid, soluble in ten parts of water, still more soluble in glycerine, and of a disagreeable, persistent, nitrous odour and taste.

ACTIONS AND DOSES.—It is **antiseptic, hypnotic**, and slightly diuretic. It hinders fermentation, and flesh placed in a two per cent. solution has been kept fresh for two months. It is a more effectual hypnotic than hypone or urethane, but does not produce sleep in man or dogs as readily as opium or chloral, while horses are brought under its soporific effects with still greater difficulty. Fröhner, experimenting on horses, found that 200 grammes ($7\frac{1}{2}$ fluid ounces) produced only slight trembling, vertigo, and staggering; 450 grammes induced powerful trembling, yellow-red colouring of the visible mucous membranes, the presence of hæmoglobin in the urine, but no sleep; the effects passed off in an hour. 500 grammes caused staggering, excitement, pawing, plunging, difficult breathing, dulness, diminished sensation, yellow membranes, solution of the red globules, with discharge of hæmoglobin in the urine, great weakness continuing for twelve hours, while weariness, anæmia, and emaciation persisted for a week (*Arzneimittellehere*).

Dogs receiving three to four grammes per kilogramme of body-weight had difficulty in balancing themselves, and cerebral narcosis followed later. Medicinal doses of fifteen to thirty minims, after brief excitement, cause sleep, lasting six or eight hours. But its effects are by no means certain when the patient is excited or pained. In human practice it is prescribed in nervous insomnia, and as a hypnotic in cardiac cases. On account of its local irritant effects it is unsuitable for hypodermic injection.

PEPPERMINT.

OLEUM MENTHÆ PIPERITÆ. Oil of Peppermint. The oil distilled in Britain from fresh flowering peppermint (*Mentha piperita*). (B.P.) *Nat. Ord.*—Labiatae.

The natural family Labiatae furnishes peppermint, spearmint, pennyroyal, lavender, rosemary, marjoram, and thyme; and

from these plants, when fresh flowering, aromatic antiseptic volatile oils are obtained. Similar oils are extracted from the leaves of various Myrtaceæ, from the petals of roses, from the flowers and fruit of various Aurantiæ, and from the seeds of various Umbelliferæ (p. 242).

Of the Labiatae volatile oils peppermint is the most commonly used. The fresh plant yields 1 to 1.25 per cent. of the colourless or pale yellow oil, characterised by its warm aromatic taste and subsequent sensation of coldness, and by the blue colour and red fluorescence produced when it is acted on by acetic, sulphuric, hydrochloric, or nitric acid. It consists of two isomeric oils—the fluid **menthene** ($C_{10}H_{18}$), and the solid or crystalline **menthol** ($C_{10}H_{20}O$), which is homologous with thymol, the stearoptine of the oil of thyme.

ACTIONS AND USES.—Oil of peppermint is a typical volatile oil; it is an antiseptic, topical stimulant, and anæsthetic, carminative, antispasmodic, and parasiticide (p. 243). It is more active than the oil from *Mentha viridis*, or spearmint, or *M. pulegium*, or pennyroyal. Diluted solutions arrest the development of bacilli as effectually as carbolic acid, or eucalyptus oil, and are hence used as dressings for wounds, and as sprays or gargles for ulcerated or diphtheritic throats. It destroys vegetable and animal parasites infesting the skin. After stimulating, it paralyses the ends of sensory nerves with which it is brought into contact, and hence relieves gastro-intestinal, neuralgic, and other pains. Painful surfaces are gently rubbed with a pencil of menthol, solution being promoted by wetting with a little spirit. Increased analgesia is secured by diluting the menthol with eight or ten parts of ether, or mixing it with equal parts of thymol, carbolic acid, or chloral hydrate. Peppermint oil is used to prevent the nausea and spasms sometimes produced by purgatives, to flavour medicinal preparations, or cover their unpalatable taste.

DOSES, &c.—For horses and cattle, ℥ xx. to ℥ xxx.; for dogs, ℥ iii. to ℥ v., given on a piece of sugar or in spirit and water. Peppermint water contains one and a half fluid drachms of oil to the gallon of water. The essence consists of one part of oil to four of rectified spirit.

PEPPERS.

The black and white peppers in daily domestic use are obtained from the brown wrinkled berries of an East Indian perennial climbing plant—the *Piper nigrum*, of the natural order **Piperaceæ**. They are imported from the Malabar coast, the islands of the Indian Archipelago, and the West Indies. The pendulous spike, bearing twenty to thirty berries, is gathered as it begins to redden, shortly before ripening, and is dried in the sun. The berries rubbed off, and ground without separating their outer covering, yield **black pepper**. To prepare the milder **white pepper**, the best and soundest ripe berries are steeped in water, and stripped of their pungent outer covering before they are ground. **Long pepper**, the produce of *Chavica Roxburghi*, is brought from Singapore and Batavia, and consists of small, closely-attached berries, arranged on cylindrical grey spadices one or two inches long.

The peppers when ground have a hot, pungent, spicy taste, and owe their properties to 1·6 to 2·2 per cent. of a **volatile oil**—isomeric with oil of turpentine ($C_{10}H_{16}$), a soft, pungent **resin**, and 2 to 3 per cent. of the colourless, crystallisable, neutral **piperine**, $N(C_5H_{10})(C_{12}H_9O_3)$, which is isomeric with morphine, and when boiled with caustic potash yields an active oily alkaloid, piperidine, $N(C_5H_{10})H$.

Cubebs, or *Cubeba*, are the dried, partially ripened fruit of the *Piper Cubeba*, cultivated in Java and other islands of the Indian Archipelago. The berries are stalked, and lighter coloured than those of common pepper, are globular, rough, and wrinkled, with a strong odour, and pungent, aromatic, bitter taste. They contain a volatile oil, a resin, and the neutral crystalline cubebin, which is devoid of any marked action.

Piper angustifolium, a shrub found in moist regions throughout Brazil and Peru, yields the **matico leaves**, much used in America as a styptic dressing, and also occasionally administered for the arrest of internal hæmorrhage.

Pimenta, pimento, Jamaica pepper, or allspice, closely resembles the true peppers; is the dried, unripe berry of *Pimenta vulgaris*, an evergreen West Indian tree of the

natural family *Myrtaceæ*. The berries are about the size of those of the *Piper nigrum*, have the same penetrating aromatic odour, and hot, pungent taste, but are more truly aromatic and less acrid. They contain an acrid **fixed oil**, and about six per cent. of **volatile oil**, resembling oil of cloves, with traces of an **alkaloid**, having the odour of coniine (Flückiger).

Capsicum—the dried ripe fruit of *Capsicum fastigiatum*—is also known as Chili pepper, chillies, Guinea or pod pepper. The red pods are filled with numerous small round or ovoid red-brown seeds. Both pericarp and seeds are pungent, and when ground constitute the familiar **Cayenne pepper**, which owes its pungent acidity and irritant properties to an acrid volatile substance, **capsaicin** ($C_9H_{14}O_2$), and an alkaloid resembling coniine in odour.

ACTIONS AND USES.—The peppers are **irritants, stimulating stomachics, and rubefacients**. Large doses, especially in carnivora and omnivora, are irritant poisons, inflaming the alimentary and sometimes also the urino-genital mucous membranes. That they are especially poisonous to pigs is a popular error. Properly regulated doses promote salivary and gastric secretions, are stomachic and carminative, and during their excretion stimulate the urino-genital mucous membrane. Rubbed into the skin they cause redness, irritation, swelling, and sometimes suppuration. The several peppers differ in the intensity of their action. The black is more active than the white and long peppers, which are of nearly equal strength. Pimento is less active, while capsicum and cayenne are more irritant than black pepper. In virtue of its stimulant effects, and its rendering the urine antiseptic, cubebs checks irritation and discharges from the urino-genital mucous membrane.

Black pepper (the variety chiefly used in veterinary practice) is administered in simple indigestion, and for obviating the disagreeable taste and nauseating effects of various drugs. It is not now given as a sialogogue, nor for the object of increasing sexual appetite, which, when defective, may usually be restored, not by irritating drugs, but by measures which improve general vigour. It ought not to be used for blistering ointments, or for smearing setons, nor introduced into the

rectum of horses exposed for sale—a barbarous practice, apt to induce serious intestinal irritation.

DOSES, &c.—Of black pepper, as a stomachic, horses take about ℥i.; cattle, ℥ij.; sheep and swine, grs. x. to ℥ss.; dogs, grs. v. to grs. x., repeated two or three times a day, given in bolus, dissolved in water or spirit, or suspended in well-boiled gruel.

PEPSIN.

A preparation of the mucous lining of the fresh and healthy stomach of the pig, sheep, or calf. (B.P.)

Pepsin is prepared by several processes. The stomach is digested in water acidulated with hydrochloric acid, and the pepsin thus extracted is precipitated by sodium chloride. More commonly the mucous surface is cleansed, slightly washed, the surface scraped with a blunt knife, and the viscid pulp thus obtained dried at a temperature not exceeding 100° Fahr. Thus prepared, especially from the stomach of the calf, the pepsin is mixed with other two ferments—one which curdles milk, probably by hydration of the casein, and another which decomposes milk sugar, producing lactic acid (*Textbook of Human Physiology*, Landois and Stirling).

ACTIONS AND USES.—Pepsin dissolves proteids and converts them into peptones, but does not affect fats or starch. Its therapeutic value is hence limited to young herbivora while receiving milk, and to dogs living chiefly on animal food. In such patients it is given along with or immediately after meals. When gastric secretion in the domestic animals is at fault, it is more probably from deficiency of the acid than the pepsin, and such a condition is appropriately treated by hydrochloric acid, administered with or after meals.

Pepsin is sometimes used to dissolve fatty and malignant tumours, into which it is injected along with a few drops of hydrochloric acid.

A vegetable pepsin is obtained from the unripe fruit and leaves of *Carica Papaya*, a plant found in the East and West Indies. Although the animal pepsin acts only in acid solutions, the vegetable is equally effectual in acid, neutral, and

alkaline solutions. It is prescribed in dyspepsia, and dissolves the false membranes of croup and diphtheria.

Doses, &c.—Foals, calves, and dogs take grs. ij. to grs. x, of either pepsin, usually given in water, with a few drops of hydrochloric acid. The pepsin wines and essences seldom contain much of the ferment.

PETROLEUMS OR PARAFFINS.

The petroleums or paraffins are hydro-carbons, produced by the decomposition of vegetable matter. They are obtained from the destructive distillation of coal, from bituminous shales, and from the oil-wells found in various parts of the world. They occur as gases, fluids, and solids, and many are used in the arts and in medicine. The simplest of the series is **marsh gas, methane**, fire-damp, or light carburetted hydrogen (CH_4)—the inflammable gas which causes coal-pit explosions. The members of this homologous series all contain C and H in the proportion expressed by the formula $\text{C}_n\text{H}_{2n} + 2$, where n represents any whole number.

The following are the chief members of the series present in the rock-oil got on the Caspian coasts, and from the oil-wells of Canada or Pennsylvania. They differ in specific gravity and boiling point, which rises with the number of the carbon atoms. The liquids with a low boiling point are more volatile, and have more activity than those which have a higher boiling point:—

Methane, CH_4	gas.			Fluid, boils at	
Ethane, C_2H_6	„	Heptane, C_7H_{16}			98° C.
Propane, C_3H_8	„	Octane, C_8H_{18}			125° C.
Butane, C_4H_{10}	„	Nonane, C_9H_{20}			148° C.
				Fluid, boils at	
Pentane, C_5H_{12}	38° C.	Decane, $\text{C}_{10}\text{H}_{22}$			168° C.
Hexane, C_6H_{14}	70° C.	Dodecane, $\text{C}_{12}\text{H}_{26}$			202° C.
		Hexadecane, $\text{C}_{16}\text{H}_{34}$			278° C.

When **rock-oil** is distilled, ethane and other gaseous paraffins are first evolved, are collected, and in great part liquefied by a condensing pump, and yield the liquid **cymogene**, which, on account of the cold produced by its rapid evaporation, is used

in freezing machines. Proceeding with the fractional distillation, the products which come off below 170° Fahr., and consist chiefly of pentane and hexane, are sold as **petroleum spirit**, or petroleum ether, and are used for making varnishes, for dissolving indiarubber, and for singeing horses, but are not safe for burning in ordinary lamps, as they readily evolve inflammable vapours, which form explosive compounds with air. The next portion of the distillate, coming off about 212° Fahr., is heptane, and is used for illuminating purposes, under the names of **benzoline**, **paraffin oil**, or mineral sperm oil. For safe use such oils, when placed in an open saucer at 100° Fahr., should not kindle when a light is brought near their surface. The petroleum distilling over between 300° and 400° Fahr. is chiefly nonane and dodecane, and is used for lubricant purposes. At higher temperatures there come off hexadecane and other paraffins, richer in carbon, constituting such soft solids as **vaselin** and the **soft petroleums**, while still higher temperatures produce the **hard paraffins**, cereses, or paraffin waxes. These soft and hard paraffins are also got by distillation from shale, the liquid portions being separated by refrigeration, and the solid products purified by melting and filtration. They are frequently substituted for oils, lard, and wax in the making of ointments.

The **Rangoon petroleum**, obtained from wells on the Caspian shores, and the analogous Barbadoes or **mineral tar**, found in the island of Barbadoes floating on the surface of springs or pools, and in Trinidad forming extensive beds or lakes, are of the consistence of treacle, of a dull green-brown colour, with a petroleum odour and a bitter taste.

ACTIONS AND USES.—The petroleums belong physiologically to the fatty or alcohol series of hydro-carbons. Methane, ethane, and the gases low in the series, and the more volatile liquids, are more easily absorbed and excreted than the heavier liquids and solids, and are stimulants, anæsthetics, and inebriant narcotics.

Petroleum benzin, or petroleum spirit, is a topical irritant, germicide and vernicide, a stimulant and antispasmodic, and is used for many of the purposes of oil of turpentine. It must be distinguished from the benzine (C_6H_6) obtained from

the distillation of coal-tar, and which has a higher specific gravity and a higher boiling point (p. 294). The dose for horses and cattle is fʒss. to fʒj.; for dogs, fʒj. to fʒij., given in milk or gruel.

Animals are sometimes poisoned by the refuse oils from petroleum works contaminating the drinking water. Professor Williams records cases of cattle suffering from diarrhœa, wasting, and anæmia, and their intestinal glands being found saturated and darkened with the oil (*Principles and Practice of Medicine*).

The petroleum spirit and other paraffin oils, in virtue of their diffusive, solvent, stimulant, and antiseptic actions, are applied in scaly skin complaints, as in old-standing cases of grease in horses, to remove scurf and dissolve accumulated sebaceous matters, stimulate the dermis, and promote growth of hair. For such purposes they are frequently used in conjunction with alkalies, bland oils, or vaselin. In the treatment of ring-worm, mange, and scab, they are united or alternated with sulphur, iodine, or solutions of tobacco or stavesacre.

Vaselin, the petrolatum of the U.S.P., is prepared by the Chesebrough Manufacturing Company, New York, by heating rock-oil in iron retorts, and filtering the residual heavier oils through animal charcoal. It is red, yellow, or white, according to the proportion of colouring matter retained. It has the consistence of summer butter, is tasteless, odourless, and neutral. It melts about 95° Fahr., and boils about 300° Fahr. It is insoluble in water, glycerine, cold alcohol, and ether, but is soluble in chloroform, carbon disulphide, and in fixed and volatile oils. A handy solvent is made of one part of castor oil and eight of water or watery fluid. Vaselin dissolves bromine, iodine, sulphur iodide, and carbolic acid, as well as fixed and volatile oils and alkaloids, and is a serviceable basis for ointments, liniments, and pomades. It has the advantage of being nearly free from greasiness; it is not oxidisable, and hence does not become rancid. Ointments prepared with it accordingly keep better than those made with animal and vegetable fats. It is used as a lubricant and emollient for irritable, inflamed, or blistered mucous and skin surfaces. It is a convenient basis for electuaries for sore-throat. It is

used for making up boluses, and as a protective for leather and cutlery.

Rangoon and Barbadoes tars were at one time prescribed in chest diseases and as anti-emetics, but are not now used internally. Externally, they are applied for the same purposes as wood-tar, and particularly in the treatment of skin complaints, thrush, canker, and other diseases of the feet. **Coal-tar** differs from Barbadoes tar in having a stronger and more offensive sulphurous smell, but it deserves its popular credit as an antiseptic and stimulant adhesive for diseases of the feet. The alkaline solution of coal-tar, sold as liquor carbonis detergens, is useful in eczema, one to two drachms in a pint of warm water being applied either alone or with liquor plumbi diacetatis.

PHOSPHORUS.

A non-metallic element obtained from bones. (B.P.)

Phosphorus is prepared by the digestion of bones in sulphuric acid; the acid calcium phosphate remaining in solution is evaporated, mixed with charcoal, and distilled, when phosphorus comes over, and is condensed under water. Two allotropic forms occur. The first is vitreous, easily cut with a knife, of a yellow-white colour, volatile, readily oxidisable and inflammable, luminous, soluble in carbon disulphide, and an irritant corrosive poison. The second—prepared by keeping the yellow phosphorus for a considerable period at a temperature of 450° Fahr. in an atmosphere of carbonic anhydride or nitrogen—is red, amorphous; at ordinary temperatures has little affinity for oxygen; is not volatile, luminous, or soluble in carbon disulphide; heated to the boiling point it reverts to the vitreous form. It is innocuous.

ACTIONS AND USES.—Phosphorus is an active member of the group of pentad elements, comprising nitrogen, antimony, arsenic, and bismuth. They have a marked affinity for oxygen, modify tissue change, act especially on the glandular, nervous, respiratory, and cutaneous systems. Phosphorus is an in-contact irritant. It is slowly dissolved and absorbed, stimu-

lates growth of bones, and is occasionally prescribed as a nerve tonic, alterative, and aphrodisiac. Full doses when swallowed cause gastro-enteritis. Repeated doses break up the albuminoid textures and induce fatty degeneration.

Toxic Effects.—A piece of yellow phosphorus, or a strong solution applied to the skin, **abstracts oxygen** and produces **limited inflammation**, sometimes terminating in gangrene. When swallowed it is oxidised, perhaps vaporised, and is slowly dissolved by the bile and any fatty matters with which it comes into contact. It exerts on the alimentary tract its **local irritant** effects; minute doses are gastro-intestinal tonics; larger doses cause diarrhœa and emesis in animals that vomit; while fifteen grains cause gastro-enteritis in horses and cattle. When absorbed, minute doses **promote development of bone** and stimulate the central nervous system. Larger doses, such as thirty grains in horses or cattle, and half a grain to a grain in dogs or men, produce paresis, convulsions, coma, and death usually within two or three days. The paresis occasionally affects the heart, causing sudden death. Moderate to full doses, repeated several times daily, within a few days produce **fatty degeneration** of the albuminoid tissues, hypertrophy of connective structures, and acute cirrhosis. Persons working with phosphorus are liable from its in-contact effects to suffer from necrosis of the lower jaw. It is excreted by the kidneys and lungs, chiefly as phosphorous and phosphoric acid. Neither of these acids nor the salts they form have, however, the specific action of phosphorus.

The antidotes consist in emptying the stomach by emetics or the pump, administering mucilaginous fluids, but avoiding milk, oils, or eggs, which dissolve the poison, and prescribing frequently repeated doses of old turpentine and of copper sulphate, which forms an insoluble phosphide.

Medicinal Uses.—Small doses promote tissue growth, replace spongy texture of bones with denser tissue, and, in chickens experimented with, increased osseous deposits, so as to obliterate the medullary canal of long bones. It is accordingly prescribed in rickets, bone softening, and chronic malnutrition. It has been substituted for arsenic in persistent skin disorders. It is empirically administered in epilepsy, chorea, and general

paralysis, and in such cases it is sometimes applied as a topical irritant.

Doses, &c.—Horses and cattle take gr. ss. to grs. v.; sheep and pigs, gr. $\frac{1}{100}$; dogs, gr. $\frac{1}{200}$, given in pill or electuary, or dissolved in oil or vaselin. For external purposes a liniment is made with one part phosphorus to 100 parts olive, almond, or other oil. The paste for the destruction of rats usually consists of one part phosphorus to sixty each of water and flour.

PODOPHYLLUM—PODOPHYLLIN.

Dried rhizome and rootlets of *Podophyllum peltatum*, from which the resin *Podophyllin* is extracted by rectified spirit. *Nat. Ord.*—Ranunculaceæ.

The *Podophyllum*, *May apple*, or *mandrake*, is a perennial herbaceous plant, plentiful in the Northern States of America, where its subacid fruit is eaten under the name of wild lemons. The root is imported in flattened cylindrical pieces of variable length, one-fifth to one-third of an inch thick; marked with irregular tuberosities giving off brittle brown rootlets. It is reddish-brown externally, white within, and breaks with a short fracture. The powder has a yellow-grey colour, a narcotic, disagreeable odour, a bitter, sub-acrid, nauseous taste.

The B.P. resin—podophyllin—is prepared from a strong tincture, made by exhausting the root with rectified spirit. It is a greenish-brown amorphous powder, soluble in water, ether, or ammonia, and consisting of an inert, fatty, resinous acid, and two amorphous, bitter, **active resins**—*podophyllotoxin* and *picropodophyllin*, the former being the most powerful.

ACTIONS AND USES.—Both root and resin are topical irritants and drastic purgatives. The resin is dissolved by the alkaline secretions of the duodenum; stimulates glandular secretion and peristalsis, in full doses causing spasm; is carried into the liver, and stimulates the hepatic cells, increasing secretion of bile. In dogs and cats, as in human patients, it is an emetic. Repeated doses in horses and dogs reduce the force and frequency of the pulse, even when the bowels are only slightly

acted on. It is eliminated by the bowels, in smaller amount by the kidneys.

GENERAL ACTIONS.—The root has long been used by the American Indians as an **emetic** and **anthelmintic**. Its actions being supposed to resemble those of calomel, it has been styled vegetable mercury. The **cholagogue** actions of podophyllin have been investigated by Professor Rutherford, of Edinburgh. Moderate doses introduced into the duodenum, whether of fasting or recently fed dogs, become absorbed, and increase secretion both of the fluid and solid constituents of the bile. He believes that it directly stimulates the hepatic cells, but does not increase the blood supply of the liver. Excessive doses are imperfectly absorbed, and do not increase biliary secretion. This special stimulation of the liver by small but not by large doses is also observed in the case of aloes, rhubarb, cochicum, croton oil, and other cholagogues. In common with other purgatives acting upon the small intestines, it sweeps out food, which, when absorbed, stimulates the liver; while, moreover, it carries away bile poured into the canal, and thus prevents its reabsorption.

In the domestic animals the **cathartic effects** of podophyllin are produced tardily and not very certainly; while even moderate doses are apt to cause nausea and griping. The manner in which the force and frequency of the pulse are reduced requires investigation.

The late Dr F. G. Anstie made, in 1863, a series of experiments with alcoholic solutions containing one to two grains podophyllin, which he injected into the peritoneum of dogs, cats, and rats, and produced in ten to fifteen hours vomiting, bloody fæces, hurried, shallow breathing, and death from exhaustion (*Medical Times and Gazette*, March and May 1863).

Mr D. B. Howell, of Reading, reports podophyllin to be a prompt and effectual purge for dogs, acting usually in four hours. One drachm to one drachm and a half, with two drachms ginger, he states, moved the bowels of horses in six or eight hours. Not only was the action said to be prompt and certain, but no griping was noted, even when the resin was given without preparation, and water allowed *ad libitum*.

About a drachm is recorded to have purged a cow in nine hours (*Veterinarian*, August 1865).

I have not been able to obtain such marked results. I have repeatedly given healthy **horses**, prepared by mashes, two drachms podophyllin without perceiving any increased action of the bowels. Two drachms, even when united with one or two drachms of aloes, added to determine, if possible, its action on the bowels, produced little more softening of the discharges than might be expected from the aloes alone. To three healthy **shorthorn cows** I gave three drachms each, and to another cow half an ounce, without observing any laxative effect. One grain podophyllin, given in pill or bolted in a piece of meat by English **terriers** weighing about twenty pounds, produced no notable effect upon the bowels; while two grains acted as a gentle laxative, but only after six or eight hours.

Mr Thomas A. Dollar, of New Bond Street London, has used the drug frequently, both in **horses** and **dogs**, and has kindly placed at my disposal his notes of the following cases :—

A thoroughbred horse, well prepared by mashes, had two drachms podophyllin without its producing the slightest purgative effect. Two days later he again received two drachms, with a drachm of aloes, still without any noticeable action on the bowels. Four hours after the second dose the pulse, however, was observed to have fallen from 44 to 34 beats per minute. During three days this horse ate nothing but bran; getting tired of this, he had for two days hay and a little corn; for twenty-four hours he was again restricted to bran mashes, and then received two drachms each of podophyllin and aloes, which, even after this careful preparation, only produced slight laxative effects.

To a well-bred hunter, nearly sixteen hands high, under treatment for injury of the psoæ muscles, and fed for twenty-four hours on bran, Mr Dollar administered two drachms podophyllin in a ball, and two ounces Epsom salt in solution. Scarcely any perceptible action was observed on the bowels; and two days later two drachms podophyllin and one drachm calomel were given, also without purgative effect, but with a

reduction, as in the previous case, of nearly ten beats per minute on the pulse.

A powerful cart horse, under treatment for sand-crack, and previously restricted for twenty-four hours to a mash diet, got four drachms podophyllin in a ball. Although no purgation followed, there was much nausea, and in two hours the pulse became soft and somewhat weakened, fell from 36 to 24 beats per minute, and did not recover its natural force or number until next day. The appetite continued impaired for a week.

A thoroughbred mare, $14\frac{1}{2}$ hands, under treatment for abscess from speedy-cut, was placed on mash diet for twenty-four hours, and then received two drachms podophyllin in a ball, but showed no increased action of the bowels. For four consecutive days the mashes were continued, and two drachms of the drug repeated daily until ten drachms had been taken, still without any purgative effect. The pulse, however, which at first was 44, had gradually fallen a few beats daily, until on the fifth day it was 30. By the end of the experiment the coat stared, all food was refused during nearly two days, and a fortnight elapsed before the mare recovered her usual appetite and appearance.

A Scotch terrier, eight months old, received half a grain podophyllin in a pill, without any apparent effect; and on the following day a grain, which in the course of an hour caused nausea and vomiting. Considerable dulness remained for twenty-four hours.

A bull terrier bitch, 36 pounds weight, received four grains in a pill, without showing any notable symptoms, and on the following day had a further dose of six grains, which in twelve hours produced great uneasiness and griping, and gentle catharsis. During the two following days the bitch refused food, and for a week continued dull and listless.

A French poodle, suffering from mange and constipation, had a pill containing two grains podophyllin, half a grain calomel, and twenty grains jalap. No effect was observable at the end of twelve hours, when the dose was repeated, and after eight hours the dog was briskly purged. Half the above dose was repeated every second day for a fortnight, with the result of gently moving the bowels. In all these cases the

pulse was reduced in number and in strength, the urinary secretion was unchanged, and the fæces were little altered in colour.

MEDICINAL USES.—Mr Dollar's experiments demonstrate that for veterinary patients podophyllin resin is a tardy and uncertain purgative, especially when used alone. In combination, however, with aloes, jalap, or calomel, it relieves **torpidity or congestion of the liver**; while its nauseant and sedative effects may occasionally be used for **lowering cardiac action** in acute lymphangitis, rheumatism, and other inflammatory disorders in robust patients. Although possessed of **vermifuge** powers, depending upon its purgative effect, it does not appear to have any special vermicide action. For human patients it is prescribed, both in this country and America, in habitual constipation, congested states of the liver, in some forms of sick headache, and, in smaller doses, as an alterative in skin diseases and rheumatism. Half a grain to a grain of the resin slowly empties the human bowels.

DOSES, &c.—For cholagogue or sedative purposes, horses and cattle take ℥j. to ℥ij. of podophyllin resin, united with aloes or calomel, with nitre or Epsom salt. For dogs, gr. j. to grs. ij.; with calomel, gr. j. to grs. ij., may be conjoined with half a dose of jalap or of oil. Nausea and griping are obviated by admixture of ginger or other carminative, and of henbane or *cannabis indica*.

POTASSIUM AND ITS MEDICINAL COMPOUNDS.

Potassium salts are obtained from (1) carnallite, a chloride of potassium and magnesium ($KClMgCl_2 \cdot 6H_2O$) overlying the rock-salt in the mines of Stassfurt in Saxony; (2) from the crude potashes got from wood ashes; and (3) from the argol deposited during the fermentation of wine (p. 593). Most are soluble in water. They are identified in solution by their negative reaction with the several group tests for the metals, while moderately strong neutral solutions rather slowly form, with sodium hydrogen tartrate, a white crystalline precipitate ($KHC_4H_4O_6$), soluble in hydrochloric acid and in caustic potash. Evaporated to dryness, and ignited with alcohol, they produce

a distinctive violet-coloured flame, which gives on the spectrum two lines—one intense on the red, the other transient on the violet.

ACTIONS AND USES.—The **alkalies** comprise salts of potassium, sodium, lithium, and ammonium. They are the opposites of the acids (p. 177). They combine with acids, dissolve albumin, and saponify fats, and in virtue of these affinities are irritant and caustic. They are destitute of astringency, and in dilute solutions rather relax and soothe the tissues with which they come into contact. They increase acid and diminish alkaline secretions. They are hence prescribed in cases of dyspepsia where the gastric acidity is insufficient, being given half an hour before feeding. They are also used to neutralise excessive acidity developed from undue fermentation, in these latter cases being administered an hour after eating. The alkalies and their salts alter osmosis in animal membranes, and hence promote both catharsis and diuresis. When absorbed, they increase the alkalinity of the blood, encourage oxidation processes, and promote other alterative effects.

Potassium salts are **protoplasmic poisons**, and when applied sufficiently long, or in sufficiently strong solution, destroy muscles, nerve-centres, and nerves. They are more soluble, more readily absorbed and diffused, but are also more quickly excreted than sodium salts. As muscle irritants they are more powerful. They paralyse the reflex centres of the cord, usually after transitory excitement. They paralyse the heart, especially when injected into the veins. On the circulation their action somewhat resembles that of digitalis. Large doses cause a rapid fall of blood-pressure and pulse rate. Small doses, after a slight fall, raise both pressure and pulse rate, depending, it is believed, on constriction of the arterioles. They cause death, preceded by convulsions, and depending on stoppage of the heart (Brunton).

They **occur in land plants and animals**, and hence are essential constituents of the food of both. Their removal from the food of dogs impairs nutrition and growth more decidedly than deprivation of the corresponding sodium salts. In animal bodies potash salts occur chiefly in the solid textures,

notably in the muscles; sodium salts in the nutrient fluids. Dr Ringer teaches that potash salts have a high diffusive power, rapidly enter the blood, increase its alkalinity, promote oxidation and tissue metamorphosis, are solvents of albuminoids, and in one or other of these ways help to abate febrile and inflammatory attacks. They are **alteratives**, and antidotes to poisoning by barium salts. They are quickly **excreted**, mainly by the kidneys; increase chiefly the watery parts of the urine, neutralise its acidity, and often exert soothing effects on the urino-genital mucous surfaces. In febrile complaints they are eliminated in amounts three or four times larger than in health, and in larger proportion than the soda salts, which are excreted more largely during convalescence.

Recollection of the uses of the several potassium salts is facilitated by dividing them into **three groups**. First. Salts which are corrosive, antacid, antilithic, and alterative—such as the hydrate and carbonates. The salts of the weaker vegetable acids—tartrates and citrates—in their passage through the body are decomposed into carbonates, rendering the urine alkaline. Second. Salts which are cathartic, diuretic, alterative, febrifuge, and refrigerant—such as the sulphate, acetate, tartrate, nitrate, chlorate, and permanganate. Third. Salts which exhibit prominently the actions of their acid or salt radical constituent—such as potassium sulphuretum, iodide, bromide, bichromate, and cyanide.

POTASSIUM HYDRATE. Potassa Caustica. Potassa Fusa. Potassic Hydrate. Hydrate of Potash. Caustic Potash. KHO .
 POTASSIUM HYDRATE SOLUTION. Liquor Potassæ. Caustic Potash Solution.

Crude **potashes**, obtained by dissolving the ashes of land plants, when calcined lose some of their organic impurities, and are known as **pearl ashes**. When this still impure potassium carbonate is boiled with calcium hydrate, calcium carbonate ($CaCO_3$) is precipitated, and **potassium hydrate** (KHO) remains in solution, twenty-seven grains being present in the fluid ounce of the **liquor potassæ**. This is a dense, oily-like fluid, of specific gravity 1.058, colourless and odour-

less, with an intensely acrid, alkaline, soapy taste, and an alkaline reaction on colouring matter. Boiled with oils and fats, it forms soaps; mixed with acids, it forms neutral, soluble, crystallisable salts. It softens and dissolves soft animal and vegetable tissues. Although little used in medicine, it is of much importance in chemistry, pharmacy, and other arts. When boiled until a drop removed on a stirrer becomes hard on cooling, and poured into pencil-like moulds, there are formed the grey or white deliquescent, hard, crystalline sticks of **caustic potash**.

ACTIONS AND USES.—Full doses of potassium hydrate, whether solid or in concentrated solution, are actively dehydrating, and hence are irritant, corrosive, and are also cardiac sedatives. Medicinal doses are antacid, alterative, febrifuge, and diuretic. Externally, they are used as active, penetrating caustics.

TOXIC EFFECTS.—Large doses, when swallowed, soften, corrode, and inflame the œsophagus and stomach, sometimes so severely as to cause perforation; while great depression accompanies the local lesions. Hertwig records that two drachms, dissolved in six ounces of water, killed a horse, with symptoms of colic, in thirty-two hours. Orfila gave a dog thirty-two grains, which caused violent vomiting, restlessness, and death in three days. **Post-mortem** discovered the mucous coat of the œsophagus and stomach red and black from extravasation of blood, with a perforation measuring three-quarters of an inch near the pylorus, surrounded by a hard thickened margin (Christison *On Poisons*). The blood is dark-coloured and generally fluid, owing to the solvent action of the alkali. Smaller or more diluted doses gradually impair digestion and assimilation, and destroy life by inanition. The **antidotes** are diluted acids which form mild salts, and oils which produce soaps—themselves of service as demulcents, and in men and dogs as auxiliary emetics. Irritation is also relieved by milk, gruel, or other demulcents.

MEDICINAL USES.—Dr John Shortt, of Madras, used the diluted solution both internally and externally as an **antidote for the poison of snakes** and vipers. Half a drachm, repeated twice daily, has been prescribed for feeding sheep affected with **vesical and urethral calculi**; but the carbonate is milder

and equally effectual. It is occasionally added to cough mixtures when bronchial secretion is scanty.

Caustic potash is used for eradicating **warts and fungous growths**, making issues, and cauterising poisoned wounds. On account of its deliquescence and liability to spread and penetrate, it must, however, be applied cautiously, and any excess of alkali neutralised by subsequent washing with a weak acid. Mixed with one-third lime, constituting **Vienna paste**, it is less deliquescent, and hence more safe and manageable.

POTASSIUM CARBONATE. Potassii Carbonas. Potassic Carbonate. Carbonate of Potash. K_2CO_3 .

POTASSIUM BICARBONATE. Potassii Bicarbonas. Hydro-potassium Carbonate. $KHCO_3$.

Potassium carbonates are got by several processes—(1) the American **pot or wood ashes**, in their partially purified condition of **pearl ashes**, contain about eighty per cent. of potassium carbonate, with twenty per cent. of potassium sulphate and chloride, which, being less soluble, are got rid of by dissolving the pearl ashes, with brisk agitation, in an equal weight of water, pouring off the solution, and evaporating it to dryness. (2) From the sulphate they are obtained by a process similar to that followed in making sodium carbonate. (3) A pure carbonate is got by burning potassium tartrate with charcoal.

The carbonate occurs in crystals, as a crystalline powder, but more generally in grains. It is white, opaque, and inodorous, with a strong alkaline taste, and an alkaline reaction on test-paper. It is soluble in its own weight of water at 60° Fahr., deliquesces rapidly in the air; but as it gradually absorbs carbonic acid, it again slowly dries up. Exposed to a red heat, it loses water of crystallisation to the amount of sixteen per cent.

Potassium bicarbonate, or acid carbonate of potash, is prepared by passing carbonic acid gas through a strong aqueous solution of the neutral carbonate. It occurs in transparent, colourless, right rhombic prisms; has a mild, saline, and slightly alkaline taste; dissolves in about four times its weight

of water at 60° Fahr.; when heated to redness, it gives off carbonic acid and water, and is converted into the neutral carbonate. It is **distinguished** from the neutral carbonate by its milder non-acrid taste, its lesser solubility in water, its more abundant effervescence with hydrochloric acid, its not deliquescing when exposed to the air, and its giving, in diluted solution, no precipitate with Epsom salt or corrosive sublimate.

ACTIONS AND USES.—The two carbonates have the potassium group actions (p. 576), and differ only in degree. Both resemble the hydrate, but have their activity tempered and diminished by combination with carbonic acid. The **neutral carbonate**, in concentrated solution, has much of the corrosiveness of the hydrate. Two drachms given to a dog caused vomiting, great agony, and death in twenty-five minutes (Orfila). Three ounces are said to be fatal to horses or cattle (Kaufmann). Its antidotes are the same as those of caustic potash. The **bicarbonate** has no irritant or corrosive action, is preferable as an antacid, and, in virtue of its liberating carbonic acid, exerts soothing effects on the irritable gastric membrane. It is less of an alkali and more of a pure saline. Both carbonates are antacid antidotes for overdoses of acids, and are alterative and diuretic.

MEDICINAL USES.—Potassium bicarbonate is occasionally substituted for sodium bicarbonate to aid the **emulsionising of fats**, and, on account of the evolution of carbonic acid, to soothe the irritable stomach. Prescribed usually with a bitter, and before meals, it **increases secretion of gastric juice**; given after meals, it **neutralises excess of acid**, resulting from undue secretion of gastric fluid, or from such acid fermentation of starch, sugar, or fats as occurs among carelessly fed calves. In **rheumatism**, small repeated doses of alkaline bicarbonates sometimes prove beneficial, apparently by promoting metamorphosis of albuminoids, neutralising excess of sacro-lactic acid, and encouraging the action of the kidneys. In such cases it is conjoined, according to circumstances, with oil of turpentine, salicylic acid, quinine, or potassium iodide. Similar **antacid** treatment is also successful in nettle-rash, lichen, and occasionally in eczema, a diluted solution being

also applied externally to raw, weeping, painful, or itching surfaces. Potassium bicarbonate is specially suitable for preventing or removing **uric acid deposits**, which occasionally occur in over-fed dogs; and the potassium is much more soluble than the sodium urate. **Calculi and deposits**, largely made up of ammonio-magnesian phosphate, occur in the bladder and urethra of highly-fed rams and wethers. In the treatment of these cases, Mr Litt, of Shrewsbury, with exercise and laxative diet, recommends castor oil, fʒij. to fʒviij., with belladonna extract, grs. viij. to grs. xvj., followed by potassium bicarbonate, ʒss. to ʒj., repeated thrice daily, freely dissolved in water or other diluents. **As diuretics**, the carbonates are less certain than the nitrate or acetate. Professor Walley finds that both the carbonates and hydrate, as well as the corresponding sodium salts, increase the activity of aconite when given along with it.

Externally, the carbonates are applied as **stimulants** and **detergents**. Used with soap and hot water, they soften and remove skin incrustation, whether consisting of sebaceous matters, thickened scales, abnormal discharges, or dirt. Diluted with 100 to 200 parts of water, along with a little glycerine, the carbonate forms a soothing dressing for the earlier weeping stages of eczema, especially in dogs. The itching parts should be kept continually wetted, while, to prevent evaporation, the wet lint should be covered with gutta-percha tissue. Cases of itching which are not relieved by alkaline dressings should be tried with a dilute acid, and such alternation is sometimes successful, when neither the alkaline nor acid treatment alone succeeds. The bicarbonate proves a serviceable injection in leucorrhœa in all patients. In the Cape Colonies a ley made from wood ashes is used successfully as a remedy for scab, either alone or mixed with sulphur.

DOSES, &c.—Of either carbonate, horses and cattle take ʒss. to ʒj.; sheep and pigs, ʒss. to ʒj.; dogs, grs. x. to grs. xl., repeated several times a day, liberally diluted with water. For stimulating gastric secretion they are given half an hour before eating; but in most dyspeptic cases acids are more permanently effectual.

POTASSIUM SULPHURETUM. Potassa Sulphurata. Sulphurated Potash. Potassium Sulphide. A mixture of salts of potassium, of which the chief is sulphide. (B.P.)

One part of sulphur and two of potassium carbonate are mixed and heated until fusion occurs, poured on a stone slab and cooled. There is produced a liver-brown, bitter, acrid, alkaline substance, which is odourless when dry, but when moistened smells of hydrogen sulphide. It readily dissolves in water, forming a yellow solution.

ACTIONS AND USES.—It conjoins the action of a sulphide and a potassium salt. Large doses are irritant and narcotic. Medicinal doses are laxative, and, like other sulphides, stimulate the secretions of the skin and respiratory mucous membrane, and are alterative. Externally, it is occasionally applied as a substitute for sulphur in the treatment of chronic skin diseases, and as a rubefacient, resolvent, and antiparasitic.

TOXIC EFFECTS.—Two ounces are stated to have destroyed a horse (Bouchardat); six drachms and a half, introduced into the stomach of a dog, and retained by ligature on the œsophagus, occasioned death with tetanic symptoms in seven minutes; a drachm and a half in small fragments, introduced into the subcutaneous areolar tissue of dogs, caused extensive inflammation, coma, and death in thirteen hours (Christison). It appears to act much in the same manner as sulphuretted hydrogen, decomposing the hæmoglobin of the blood, and causing nervous and muscular paralysis.

MEDICINAL USES.—It has been used in chronic cough, rheumatism, and skin diseases, in doses of $\mathfrak{z}\text{i}$. to $\mathfrak{z}\text{ij}$., for horses and cattle, and grs. ij. to grs. x. for dogs. Like sodium and calcium sulphides, when given several times daily it hastens maturation of indolent boils and abscesses, and prevents further formation of pus (Ringer). Once a panacea for all kinds of poisoning, it is now used only in poisoning by lead, which it converts into a black insoluble and almost inert sulphide.

POTASSIUM SULPHATE. Potassii Sulphas. Sulphate of Potash.
 K_2SO_4 .

POTASSIUM BISULPHATE. Hydropotassium Sulphate. Bisulphate
of Potash. $KHSO_4$.

Potassium sulphate is got from certain salt mines, and from the mineral kanite, which is a double sulphate of potassium and magnesium. It occurs in transparent, colourless, rhombic prisms, which have a sharp, saline, bitter taste, are hard and difficult to powder, and dissolve in four parts of water at 212° Fahr., and in sixteen parts at 60° Fahr.

The **bisulphate** is the residue in the preparation of nitric acid from nitre and sulphuric acid. It is colourless, crystalline, and soluble, with an acid taste, and an acid reaction on colouring matter. It is distinguished from the neutral sulphate by its small flat prisms, its greater fusibility and solubility in water, its acid taste and reaction, and its decomposing carbonates with effervescence—a property which has led to its being occasionally substituted for tartaric acid in making effervescent powders.

ACTIONS AND USES.—The sulphates are the most irritant of the potash salts. They are cathartic, cholagogue, and diuretic. As cathartics they cause both hydragogue and peristaltic actions, while as diuretics they are less certain than the nitrate or acetate. Professor Rutherford found that potassium sulphate has a distinct stimulant effect on the liver, shared by sodium sulphate, but not by magnesium sulphate. On account of its hardness and inaptness to absorb moisture, it is used for facilitating trituration of such tough vegetable substances as opium, ipecacuan, and jalap.

POTASSIUM IODIDE. Potassii Iodidum. Potassic Iodide.
Hydriodate of Potash. KI .

The iodide is **prepared** by slowly adding iodine to a solution of potash until it acquires a brown colour, evaporating to dryness, mixing the residue with one-tenth of its weight of powdered charcoal, and fusing in a red-hot crucible. The fused mass is dissolved in hot water, filtered and evaporated

until a film appears on the surface, when it is set aside to crystallise.

PROPERTIES.—Cubical crystals, colourless, generally opaque, with a faint odour of iodine, a saline taste, decrepitating when heated, fusing at a red heat, at a higher temperature volatilising unchanged, dissolving in two-thirds of its weight of water at 60° Fahr., and in half its weight of boiling spirit. Both aqueous and alcoholic solutions dissolve iodine freely, and are hence useful vehicles for its exhibition.

ACTIONS AND USES.—Potassium iodide closely resembles iodine (p. 449), but is less powerful, and devoid of local irritant action. It stimulates the lymphatic system. Medicinal doses are antiseptic, alterative, deobstruent, and diuretic. Sodium iodide has the same actions.

It is readily soluble, and is **quickly absorbed**; in the tissues it **undergoes decomposition**; the iodine, when liberated, apparently combines with albuminoids, and **acts specially on lymphatic glands and vessels**, modifying nutrition, hastening metabolism, and promoting absorption. It is doubtless in this way that it also unites with lead and mercury deposited in the tissues, renders them soluble, carries them into the circulation, and causes their elimination. It is quickly **excreted** by the mucous and skin surfaces, and by the kidneys. Full doses increase both the solids and fluids of the urine.

TOXIC EFFECTS.—Large doses, such as three ounces in horses or cattle or a drachm in dogs, enfeeble the heart, and also the spinal and cerebral functions. It causes **iodism**, especially when it is mixed with iodates; but this chronic poisoning is much rarer in animals than in man (p. 450). **Dogs** receiving two to three drachms dissolved in water vomited, showed great depression, and died in a few days; rabbits were similarly affected by one drachm; three drachms, injected beneath the skin of the back of a dog, caused extensive subcutaneous inflammation, and death in three days. Iodine is detected after death in the blood and urine, in the brain and spinal cord, in most of the internal organs, and even in the muscles and bones (Cogswell).

MEDICINAL USES.—It is given, either alone or with iodine, to **promote absorption** of morbid products, as in lymphangitis

in horses, pleuritic and other serous effusions, enlarged glands, and lung consolidations in all animals. For such purposes full doses are generally prescribed twice or thrice daily for a fortnight, and, where the lesions are superficial, iodine and soap liniments are also used externally. M. Trasbot, from ten years' study of the action of potassium iodide, is satisfied that in **bronchitis, pneumonia,** and pulmonary congestion, especially in horses, a few doses diminish the frequency and force of the pulse, the difficulty and quickness of breathing, and the abnormal temperature. These benefits are ensured, and congestion and dryness of the bronchial membrane relieved, by conjoining the iodide with ammonium acetate solution. M. Trasbot further states that, like digitalis, potassium iodide is serviceable in **troublesome cough** and in **chronic cardiac cases** (*Revue Vétérinaire*, January 1890). These latter effects probably depend mainly upon its action as a potassium salt (p. 576). In roaring, Professor Robertson prescribed potassium iodide and arsenic. Professor Thomassen, of Utrecht, and Professor Nocard, after experience of upwards of a hundred cases, trust implicitly to the iodide in **actinomycosis**, especially in those hitherto unsatisfactory cases affecting the tongue of cattle. Ninety grains in about a pint of water are given daily for eight or nine days; within that period swelling and pain abate, the animal is able to eat, and the cure is "always successful," usually within a month (*Journal of Comparative Pathology and Therapeutics*, June 1892). Professor Dieckerhoff recommends the intratracheal injection of dilute iodine solutions in equine purpura hæmorrhagica, and other German practitioners have approved of the treatment. The solution used consists of five parts potassium iodide, one part iodine, and 100 parts water. Five drachms of the solution are injected into the lumen of the trachea with a hypodermic syringe. **Rheumatism** and **eczema** are frequently benefited by a course of the iodide. In chronic **poisoning with lead or mercury** it removes the metals from the tissues and from the body.

Externally, usually with soap liniment and laudanum, it is applied to painful, swollen, rheumatic joints, and to inflamed udders in cows and ewes. It is much used for increasing the solubility of iodine, both in water and alcohol.

DOSES, &c.—Horses and cattle take ℥ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xx., repeated two or three times a day, and given either in bolus or solution, in water or spirit. Dr Lauder Brunton suggests that its effects are increased when it is given with common salt, more iodine being thus liberated (*Practitioner*, September 1876). It is occasionally used intratracheally (Kaufmann).

POTASSIUM BROMIDE. Bromide of Potassium. KBr. (*See* "Bromine and Bromides," pp. 303–305.)

POTASSIUM NITRATE. Potassii Nitras. Nitrate of Potash. Nitre. Saltpetre. KNO_3 .

In the East Indies, Persia, Egypt, Spain, and other dry climates, a brown incrustation, consisting largely of nitre, covers considerable tracts of country. It is dissolved in water, mixed with impure potassium carbonate, and purified by repeated solution and crystallisation. In France and other Continental countries, nitre is prepared artificially by heaping animal and vegetable refuse with old plaster and other calcareous matters. The heaps, sheltered from rain but freely exposed to the air, are frequently watered with urine, occasionally turned, and, after about two years, lixiviated. By decomposing sodium nitrate with potassium chloride, nitre is also prepared.

PROPERTIES.—White, opaque, crystalline masses, or transparent, colourless, anhydrous, slender, six-sided prisms, with a sharp, cooling, saline taste, undergoing no alteration in the air, deflagrating when thrown on flame. It is soluble in $3\frac{1}{2}$ parts of cold water, and one-third of its weight of boiling water; during solution much heat is abstracted; it is insoluble in alcohol. Warmed in a test-tube, with sulphuric acid and copper filings, it evolves ruddy fumes of nitric peroxide; heated to fusion, the melted mass forms, on cooling, the hard, white, fibrous **sal-prunelle**. None of its common impurities interfere with its medicinal actions.

ACTIONS AND USES.—Large doses irritate both the bowels and kidneys. Medicinal doses are alterative, febrifuge, diuretic, and feebly cathartic. It is excreted from the bronchial glands,

the skin and kidneys, increasing the secretions of these organs. Used externally, it is stimulant and refrigerant.

TOXIC EFFECTS.—Large doses cause, in man and carnivora, fatal gastro-enteritis, with vomiting, weakness, and arrest of circulation, partly depending on reflex action, partly on direct action on the heart (Brunton). Dr Paul Guttman, experimenting, chiefly upon dogs, states that, in common with other potash salts, poisonous doses, besides in-contact irritation, paralyse the spinal cord, cause dyspnoea, and occasionally convulsions and muscular weakness, first overtaking the hind extremities, and lessen the frequency and force of the heart-beat, which in fatal cases ceases in diastole. Although an ounce has proved fatal in human patients, two ounces have no permanent injurious effect on horses or cattle. Mr Morton, indeed, gave a healthy horse 2 pounds, dissolved in 6 pounds water, and found that it acted both on the kidneys and bowels, but that its effects ceased in twenty-four hours (*Veterinarian*, 1837). Moiroud, however, reports that half a pound given to horses, and two or three drachms to dogs, inflame the alimentary canal and urinary organs, causing depression and death, usually within twenty-four hours. Kaufmann states six ounces as the toxic dose for horses and cattle, six drachms for sheep, and seventy-five grains for dogs.

MEDICINAL USES.—It is soluble, diffusible, and quickly enters the blood; but its action on living blood and on tissue metamorphosis is not clearly explained. As a potash salt, and also as a nitrate, it reduces cardiac action. Like other salines, it influences osmosis by changing the density of liquids on either side of a secreting membrane. It promotes bronchial, cutaneous, and urinary secretion. Clinical experience accords it notable alterative and febrifuge properties. In conjunction with ammonium acetate solution, it is prescribed in catarrhal disorders, in which it has the twofold advantage of promoting discharge from the dry respiratory membranes and abating fever. Mr Alexander Lockhart, of New York, and other American practitioners, use nitre freely in laminitis, which, owing to careless feeding and long fasts, is still common in America; give as much as two ounces, dissolved in a pint of water, repeated thrice daily, and assure me that fever and

pain are abated and exudation controlled. One-fourth of the dose would be safer, and perhaps equally effectual. Repeated doses, conjoined with quinine, are given in **purpura**. It is serviceable in **rheumatism**, being frequently prescribed with the carbonate or iodide, or with salicylic acid. Most heavy draught horses, while living on hard food, on Saturday night have a mash containing an ounce of nitre, which helps to maintain bowels, kidneys, and skin in good order, and to ward off attacks of swelled legs and weed common when hard-worked horses have one or two idle days.

Nitre, when dissolving in water, abstracts heat, and is hence sometimes used externally as a **refrigerant**; its cooling effects are increased by admixture with sal-ammoniac. Five ounces each of nitre and sal-ammoniac, dissolved in sixteen of water, reduce the temperature from 50° to 10° Fahr. (Pereira). For such purposes ice, however, is cheaper, and more convenient.

Doses, &c.—As a **diuretic**, horses take ℥ss. to ℥j.; cattle, ℥j. to ℥ij.; sheep, ℥j. to ℥ij.; pigs, ℥ss. to ℥j.; dogs, grs. x. to grs. xxx. Soap, resin, with other diuretics, and free solution in water, hasten and increase the action of nitre on the kidneys.

The **diuretic mass** of the Royal (Dick's) Veterinary College is thus made:—Take soap and nitre, of each lbs. ij.; resin, lbs. iij.; Venice turpentine, lbs. ij.; oil of turpentine, f℥viiij. Melt the soap and resin over a slow fire; remove the mixture from the heat, and when it has somewhat cooled stir in the other constituents. The dose of this mass is ℥ij. The balls are made up with a little linseed meal or flour.

As an **alterative and febrifuge** nitre is given in about half the doses used to cause diuresis, is repeated several times a day, and is generally conjoined with other medicines. A sedative febrifuge and laxative ball for the horse is prepared with an ounce nitre, a drachm aloes, and twenty grains calomel. For a horse with febrile cold and impaired appetite, a useful draught is made with Epsom salt two ounces, and nitre and ammonia acetate solution, of each an ounce, dissolved in gruel or ale. Catarrhal symptoms and sore-throat are relieved by four drachms nitre and one drachm each of ipecacuan, camphor,

and belladonna extract, made into bolus, and repeated every two or three hours. An ounce each of potassium nitrate and carbonate, with two drachms iodide, are useful in rheumatism. Amongst **cattle** similar combinations are serviceable. For them a convenient alterative is made with two ounces each of nitre, sulphur, and ginger, given in treacle and water, or in ale.

For the **dog** a good febrifuge consists of five grains each of nitre and Dover's powder, and one grain calomel, either placed upon the tongue, bolted in a piece of meat, or made into pill with syrup, or with liquorice powder and water. Mr Mayhew recommends three to eight grains nitre, one to four grains James's powder, and the same quantity of belladonna extract, made into pill with confection of roses. Cats take about half the doses requisite for dogs.

POTASSIUM CHLORATE. Potassii Chloras. Chlorate of Potash.
 KClO_3 .

Chlorine gas, evolved from manganese black oxide and hydrochloric acid, is passed rapidly into a strong solution of potassium carbonate and calcium hydrate. The hypochlorate first formed is decomposed by the heat evolved. The mass, when charged with chlorine, as indicated by its acquiring a pink colour, is boiled, and the crystals formed in cooling are purified by re-solution in boiling water. They are colourless rhomboidal plates, have a cool saline taste, are soluble in sixteen parts of cold water, and in two parts at 212° Fahr. The salt readily parts with its oxygen; thrown on red-hot coal it deflagrates; triturated with sulphur or phosphorus it explodes. Explosive gases are also evolved when it is heated with sulphuric or hydrochloric acids. It is distinguished by its negative reaction with silver nitrate solution, by a crystal evolving oxygen when heated, and by the residue boiled with a few drops of water, giving, with silver nitrate, the white precipitate of chloride.

ACTIONS AND USES.—Potassium chlorate is antiseptic, alterative, sialagogue, and diuretic; used externally, it is antiseptic, mildly stimulant, and refrigerant. It is less soluble than sodium chlorate, which it closely resembles.

MEDICINAL USES.—The chlorate does not exhibit the charac-

teristic actions of potassium salts, but it readily parts with chloric acid and oxygen, and in some of its actions resembles the nitrites. Poisonous doses highly **oxidise the hæmoglobin** of the blood, converting it into methæmoglobin, which holds oxygen firmly, and thus interferes with aëration of blood in the remote capillaries. Respiration accordingly is impaired, blood-pressure falls, hæmaturia and asphyxial convulsions precede death. A small quantity mixed with recently-drawn blood increases its coagulability and keeping properties. Used as a wash or gargle, it **stimulates the salivary and buccal glands**, moistening the dry, parched mouth. It **soothes and heals aphthous eruptions** and ulcerations of the mouth and throat; while in catarrh, sore-throat, and bronchitis it thins the secretions and promotes expectoration.

It is readily absorbed, and in febrile and blood-poisoning cases is believed to **exert antiseptic effects**, depending upon its saline properties, and on its readily parting with oxygen and chloric acid. But this explanation is not altogether satisfactory, for it is excreted in great part unchanged, small doses being removed by the kidneys, and larger by the bowels. Like other salines, in **febrile and inflammatory cases**, whether in horses or cattle, it is believed to lower pulse and temperature, clean the tongue, improve appetite, gently stimulate the bowels, and render their evacuations more natural and less coated with mucus. It is frequently prescribed with Epsom salt, gentian, or ether. Hard-worked horses, **overdone or suffering from cold**, are usually benefited by half an ounce, given night and morning, with gentian and ether. Mr Thomas A. Dollar, of New Bond Street, London, frequently administers it in such cases, and states that its use for a week or two appears to arrest the progress of farcy. In the **catarrhal epizootics** of horses, Principal Robertson ordered it with sweet spirit of nitre and camphor. In the treatment of **purpura**, Professor Williams prescribes it usually with iron salts, believes that it increases—as it does outside the body—the coagulability of blood liable to extravasation, uses an ounce daily, divided into two or three doses, but after the second day finds that less doses suffice. It is rapidly eliminated in the urine, rendering it acid even in herbivora.

Solutions of six to twenty grains to the ounce of water are used as **antiseptic stimulants** for unhealthy wounds.

DOSES, &c.—Horses take ℥j. to ℥iv.; cattle, ℥ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv., repeated two or three times daily, given either in bolus or solution, alone or conjoined with other salines, bitters, tonics, or stimulants. Most horses of their own accord will take an ounce daily, dissolved in water or gruel. As a soothing electuary for sore-throat it is conjoined with camphor, belladonna extract, and treacle.

POTASSIUM PERMANGANATE. Potassii Permanganas. Condy's Red Fluid. KMnO_4 or $\text{K}_2\text{O.Mn}_2\text{O}_7$.

When manganese black di- or peroxide (MnO_2) is fused with potassium hydrate, a green mass, or, with addition of water, a green solution, of **potassium manganate** (K_2MnO_4) is formed. Sodium and potassium manganates in solution constitute Condy's green disinfecting fluid.

Potassium permanganate is prepared by fusing four parts manganese dioxide, five parts potassium hydrate, and three and a half parts potassium chlorate, which readily parts with its oxygen, producing the permanganate (KMnO_4), which can be got in dark purple, slender prisms. It is without colour, but has a sweet, astringent, disagreeable taste. It is readily soluble in cold water, producing a deep-red solution. So readily does it part with oxygen that when mixed with such easily oxidised substances as sugar or glycerine it takes fire or explodes spontaneously. The solution also readily evolves oxygen, and hence is an effectual bleacher and deodoriser. **Condy's red disinfecting fluid** is a mixture of potassium and sodium permanganates, and is about half the strength of the B.P. liquor potassii permanganatis, which contains about one per cent. of the salt.

ACTIONS AND USES.—The manganates, and more notably the permanganates, in virtue of their power of oxidation, are **deodorisers**, and also **topical stimulants**. Strong solutions are irritants and caustics. Their power of breaking up various unstable organic substances is further illustrated when they

are mixed with the cobra poison, which, thus treated, loses its deadly power, and may with impunity be injected subcutaneously. When an animal, however, has been bitten by a cobra, the permanganate solution, hypodermically injected, appears to be decomposed before it comes into contact with the poison, and has no antidotal effect. When swallowed it does not seem to exert the alterative or febrifuge effects of the nitrate or chlorate.

Potassium permanganate, although it has not the antiseptic power of corrosive sublimate, effectually **destroys bacteria**, and Koch found that a five per cent. solution arrested development of the spores of anthrax soaked in it for one day. It is used to **deodorise and disinfect** badly-smelling wounds, the nostrils in ozæna, the mouth in aphtha, the throat when ulcerated, the uterus in metritis, and in retention of the placenta; and also to cleanse the hands or instruments that have been in contact with decomposing or contagious matters.

Permanganate solutions, in the convenient form of Condy's fluid, are frequently placed in shallow vessels about buildings to be deodorised; or cloths, saturated with one part of the fluid to fifty or sixty of water, are hung about. But for thorough disinfection such a non-volatile body is not so trustworthy as chlorine, sulphurous acid gas, or the volatile tar acids. Effectual results are, however, obtained when the permanganates are brought into absolute contact with the injurious organic particles. Thus, four ounces of Condy's red disinfecting fluid, stirred amongst 100 gallons of stale-smelling, unsightly rain-water left in a foul cistern, usually precipitates all impurities, and after some hours the clarified water becomes sweet and fit for use. The rapidity with which a known quantity of the permanganate solution parts with oxygen and loses its purple or pink colour, is a handy test of the amount of **organic contamination** in water, other fluids, or even in air. Its expense, however, precludes its extended use in veterinary practice.

Doses, &c.—Potassium permanganate has been given to horses and cattle as an alterative and febrifuge in drachm doses; but observation does not justify its preference to the nitrate or chlorate. For antiseptic and deodorant purposes Condy's red fluid is dissolved in 50 to 100 parts of water.

POTASSIUM ACETATE. Potassæ Acetas. Acetate of Potash.
 $KC_2H_3O_2$ or KCH_3CO_2 .

When potassium carbonate is neutralised by acetic acid the white, asbestos-like, soluble, deliquescent acetate is produced. In its actions and uses it closely resembles the nitrate, effectually alkalinifies the blood and secretions; like other alkaline salts containing a vegetable acid, when it enters the body it is mainly converted into a carbonate, and is chiefly excreted in the urine, producing diuresis. It is the inorganic diuretic most frequently prescribed in human medicine. The doses are the same as those of the nitrate.

POTASSIUM ACID TARTRATE. Potassæ Tartras Acida. Potassæ Bitartras. Acid Tartrate of Potash. Potassium Hydrogen Tartrate. Cream of Tartar. $KHC_4H_4O_6$.
 POTASSIUM TARTRATE. Potassii Tartras. $K_2C_4H_4O_6.H_2O$.

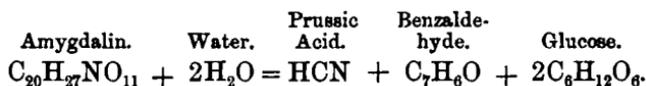
The **crude tartar**, or **argol**, obtained from the interior of wine-casks, when purified by solution and crystallisation, occurs in white, hard, crystalline masses, with a sharp, acid taste. When administered it retains water with avidity, and is slowly absorbed; although it does not cause intestinal irritation or peristalsis, doses of several ounces given to horses or cattle render the fæces fluid, and are **mildly laxative**. Lesser doses, like those of the alkaline salts of most organic acids, are converted in the body into the carbonate, and excreted mostly in the urine, causing **diuresis**.

The **normal potassium tartrate** is prepared by boiling, for a few minutes, about one part potassium carbonate and two parts potassium acid tartrate, cautiously adding, as required, a little either of the alkaline or acid salt, until the solution is neutral to test-paper, filtering, and crystallising. It occurs in small, colourless four or six-sided prisms. It **resembles the acetate and nitrate**; in small doses is **diuretic**, in larger **purgative**. Professor Robertson used to recommend it with magnesium or sodium sulphate for anæmic young horses affected with congested liver.

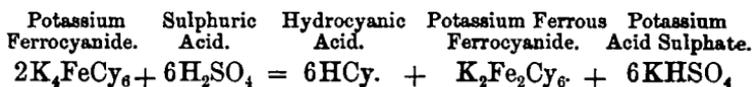
PRUSSIC OR HYDROCYANIC ACID.

Acidum Hydrocyanicum. HCN or HCy.

Prussic acid was so called from being first obtained from Prussian blue. Its title of hydrocyanic acid is derived from its being composed of hydrogen and the compound radicle cyanogen. It is one of the products of the distillation of coal, and traces are found in imperfectly purified coal-gas. The leaves and kernels of various stone fruits of the apple and almond natural orders, when crushed and moistened, undergo a species of fermentation, their albuminoid emulsin decomposing the glucoside amygdalin, and producing hydrocyanic acid, a hydrocyanated oil, benzaldehyde, and glucose.



Medicinal hydrocyanic acid may be made by decomposing any cyanide with an acid, but is generally prepared by slowly distilling dilute sulphuric acid with potassium ferrocyanide. The following equation represents the result :—



The anhydrous acid is obtained by cautiously distilling the medicinal acid, and collecting the vapour in a receiver kept cold by ice. It may also be got by passing dry sulphuretted hydrogen gas through a tube containing mercuric cyanide. It is a colourless, very volatile, inflammable liquid, and, alike in its gaseous and liquid form, is a most active deadly poison.

The medicinal acid, when freshly prepared, **contains two per cent. of anhydrous acid**, but on account of its volatility it is apt to lose strength. This may in part be obviated by keeping it in well-corked bottles, tied over with some impervious covering, laid down inverted, and in a dark place. It is colourless, with a diffusible, peculiar odour, allied to that of cherry laurel water and bitter almonds, but without ratafia

aroma. Its specific gravity is .997. It only slightly and transiently reddens litmus paper. Evaporated on a platinum capsule it leaves no residue.

It is distinguished by the following tests:—(1) **Prussian blue** is produced when a slight excess of caustic potash is added, then a solution of mixed ferrous and ferric sulphate, and a sufficiency of hydrochloric acid to neutralise the potash. (2) **Silver cyanide** is precipitated by the addition of silver nitrate; it resembles the white silver chloride in being soluble in ammonia and in hot dilute nitric acid; but is insoluble in cold concentrated nitric acid; while it also differs from the chloride in evolving, when heated, the heavy, strong-smelling cyanogen gas, which, if kindled as it passes from a narrow tube, burns with a rose-coloured flame edged with green. (3) **A sulpho-cyanide is produced** by heating a cyanogen compound with ammonium sulphide, previously boiled with sulphur, getting rid of the ammonium sulphide by evaporation, and adding ferric chloride, which develops a blood-red solution of ferric sulpho-cyanide, which is bleached by mercuric chloride.

ACTIONS AND USES.—Prussic acid paralyses all nerve structures with which it comes into contact. A few drops of medicinal acid applied to mucous or skin surfaces diminish or destroy sensation. It is hence used as an analgesic for relief of irritation and pain, especially of the skin, stomach, and throat. It is quickly absorbed. Full doses paralyse the cerebro-spinal axis, kill almost instantaneously by cardiac arrest, or somewhat less suddenly by respiratory arrest.

GENERAL ACTIONS.—It stops protoplasmic movements both in plants and animals, kills infusoria, checks oxidation, and arrests fermentation (Brunton). The anhydrous acid applied to the skin, after momentary irritation, **paralyses and anaesthises**. The two per cent. medicinal acid applied to skin or mucous surfaces quickly penetrates and paralyses the nerve endings, impairing and destroying tactile sensation and sensibility to pain. If the surfaces are freely moistened, these effects usually continue for one or two hours. Its volatility and rapidity of diffusion ensure quick absorption, and poisonous doses promptly **paralyse the central nervous system**. The

respiratory vaso-motor and spasm centres of the medulla, and the peripheral afferent nerves, are early and notably affected; and in all mammalia death usually occurs within a few minutes. When poisoning is not immediate, it is, according to Dr Lauder Brunton, **divisible into three stages**—(1) The brain is affected; there is giddiness, staggering movements, and a few slow inspirations, followed by rapid expirations and irregular heart action. (2) Convulsions, both tonic and clonic, appear, depending upon paralysis of the cerebro-spinal axis, and hence differing entirely from those of strychnine, which result from stimulation of the cerebro-spinal axis. (3) Coma, anæsthesia, and paralysis of voluntary muscles supervene, with weak cardiac and respiratory movements, and death from paralysis of the cardiac or respiratory centres (*Pharmacology*). Concurrently with these in-contact effects on nervous tissues, and most notable where life is prolonged, is the combination of the acid with the hæmoglobin of the blood, forming cyan-hæmoglobin, which parts slowly with its oxygen, and hence impairs internal respiration. Unlike other acids, prussic acid does not coagulate albumin or break down the formed elements of the blood. The potassium and other cyanides are soluble, readily yield their cyanogen, and are active poisons; but the ferro-cyanides are insoluble, and greatly less active.

Toxic Actions.—**Horses** are poisoned in one or two minutes by ten to twenty minims of anhydrous acid, injected hypodermically. MM. Trousseau and Pidoux placed a piece of cotton wool, on which six minims of anhydrous acid had been dropped, in the nostrils of two horses. In six seconds they dropped as if dead, and continued for an hour to exhibit grave nervous symptoms—convulsions, spasms, vertigo, paralysis, and stupor (quoted by Kaufmann, *Traité de Thérapeutique*). Horses swallowing four to five drachms of the two per cent. medicinal acid usually die within an hour. Professor Coleman gave an aged horse repeatedly, at intervals of several days, one to three drachms of acid, containing about four per cent. of anhydrous acid, and noted much excitement, the pulse raised to 100, and in one experiment to 160, laboured breathing and tetanic contraction of the muscles; but the effects gradually passed away. Six ounces of medicinal acid given to Wombwell's old elephant,

killed at Birmingham in 1855, caused only slightly laboured breathing.

Dogs, cats, and rabbits, which had one to four drops of anhydrous acid placed on the tongue or within the eyelids, in ten to thirty seconds made three or four hurried inspirations, a convulsive expiration, often a cry, had tetanic convulsions, and died in one to three minutes. Air saturated with the gas killed one dog in ten seconds, another in five, and a cat in two seconds. Guinea-pigs inhaling it for one second die in fifteen seconds. Strong rabbits inhaling it for three seconds die in thirty seconds; but birds are not so susceptible, and frogs are still less so. Dogs and cats receiving forty to sixty minims of the two per cent. acid were sometimes poisoned almost as rapidly as with the anhydrous. More frequently, however, life is prolonged for several minutes, and death is preceded by giddiness, impaired voluntary movement, dilatation of the pupil, a slight rise and subsequent fall of blood-pressure, slowing of the pulse, rapid failure of respiration, and tetanic convulsions. The heart continues to beat for several minutes after respiration has ceased. In experiments made by direction of the Messrs Young, of Leith, two ounces were found to cause rapid death of **Greenland whales**, when discharged by an ingenious device into the wound made by the harpoon. Direct application of the acid to the medulla of an alligator, which had been imperfectly affected by doses administered internally, caused a long, deep expiration, tetanic spasm of the respiratory muscles, and death (Jones and Bartholow).

Post-mortem discloses variable appearances. Animals dying almost instantaneously from cardiac arrest have the blood of an arterial hue, as if, from dilatation of the remote capillaries, it had passed through them without change. When the respiratory centre of the medulla has been paralysed, causing death somewhat more slowly by respiratory arrest, the appearances are those of suffocation. For some hours after death the blood remains fluid, of a blue colour, and occasionally evolves the peculiar odour of the acid.

ANTIDOTES.—Prussic acid is usually so rapidly fatal that the animal is often dead before any remedial measures can be adopted; but so volatile is the poison, and so rapidly is it

removed from the body, chiefly by the lungs, that if the animal lives for half an hour it will generally recover. **Artificial respiration** sometimes saves animals that have had lethal doses. Cautious hypodermic injection of small doses of **atropine sulphate** stimulates the cardiac and respiratory centres, and may thus avert mortal paralysis. Inhalation of ammonia is also recommended, and affusion alternately with cold and warm water is applied to the head and neck. The most effectual **chemical antidote** is a mixture of a ferrous and ferric salt, administered with magnesia or potassium carbonate, and forming the insoluble Prussian blue. But to be effectual the antidote must be swallowed before the rapidly-acting poison is absorbed.

MEDICINAL USES.—By paralysing the ends of the sensory nerves, the acid **allays** the **irritation** of urticaria, prurigo, and other itching skin complaints. In like manner it sometimes relieves gastrodynia and chronic vomiting, being conjoined in such cases with ice, bismuth, and morphine; while in irritable conditions of the throat it is prescribed with cocaine, chlorodyne, morphine, or atropine. For destroying the strongylus micrurus of calves, and soothing consequent irritation, Professor Williams prescribes ℥x. to ℥xx. of acid, conjoined with sodium carbonate and gentian.

DOSES, &c.—Of the B.P. two per cent. acid horses and cattle take ℥xx. to ℥l.; sheep, ℥x. to ℥xv.; pigs, ℥ij. to ℥vij.; dogs, ℥ij. to ℥iv., given in water sweetened with syrup. As the soothing effects are transient, the suitable doses are repeated three or four times daily, and, until perfectly regulated, their effects must be carefully watched; while, to prevent mistakes apt to occur with such a poisonous, colourless liquid, it is often made up with compound tincture of cardomoms. For **external use** it is diluted with 200 parts of water, a few drops of glycerine being added to retard evaporation. On account of its liability to absorption, lotions must be cautiously applied, especially where the skin is broken. But the potassium or other soluble cyanide being stable and not volatile, is more convenient for most external uses.

QUASSIA WOOD.

QUASSIA LIGNUM. The chips, shavings, or raspings of the wood of *Picræna excelsa*. (B.P.) *Nat. Ord.*—Simarubaceæ.

The dense, tough, white quassia wood, the produce of a handsome tree, is imported from Jamaica and other West Indian islands in billets one to two feet in length, and is met with in the shops in yellow-white chips or raspings. The wood of the *Quassia amara* from Surinam has similar properties, and is much used in France and Germany. Quassia has no odour, but a purely bitter taste, dependent on about one-tenth of one per cent. of a neutral crystalline principle, **quassiin** ($C_{10}H_{12}O_3$). It contains no tannin.

ACTIONS AND USES.—Quassia is a bitter stomachic and tonic. It resembles gentian, calumba, and cinchona. It is prescribed for the several domestic animals in dyspepsia, loss of appetite, and convalescence from debilitating disorders. Although it has no appreciable vermicide effect when given *per orem*, when used as an enema it destroys both ascarides and lumbrici. Large doses are irritant. It is a narcotic poison for flies and other insects, and is said also to kill fish (Royle's *Materia Medica*). For the destruction of flies the infusion is placed in shallow vessels about the premises.

DOSES, &c.—The B.P. infusion, prepared by macerating one part of chips for half an hour with eighty fluid parts cold water, is administered alone, or with salines, acids, or iron salts, with which, unlike most vegetable bitters, it mixes without decomposition or discoloration. Of the infusion horses and cattle take fʒij. to fʒiv.; sheep and pigs, fʒiv.; dogs, fʒj. Neither extract nor tincture is used by veterinarians.

RHUBARB ROOT.

RHEI RADIX. The root, more or less deprived of its bark, sliced and dried, of *Rheum palmatum*, *Rheum officinale*, and probably other species. Collected and prepared in China and Thibet. (B.P.) *Nat. Ord.*—Polygonaceæ.

The perennial, herbaceous rheums grow on the hill ranges of the interior of China, Tartary, and Thibet; the roots, after five

years' growth, are collected in summer, are cleaned, peeled, cut into round or flat reddish-yellow pieces, and each piece is usually bored with a hole, through which a cord is run in order to dry it hanging in the sun. The powder is bright yellow-brown, has a strong, peculiar, aromatic odour, with a bitter astringent taste, and when chewed is gritty, from the presence of calcium oxalate crystals. It is dissolved by ether, rectified and proof spirit, and less readily by cold and hot water, forming with the latter an orange-coloured solution. The East Indian rhubarb is coarser and less aromatic. **English rhubarb**, the produce of *R. raponticum*, generally cultivated for its familiar leaf-stalks, the pleasant acid taste of which is due to the presence of malic and oxalic acids, is grown extensively for its roots near Banbury, Oxfordshire, and is mixed with or substituted for the Chinese; but it is softer and more mucilaginous, has less aroma and grittiness, contains fewer crystals of calcium oxalate, and is deficient probably to the extent of one-third in purgative power.

Rhubarb contains (1) **chrysophanic acid**, in the proportion of about two per cent., extracted by ether or alcohol, insoluble in water, and occurring, as its name indicates, in brilliant yellow crystals. It appears to have tonic properties, and is one of the most effectual remedies for ring-worm of the human scalp. (2) **Chrysophan**, a bitter soluble glucoside, which, when boiled with sulphuric or hydrochloric acid, splits into chrysophanic acid and sugar. (3) **Phaoretin** and other resinous bodies appear to confer the cathartic properties. (4) **Rheo-tannic acid** imparts astringency and some tonic effects. (5) **Mineral substances** are largely present, consisting chiefly of calcium oxalate.

ACTIONS AND USES.—Rhubarb is stomachic, tonic, astringent, mildly cathartic, and cholagogue. Small and repeated doses improve the appetite, correct slight gastric derangement; in virtue of their tannin diminish secretion and peristalsis; by their chrysophanic acid impart to the fæces a yellow-brown hue, and may be detected in the blood, urine, and occasionally in the milk. Larger doses, in dogs and cats, as in human patients, are **mild cathartics**, stimulate the secretions and movements, especially of the stomach and small intestines.

and increase secretion of bile. Even small doses, insufficient to purge fasting dogs, or purging only very slightly, increase all the constituents of the bile (Professor Rutherford). In horses and cattle it has scarcely any purgative effect; a pound has been given to cattle without moving the bowels, while half a pound to a pound caused in horses only slight laxative effects after thirty-six hours (Moiroud). On skin or mucous surfaces it acts as a mild astringent.

Doses, &c.—As a stomachic and tonic, repeated several times a day, horses have ℥j.; cattle, ℥ij.; sheep, ℥j.; dogs and cats, grs. x. to grs. xx. As a laxative, dogs take ℥j. to ℥iij., usually combined with one or two grains of calomel, or with twenty grains of jalap. Rhubarb is used in powder, infusion, or tincture. The compound powder, or **Gregory's mixture**, prepared by mixing thoroughly six parts magnesia, one part ginger, and two parts rhubarb—all in fine powder—is an excellent stomachic and antacid, and is given in doses twice as large as those of the simple rhubarb. In diarrhœa in calves and foals it exerts carminative, laxative, and subsequently astringent effects. When the bowels are persistently relaxed, two drachms each of rhubarb and magnesia, with half a drachm of opium, may be given night and morning in well-boiled wheat flour gruel, with one or two tablespoonfuls of spirits or sweet spirit of nitre. One-third or one-half this quantity answers for diarrhœa amongst lambs.

SALICYLIC ACID.

ACIDUM SALICYLICUM. Hydroxybenzoic Acid. $\text{HC}_7\text{H}_5\text{O}_3$ or $\text{C}_6\text{H}_4\text{HO.CO}_2\text{H}$. A crystalline acid obtained by the combination of the elements of carbolic acid with those of carbonic acid gas, and subsequent purification; or from natural salicylates, such as the oils of winter-green (*Gaultheria procumbens*) and sweet birch (*Betula lenta*). (B.P.)

Salicylic acid was originally prepared from **salicin** ($\text{C}_{13}\text{H}_{18}\text{O}_7$), a crystalline glucoside obtained from willow and poplar barks, by fusing them with caustic potash. It can also be extracted from the stems, leaves, and rhizomes of violets. In these plants,

and in the volatile oils of the winter-green and various Spireas, it occurs as a methyl salicylate ($C_6H_4.HO.CO_2CH_3$). But the **commercial source is sodium phenol**, through which carbonic acid gas is passed for several hours. The mixture is raised to 482° Fahr., the residue is dissolved in a limited quantity of water, and treated with hydrochloric acid, when salicylic acid is precipitated, and is subsequently crystallised. Commercial specimens frequently contain cresotic acid.

PROPERTIES.—It occurs as a soft, light, colourless powder, consisting of minute acicular crystals; but it may be crystallised in bold four-sided prisms. It is odourless, but when inhaled irritates the nostrils. It has a taste at first sweet, but subsequently bitter. It is soluble in 500 to 700 parts of water at 60° Fahr., is more readily soluble in hot water, alcohol, and ether, and its solubility is increased by admixture with sodium borate or phosphate. It fuses at 311° Fahr., volatilises without decomposition below 392° Fahr., but above that is decomposed into phenol and carbonic acid gas. Iron perchloride solution produces a reddish violet colour, alike with the acid and its salts. Copper sulphate gives an emerald-green colour, destroyed by acids and by ammonia.

ACTIONS AND USES.—Salicylic acid belongs to the benzene or aromatic series of carbon compounds (p. 293), and in chemical constitution and physiological action is allied to benzoic acid. It is antiseptic and antipyretic, irritant and astringent, and is specially useful in the treatment of acute rheumatism. The acid, its alkaline salts, and salicin have the same actions, but salicin is now little used.

GENERAL ACTIONS.—Salicylic acid, although generally not so powerful an antiseptic as carbolic acid or creolin, destroys some ferments and micro-organisms more readily. The watery solutions are more powerful germicides than the alcoholic or oily. Full doses of the powder or concentrated solutions are **in-contact irritants**, provoking when inhaled sneezing and coughing, and when swallowed vomiting in carnivora and diarrhoea in all animals. Sodium salicylate, until the acid is liberated, is devoid of irritant and also of antiseptic actions. Although not very soluble, the acid and its salts are tolerably quickly absorbed. In the blood the acid occurs as an alkaline

salt, and its antiseptic powers must hence be neutralised. Both acid and salt slow the pulse and breathing, lower blood-pressure, and diminish excretion of urea. In most men and dogs full, continued doses further cause nausea, occasional vomiting, and giddiness—symptoms which resemble those of quinism. In healthy animals the temperature is not affected, but in rheumatic and malarial fevers **abnormal temperature is reduced**, sometimes to the extent of several degrees. This antipyretic effect Fröhner ascribes to an excess of carbonic anhydride, liberating salicylic acid. Clinical experience, however, does not indicate that carbonic anhydride abounds in cases in which the salicylate treatment reduces temperature. Professor Rutherford found that the acid and its soda salt, like benzoic acid and benzoates, are hepatic but not intestinal stimulants, and render the bile watery. They are eliminated more quickly in vegetable than in flesh feeders (Fröhner). They are excreted in the perspiration, saliva, and urine, in which they appear as salicylates, and in combination with glycol, as salicyluric acid. They communicate to the urine a brown or green coloration, and retard its decomposition.

Toxic doses are borne better by herbivora than gramminivora. Fröhner records that a healthy horse, weighing 1000 pounds, received during three days 300 grammes ($9\frac{1}{2}$ ounces). Slight dyspepsia resulted from irritation of the alimentary mucous membrane, but no toxic symptoms. A healthy sheep of 70 pounds during three days had 50 grammes ($1\frac{1}{2}$ ounce), but remained perfectly healthy. The like negative results also occurred in the case of a sheep of 65 pounds, which received in three days 65 grammes (2 ounces) of sodium salicylate. Dogs are not so tolerant; toxic effects were produced by 1 gramme ($15\cdot04$ grains) for each 5 kilogrammes of body-weight. A dog 10 pounds weight received 0·8 grammes in repeated doses during six hours; he vomited, had muscular trembling, and weakness of the hind limbs. A dog of 60 pounds, in divided doses, had 4 grammes, which caused weakness and cramp of the hind-quarters. A dog of 10 pounds had 5 grammes sodium salicylate subcutaneously, and exhibited dyspnoea, irregular pulse, dilated pupils, dulness, vomiting, lameness of the hind-quarters, convulsions, and fatal paresis. A dog of 18

pounds was fatally asphyxiated by 8 grammes injected into the rectum (*Arzneimittellehere für Thierärzte*).

MEDICINAL USES.—The acid and its alkaline salts are serviceable in **arresting dyspeptic fermentation** and diarrhoea in young animals. As bitters they are also gastric tonics. When administered in cases of gastro-intestinal irritation, the sodium salicylate, not being irritant, is preferable to the acid.

The salicylate treatment is almost **a specific for acute rheumatism** in human patients. It frequently relieves the pain before the temperature is reduced or fever abated. The beneficial results have been ascribed to the breaking up of lactic acid products. But British veterinarians have not found the treatment so effectual either in horses or cattle. In them such attacks are chiefly of a chronic type, on which salicylic acid has not such marked effect as in the acute cases, and it may be that the doses prescribed have not been large enough, or given with sufficient frequency, or for a sufficient period. Mr E. Price, Birmingham, is, however, satisfied with the effects on horses, and prescribes ten grains, repeated every two hours, gradually increased to a drachm, and reports the disappearance of the rheumatic pains in forty-eight hours (*Veterinarian*, February 1888). Fröhner uses both the acid and the sodium salt in muscular and arthritic rheumatism in all animals, and states that chronic cases are benefited by continued doses, that good results need not be despaired of until the drug has been persisted with for ten or fifteen days, while to prevent relapse the administration is proceeded with for some days after the symptoms have been relieved. Dogs are benefited especially where the joints are prominently affected. Mr J. Gresswell adopts similar treatment in rheumatic arthritis and bad cases of foot-and-mouth disease in sheep (*Veterinary Pharmacology and Therapeutics*).

In horses, as in human patients, a few, frequently repeated doses arrest attacks of acute catarrh when given in the earlier stages, and appear to have a similar power in gastro-intestinal and urinary catarrh. Fröhner recommends it in cystitis. Professor Robertson used it in equine influenza accompanied with gastro-intestinal symptoms. Other practitioners testify to its value in purpura and also in strangles. In typhoid, zymotic,

and malarial fevers it is not so effectual as quinine. Feser and Friedberger have shown that it exerts no antipyretic effect in septic or pyæmic fevers. Mr Dollar, of New Bond Street, London, and Mr I. Print, of Clapham, without benefit have given drachm doses daily to horses affected by farcy and nasal gleet.

In **antiseptic surgery**, salicylic acid is sometimes substituted for or alternated with carbolic acid or creolin. It is serviceable in the treatment of open joints, for abating the itching and discharge of eczema, for dressing sore teats in cows, washing out the uterus in metritis, and as an injection in otorrhœa.

DOSES, &c.—Horses and cattle take ℥iv. to ℥vii.; sheep and goats, ℥j. to ℥ij.; swine, grs. xxx. to grs. lx.; dogs, grs. v. to grs. xv. of the acid, every two to four hours, mixed with an equal quantity of borax to ensure solubility, and administered with mucilage or glycerine, either in bolus or solution. Sodium salicylate and salicin are used in similar amounts. The larger doses are given in fevers; the lesser, repeated more frequently, in rheumatism, in the muscular forms of which it is injected deeply into the affected muscles.

For **surgical purposes** convenient **solutions** are made by dissolving one part each of salicylic acid and borax with thirty to fifty parts of water. **Ointments** and **liniments** are prepared with one part acid, mixed in a heated mortar, with twenty to twenty-five of vaselin or bland oils. The B.P. ointment consists of one part acid, eighteen soft paraffin, and nine hard paraffin. Lint, cotton-wool, or jute, soaked in a strong, hot, watery solution, made with borax to ensure solubility, absorbs the acid, and is used as an antiseptic covering for wounds and burns in the same manner as carbolic, boric, or "Sanitas" lint. Being unirritating, salicylic lint is applied directly to abraded surfaces without the intervention of any protective. **Iron salicylate** is antiseptic and astringent.

SALOL.

A Salicylate of Phenol. $C_6H_4.OH.CO_2.C_6H_5$.

Salol is prepared by heating salicylic and carbolic acids with sodium phosphor-oxy-chloride. It occurs as a crystalline white powder, with an aromatic smell and insipid taste, is insoluble

in water, but soluble in alcohol, ether, chloroform, benzine, and the fixed oils.

The actions and uses are those of its two components. It is **antiseptic, analgesic, and antipyretic**. It is not so irritant as salicylic acid. By the saliva, the pancreatic and intestinal juices, it is resolved into salicylic and carbolic acids, which, with their products, can be detected in the urine. It checks undue fermentation in the digestive canal. Fröhner recommends it as an anti-rheumatic, especially in dogs; but neither in muscular nor arthritic rheumatism does it appear to be so effectual as sodium salicylate. For the several purposes of a **non-irritant antiseptic** it is used as powder, liniment, or ointment. **The doses** are the same as those of salicylic acid, and are given in electuary or pill, repeated several times daily

"S A N I T A S."

'Sanitas' occurs in the form of oily and watery fluids, prepared by oxidation of oil of turpentine, and containing or generating camphorous bodies and hydrogen peroxide.

A current of air is driven by an engine, for about 120 hours, through a series of Doulton's stoneware receivers, surrounded by vats of water, maintained by steam at a temperature of 140° Fahr. In each receiver are placed thirty gallons of American, Russian, or Swedish oil of turpentine, and about double that amount of water. The oil gradually becomes darker in colour, its specific gravity and boiling point are raised, and it acquires a balsamic odour resembling camphor and peppermint. As the process continues, **the turpentine** ($C_{10}H_{16}$) **is oxidised**, producing camphoric peroxide ($C_{10}H_{16}O_3$), which Mr C. T. Kingzett, F.I.C., F.C.S., has demonstrated to be gradually converted into another antiseptic camphoric substance ($C_{10}H_{16}O_2$), and the soluble hydrogen peroxide which passes into solution in the water.

Mr Kingzett has further shown that the several **essential oils of the terpene series** ($C_{10}H_{16}$), as well as cymene ($C_{10}H_{14}$) and menthene ($C_{10}H_{18}$), **undergo similar oxidation**, and give rise to the same products. In this way pine forests, especially

during sunshine following rain, render the atmosphere not only pleasantly balsamic but antiseptic, more highly oxygenated, and curative for throat and lung complaints. The Eucalyptus globulus in like manner pours forth these antiseptic and highly oxygenated volatile products, which are antidotes for malaria, and sometimes, it is said, even arrest the progress of pulmonary consumption; while, on a smaller scale, every plant or flower producing an essential oil exerts similar oxygenating and purifying effects (*Nature's Hygiene*, by C. T. Kingzett, F.I.C., F.C.S. Ballière & Co.)

When the manufacture of "Sanitas" is completed, there floats on the surface of the aqueous solution a yellow-brown, dense **oxidised oil** of turpentine, consisting chiefly of camphoric peroxide. This "Sanitas" oil, mixed with a suitable mineral or other basis, constitutes a useful disinfecting and deodorant powder. It is introduced into various soaps, conferring disinfectant properties, and, mixed with vaselin, oils, or fats, forms serviceable antiseptic liniments and ointments. Melted with Dammar resin and paraffin wax, a mixture is obtained which is used to impregnate muslin, forming an antiseptic gauze. Disinfectant desiccants are prepared by admixture with chalk or starch.

The watery solution, cleared by filtration, and known as "**Sanitas fluid**," consists chiefly of thymol, a proportion of the camphorous constituents which characterise the oil, and hydrogen peroxide. This hydrogen peroxide is itself a powerful oxidising agent; it parts with oxygen much in the same way as ozone, and gives off 475 times its volume of oxygen (Pelouze). It effectually prevents fermentation, destroys bacteria, and has been successfully used in human surgery for dressing ulcers and diphtheritic sore-throat.

Mr Kingzett has lately introduced a series of **bactericides**, in which five per cent. of such active antiseptics as mercuric and zinc chlorides, boric, sulphophenic, and carbolic acids, chloral and chloroform, are each united with five volumes of hydrogen peroxide. The mercuric bactericide has been specially serviceable in antiseptic surgery. Mr Kingzett claims that effectual antiseptics and disinfectants are thus produced, which yield, when required, five times their volume of nascent oxygen,

and have the power of destroying not only micro-organisms, but the toxic products to which they give rise.

ACTIONS AND USES.—"Sanitas" oils and fluids are volatile, non-poisonous antiseptics, disinfectants, and deodorants. Their several constituents in various ways attack and destroy enzymes, organised ferments, and the lower forms of vegetable and animal life. The "Sanitas" preparations have an agreeable aromatic odour, are not corrosive, and do not stain or injure clothing or other textile fabrics. Their power of checking fermentation has led to the administration of the fluid to calves fed on milk, and suffering from dyspepsia or diarrhœa; an ounce is prescribed with six ounces of water, and may be conjoined with spirit, ether, or chloroform.

Useful **antiseptic lotions** for wounds, ulcers, and bruises are prepared with one part of the fluid, diluted, according to circumstances, with four to ten parts of water. Ointments and liniments are prepared with about the same proportions of oils and fats. When wounds, for ten days or longer, have been treated with carbolic or other irritant dressings, granulation and skin growth often proceed more satisfactorily with the substitution of the milder "Sanitas." In sore-throat, diseases of the sinuses of the head, aphtha, and foot-and-mouth complaint, solutions and sprays are often useful, and, being devoid of irritant effects, are also serviceable for rectal, uterine, and vesical injections. "Sanitas" solutions and soaps not only cleanse and disinfect, but gently stimulate the skin, abate itching, remove scurf, and promote healing in prurigo, chronic eczema, or other skin complaints. "Sanitas fluid," diluted with twenty to fifty parts of tepid water, is serviceable for sponging febrile patients, and for **disinfecting** animals affected with contagious disease. In **canine practice**, diluted with four to six parts of water, it is used in canker of the ear, ulceration of the mouth, eczema, and as a uterine injection after parturition. "Sanitas" oil **destroys** the **parasites** of scab and mange, as well as lice, fleas, and maggots, and arrests the cryptogamic growth of ring-worm. Even in concentrated form, there is no risk of its exciting undue irritation, or inducing from its absorption injurious constitutional results, such as are apt to follow the free use of strong carbolic preparations.

“Sanitas” powder and “Sanitas” sawdust are used with good effect for **disinfecting** and **deodorising** stables, kennels, cow-houses, and piggeries. Sprinkled upon the floors, they also purify the air of slaughter-houses, menageries, manufactories where fermentible materials are employed; while on ship-board they destroy unpleasant odours, and substitute their own camphoric aroma. These “Sanitas” preparations are largely used in hospitals and by medical officers of health.

S A V I N.

SABINÆ CACUMINA. Fresh and dried tops of *Juniperus Sabina*, collected in spring from plants cultivated in Britain. (B.P.) *Nat. Ord.*—Coniferæ.

Juniperus Sabina is an evergreen shrub, common throughout Middle and Southern Europe, and cultivated in this country. The tops or young branches, with their attached leaves, when fresh are green, but become yellow when kept; have a strong, heavy, disagreeable odour, and a bitter, acrid, resinous taste. They communicate their properties to water, spirit, and the fixed oils, and owe their activity to about three per cent. of a colourless or pale yellow **volatile oil**, prepared from the fresh tops by distillation, isomeric with oil of turpentine ($C_{10}H_{16}$), and associated, as constantly occurs in plants, with a more oxidised oil ($C_{10}H_{16}O$). From the berries ten per cent. of these oils is said to be obtained (Phillips).

ACTIONS AND USES.—Savin is a topical irritant, occasionally used as a rubefacient and vesicant. Administered internally, moderate doses are stimulant, anthelmintic, and diuretic; they stimulate especially the urino-genital organs. Large doses produce gastro-enteritis. Excretion occurs by the skin, pulmonary membrane, and kidneys. Savin resembles the turpentine yielding coniferæ, and especially the other junipers (p. 474).

TOXIC EFFECTS.—Hertwig gave **horses** half a pound twice daily for six or eight days without effect; Professor Sick administered small doses for half a year without notable symptoms; but these observations probably underrate its activity. Mr Rose records the poisoning of five horses, of

which one died immediately, and two after five days; the others recovered, after suffering from diarrhœa, intense thirst, quickened pulse and breathing, with great prostration (*Veterinary Record* for 1850). Two drachms kill **rabbits** in a few hours, producing extreme congestion of the intestines, kidneys, and bladder. Orfila records that four drachms destroyed **dogs** in thirteen hours, when the gullet was tied to prevent vomiting; and similar effects follow when powdered savin is applied to a wound or introduced underneath the skin. Vomiting, purging, gastro-intestinal inflammation, and collapse were produced. The kidneys and bladder were irritated, usually causing copious discharge of bloody urine.

The **uterus** is also **irritated**, and savin has been ignorantly used to produce abortion and hasten parturition. Two cases of abortion in mares heavy in foal are recorded by Mr Millet, of Henley-on-Thames, in the *Veterinarian* for 1855. In these cases the continued use of savin destroyed both foals, and, being still persevered with, caused their expulsion apparently ten or twelve days later.

MEDICINAL USES.—Savin cannot be safely used to produce abortion or hasten parturition. Unlike ergot, it does not directly contract the muscular fibres of the uterus. It stimulates the uterus, and expels its contents only as a result of dangerous irritation of the intestines and urinary organs. It is occasionally used chopped with fodder for the destruction of intestinal worms; but other remedies are more safe and certain. If used at all, the best form is the essential oil. Decoctions of the tops in an alkaline ley, and the essential oil are occasionally applied as antiseptics and stimulants to indolent wounds and warts.

DOSES, &c.—As an anthelmintic—the only purpose for which savin is administered— $\text{f}\text{ʒ}\text{ij}$. to $\text{f}\text{ʒ}\text{iv}$. of the volatile oil is given to horses or cattle; $\text{ʒ}\text{ij}$. to $\text{ʒ}\text{v}$. to dogs, dissolved in any mild fixed oil or in mucilage. For external application, decoctions and ointments are used. Equal parts of savin and verdigris ointments is a popular stimulant dressing for foot-rot in sheep.

SILVER AND ITS MEDICINAL COMPOUNDS.

SILVER NITRATE. Argenti Nitras. Lunar Caustic. Lapis infernalis. AgNO_3 .

When metallic silver is gently heated with diluted nitric acid, and the solution evaporated, silver nitrate crystallises in colourless right rhombic prisms. To form the familiar sticks or pencils, the salt is fused and run into moulds. Toughened caustic is prepared by adding, before fusion, one part potassium nitrate to nineteen parts silver nitrate.

Argenti nitras is devoid of odour, has a disagreeable metallic taste, is permanent in air, but blackens on exposure to light or in contact with organic matters. It is soluble in its own weight of temperate water, and in four parts of boiling rectified spirit. It blackens the cuticle, parts readily with oxygen, and thus corrodes soft animal tissues.

Like other silver salts, it is **distinguished** by giving, with hydrochloric acid, a curdy-white precipitate of silver chloride (AgCl), insoluble in nitric acid, but soluble in ammonia, and darkened by exposure to light. Hydrogen sulphide yields a black precipitate of sulphide (Ag_2S). Caustic potash solution throws down the brown hydrate (AgOH), which readily loses water, being converted into the oxide (Ag_2O). Potassium iodide produces a pale yellow precipitate of iodide (AgI), potassium chromate a red precipitate of chromate (Ag_2CrO_4).

ACTIONS AND USES.—It is astringent, irritant, and corrosive, is used as a caustic, and administered as an astringent and nerve tonic. It induces emesis in animals capable of vomiting. Large doses cause prostration and paralysis of the central nervous system. The nitrate is the silver salt generally used, but the Pharmacopœias also recognise the oxide and iodide.

TOXIC EFFECTS.—Like iron, zinc, and copper salts, which it resembles, silver nitrate readily **unites with albumin**. Its affinities are so readily satisfied that it is absorbed with difficulty, while the **astringent, irritant, and caustic** actions of the solid nitrate or strong solutions are confined to the parts with which they come into contact. When vomiting is prevented, thirty to sixty grains given to dogs cause prostration,

weakness of heart action, intestinal irritation, and sometimes convulsions and paralysis, indicating that, like lead and other heavy metals, it irritates and inflames the anterior cornu of the spinal cord. When administered for some time it is deposited in the skin and blackens it, and has also been detected in the liver, spleen, pancreas, and bones. As in the case of arsenic, antimony, and phosphorus, chronic poisoning is accompanied by **fatty degeneration**. Rosenstern, experimenting on the vessels of the mesentery of frogs with weak solutions of various astringents, found silver nitrate most powerful; lead acetate followed next in order, requiring for production of a given effect a solution five times as strong; ferric chloride acted only feebly; alum caused dilatation (*Practitioner*, September 1876). It is slowly excreted in the albuminous secretions and in the bile, mainly by the bowels, in limited amount by the kidneys. Undue irritation, produced whether internally or externally, is diminished by solution of common salt, which forms the insoluble and inert chloride.

MEDICINAL USES.—As a **tonic** it is prescribed in chronic nervous diseases, especially amongst dogs. Its action on the spinal cord indicates its use in chronic paralysis, for which potassium chromate and arsenic are also given. Like arsenic, it is sometimes used to check chronic gastric irritation. Alone, or in combination with opium, it is given as an **astringent** in chronic diarrhoea and dysentery in dogs; while enemata of two to five grains to the ounce of distilled water or of starch gruel are occasionally also used.

Applied to irritable, relaxed, discharging skin or mucous surfaces, it coagulates mucus and albumin, **constricts dilated vessels**, produces a white film of chloride, which quickly deepens in colour, from the reduction of the salt to the conditions of sulphide and metal. The solid nitrate or strong solution rubbed into the skin **raises blisters**. The eschar remaining, after a free dressing, gradually cracks and peels off, leaving usually a healthy surface beneath. The solid nitrate acting superficially, and readily localised, is for many purposes preferable to fluid caustics, or to the deliquescent caustic potash. It is serviceable for **destroying tinea, warts, and other neoplasms**, and checking the progress of indolent boils. A crystal

rolled in a piece of tissue paper is sometimes substituted for corrosive sublimate in **fistulæ** not easily got at with the knife, and a few days after its introduction causes sloughing of the hard walls of the canal, and leaves a healthy granulating surface. Mr Robert Littler, of Long Clawson, regards it as one of the most effectual remedies for the interdigital inflammation and discharge which constitutes the contagious form of **foot-rot in sheep**.

A light dressing of the solid caustic, or of a weak solution, promotes a healthier condition of **indolent wounds** and ulcers, represses over-luxuriant granulations, often arrests the irritability of circumscribed attacks of **erythema**, eczema, or pruritus, and is an excellent dressing for obstinately **sore teats** in cows. When painted around an erysipelatous spot it sometimes limits its spreading. Solutions of ten to twenty grains to the ounce of water destroy the parasites of mange and scab.

A solution containing one-half to two grains to an ounce of water abates the pain and congestion of **conjunctivitis**, and stimulates and heals the inflamed, suppurating eyelids of weakly dogs. It removes specks and opacity of the cornea, if recent and produced by accidents, but is of little avail in cloudiness of the cornea, resulting in horses from repeated attacks of periodic ophthalmia. Solutions of ten to thirty grains to the ounce of water are sometimes used, with a spray producer, to control **laryngeal ulceration**, follicular tonsillitis, and pharyngitis.

Doses, &c.—Horses and cattle take grs. ij. to grs. v.; sheep, gr. j. to grs. ij.; pigs, gr. ss. to gr. j.; dogs, gr. $\frac{1}{8}$ to gr. ss. It may be repeated two or three times daily, and, on account of its disagreeable taste and active affinities, is given in bolus. When its astringent effects are to be directed upon an ulcerated or discharging portion of intestine, the bolus should be made with kaolin, and given coated with keratin (p. 476). The oxide, having no topical irritant effect, is sometimes substituted for the nitrate as a nerve tonic. For external purposes the **sticks** of nitrate are made with five per cent. potassium nitrate, which diminishes their brittleness; are sometimes coated with wax to preserve them from the decomposing action of air and light; and are held in quills or forceps to prevent their blackening the fingers. An **ointment** is occa-

sionally made with grs. v. to grs. viij. to the ounce of vaselin or lard. Solutions require to be protected from light, and kept in bottles with glass stoppers. Silver nitrate is incompatible with highly oxidised bodies, and forms explosive compounds with creosote and morphine.

SOAPS.

SODIUM OR HARD SOAPS. *Sapo durus.* Sodium Stearate and Oleate.

POTASSIUM OR SOFT SOAPS. *Sapo mollis.* Potassium Oleate.

Soaps consist of **fatty acids in combination with an alkaline base.** **Hard soaps** are made by boiling palm or cocoanut oils or tallow with carbonated or caustic soda, when the alkali unites with the fatty acids, displacing the basic glyceryl (p. 436). Common salt added to the gelatinous boiling ley separates the soap in flakes, which are collected, run into moulds, and dried. Such soaps are a mixture of sodium stearate, with about one-third of oleate, and thirty to sixty per cent. of water. To make yellow soap, the ley, while being concentrated, is treated with considerable quantities of resin. Many soaps are now made with a large percentage of silicates. **Mottled and marbled soaps** owe their colour to the presence of a little iron. **Glycerine soap**, prepared by heating the soap ley with water for two or three hours at 400° Fahr., contains a mixture of soap and glycerine. The costly Castile and other Pharmacopœia soaps are directed to be made with olive oil. **Soft or potash soaps** are made by boiling seal or whale oils with carbonated or caustic potash, and gradually evaporating to the required consistence.

Soaps have an alkaline, acrid taste, dissolve readily in water and spirit, but should not impart an oily stain to paper. When heated, they fuse, swell up, and leave charcoal and carbonate of their alkali. Calcium and magnesium salts, such as occur in hard waters, decompose soap; the fatty acids form insoluble flakes of stearate and oleate of calcium and magnesium; while the solubility of the alkali is also diminished by its conversion into carbonate or sulphate. Soap is hence used as a **test for the hardness of water.**

ACTIONS AND USES.—Soaps contain some free alkali, and hence are slightly irritant. They are mildly laxative, diuretic, emetic, and antacid. They form convenient adjuncts to more active laxatives or diuretics, and are serviceable additions to laxative clysters. Externally, they are used as stimulants, detergents, and lubricants, and in pharmacy as excipients.

Soap and warm water are in every-day use for **cleansing the skin**, removing scurf, neutralising acrid fatty matters, keeping open the orifices of sebaceous glands, promoting growth of hair, as well as preparing the skin for the action of blisters and of parasiticides. When **erythema** or **intertrigo** is produced from badly-fitting harness or other causes, irritation is abated by rubbing the parts with soap, and subsequently dressing with vaselin, with vaselin and sugar of lead lotion, or with "Sanitas" or other soothing antiseptic powder. Gently rubbed over slight **burns** or **scalds**, soap prevents access of air and relieves irritation. A thorough daily washing **removes** the **scales** of chronic skin diseases, and with smart friction lays bare the burrows of the mange or scab acari, for the effectual action of special parasiticides. In chronic **eczema**, soft soap, from its lubricant and alkaline properties, is often useful. For such cases a convenient dressing is made with equal parts soft soap and glycerine, half a part of zinc oxide, and six or eight parts water. For eczema and other itching skin diseases, Dr M'Call Anderson prescribes equal parts of soft soap, oil of cade, and rectified spirit. As a **stimulant** for bruises and strains, for warming horses' chilled legs, or for producing counter-irritation in sore-throat, six ounces of hard soap, cut into small pieces, are macerated with six fluid ounces of dilute liquor ammoniæ and one pint each of proof spirit and linseed oil; two or three ounces of camphor are sometimes added. Soap and water is much used for laxative clysters. A cone of hard soap inserted into the anus helps to evoke tardy action of the bowels in young animals. As **internal antacids**, soaps are less effectual than alkaline carbonates or bicarbonates, but are occasionally administered in poisoning by acids and metallic salts. Soap and water causes **emesis in dogs** as well as men. Soaps are used as excipients for boluses, and as constituents of liniments and plasters.

SODIUM AND ITS MEDICINAL COMPOUNDS.

Sodium salts abound in the ashes of marine and maritime plants. They occur native in the Chili nitre beds and in borax, but their chief **commercial source** is the chloride obtained from rock-salt deposits, or from the evaporation of sea-water. They are soluble, with the single exception of the antimoniate, which goes down very slowly from solution. They are **distinguished** by their negative reaction with the several group tests, and by their communicating to the flame of burning alcohol a bright yellow colour.

ACTIONS AND USES.—Sodium salts, chiefly as albuminates, chlorides, and phosphates, are **constituents** of the blood, bile, serous fluids, and indeed of **all animal secretions and textures**. Dr Lauder Brunton thus describes their general action:—"They diffuse more slowly than those of potassium. They are neither absorbed nor excreted so readily, and have not a marked diuretic action. When locally applied to muscle and nerve in large doses, they paralyse both, but not so powerfully as salts of potassium; nor have they such a paralyzing action upon the involuntary muscle either of the heart or the intestine" (*Pharmacology, Therapeutics, and Materia Medica*). The more soluble salts, in small doses and diluted solution, are chiefly **excreted by the kidneys**; while the less soluble, in larger doses and more concentrated solution, are **removed by the bowels**.

Like potassium salts, they **may be grouped** as follows:—

1. The hydrate carbonates and salts of organic acids, which in the body are converted into carbonates, are antacid, alterative, and slightly diuretic. The hydrate and carbonate are caustics. Sodium ethylate B.P. solution contains nineteen per cent. of the solid salt ($\text{NaC}_2\text{H}_5\text{O}$), is a colourless, syrupy liquid, becoming brown by keeping, and is used as a caustic.

2. The chloride, sulphate, nitrate, and permanganate act as soluble crystalloids, are antiseptics, febrifuges, and refrigerants; small doses are slightly diuretic, while large doses are cathartic.

3. The borate, benzoate, hyposulphite, sulpho-carbolate, chlorate, salicylate, and valerianate resemble their acid or salt radical rather than their base.

SODIUM HYDRATE. Caustic Soda. NaHO .

SODIUM CARBONATE. Sodæ Carbonas. Carbonate of Soda.
 $\text{Na}_2\text{CO}_3, 10\text{Aq.}$

SODIUM BICARBONATE. Sodæ Bicarbonas. Bicarbonate of
Soda. Hydro-sodium Carbonate. NaHCO_3 .

Sodium hydrate and solution of caustic soda resemble in their preparation and general properties the corresponding potassium compounds, but are little used in veterinary practice.

The **carbonate** was formerly prepared by lixiviating the ashes of marine or maritime plants, and from the native sesquicarbonate or natron found as an efflorescence on the margins of lakes in warm climates. For the manufacture of soap and glass, for washing, and other purposes, the 200,000 tons now annually required in this country are chiefly **obtained from common salt**, by heating it in furnaces with sulphuric acid; the sulphate thus prepared is converted into sulphide, and thence into carbonate, by roasting with coal or slack and limestone; lixiviating, calcining, and crystallising. From a saturated solution of this soda ash there separate large transparent, colourless, laminar, rhombic crystals of hydrated carbonate ($\text{Na}_2\text{CO}_3, 10\text{Aq.}$) The water may be driven off by heating to 120° Fahr., when the dried granular B.P. sodium carbonate remains. The carbonate in its several forms is alkaline to taste and reagents, efflorescent, and soluble in one to two parts of water.

The **bicarbonate** is produced by saturating the carbonate with carbonic acid gas, or by passing carbonic acid gas through a strong solution of common salt mixed with ammonia. It occurs as a white crystalline powder, or aggregation of irregular opaque scales, has a saline, slightly alkaline, not unpleasant taste, is soluble in about ten parts of cold water, and is distinguished from the carbonate by its feeble alkalinity, and its giving a colourless instead of a coloured precipitate with corrosive sublimate. **Soda water**, as ordinarily sold, is simply aerated water, but the officinal article contains in every pint thirty grains of bicarbonate, and is saturated with carbonic acid gas, dissolved under pressure of four atmospheres.

ACTIONS AND USES.—Sodium carbonate and bicarbonate are

antacids and alteratives. They differ only in the degree of their action, and resemble the corresponding potassium salts.

MEDICINAL USES.—Small doses given a quarter to half-an-hour before meals **increase secretion of gastric juice**. Given with or after food, they aid the emulsionising and digestion of fats, and neutralise the acid of the gastric juice, as well as any acid produced by excessive fermentation of food. They are hence sometimes serviceable in relieving **indigestion and flatulence**, their efficacy being increased by administration with aromatics or stimulants. Young calves fed on stale skim milk, and suffering from atonic dyspepsia, are often relieved by one to two drachms of bicarbonate dissolved in each meal of milk. They are **antidotes** for poisoning by mineral and other acids. Being less irritant than the corresponding potassium salts, they are preferred for stimulating secretion of gastric juice and neutralising acids in the alimentary canal, while potassium carbonates are more effectual antacids in rheumatism or acidity of the urine, and are more active diuretics.

Sodium carbonate solutions **lessen irritation** of urticaria, lichen, and other skin eruptions, but are not so effectual as potassium carbonates or cyanide. In more chronic cases the alkaline dressings are alternated with tar or oil of cade. The simple white non-puriform leucorrhœa is usually arrested by two or three injections of diluted sodium bicarbonate. A stronger solution abates the pain of burns.

DOSES, &c.—Of the carbonate horses and cattle take ℥j. to ℥ij.; sheep and pigs, grs. x. to grs. l.; dogs, grs. v. to grs. xv. The bicarbonate, although about half the activity of the carbonate, is more convenient for general use, and is given in double these doses, either in bolus or solution. It is frequently given to dyspeptic, diabetic, or febrile horses, dissolved in their drinking water.

SODIUM BORATE. Sodæ Biorate. Borax. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{Aq}$.

Borax occurs native in certain Austrian mineral waters, as an incrustation on the edges of various lakes in Thibet and Persia, and in streams in Southern California. As crude borax or tincal, it is imported from Calcutta in greenish pieces, moistened with

oil to prevent efflorescence. It is purified by calcining and recrystallising. Most of the borax used is now got by calcining together, in proper proportions, boric acid and sodium carbonate.

Its colourless, oblique six-sided prisms effloresce, and become opaque, have a saline, cooling taste, are soluble in twelve parts of cold and two of hot water, and are still more soluble in glycerine, which is hence a capital vehicle for applying it. Heated, it melts in its water of crystallisation, and swells into the porous **borax usta**; at a red-heat it becomes the transparent glass or anhydrous borax used as a flux. A hot saturated solution, treated with a mineral acid, deposits the crystalline scales of boric acid.

ACTIONS AND USES.—Borax is antiseptic, parasiticide, slightly astringent, and alkaline, and is used to relieve irritation of the skin and mucous membranes.

It has notable **antiseptic** powers: one part in 100 of water arrests the action of emulsin, diastase, and ptyalin; while one part in 1000 of water prevents the action of rennet; it requires, however, according to Koch, one part in forty-eight of water to kill developed bacteria.

It has been prescribed in the same doses as the bicarbonate in **gastric irritation**. It is a useful antiseptic in **aphthous** and **ulcerated conditions** of the mouth and fauces, is sometimes conjoined with potassium chlorate, and applied either in powder or with "Sanitas," or glycerine and water. It **allays irritation and itching** in many cases of erythema, intertrigo, eczema, and psoriasis. It is preferable to more active and poisonous remedies for dogs, which are apt to lick their dressings. In acute eczema one part each of borax and aluminium acetate is used, dissolved in fifty parts of water. It is an effectual injection for leucorrhœa. In America it is used for the destruction of cockroaches. It is a good solvent for salicylic and benzoic acids.

SODIUM SULPHATE. Sodæ Sulphas. Sulphate of Soda. Glauber's Salt. $\text{Na}_2\text{SO}_4 \cdot 10\text{Aq.}$

The sulphate effloresces on the surface of the soil in various parts of India, occurs in masses in Spain, and is a constituent of sea-water, of many aperient mineral waters, of various plants,

and of several animal secretions. When two parts sodium chloride are heated with one part sulphuric acid, hydrochloric acid is evolved, and sodium sulphate crystallises from the solution. It occurs in colourless, transparent, oblique prisms, which effloresce on exposure to air, have a saline, bitter taste, and at 60° Fahr. are soluble in less than their own weight of water.

ACTIONS AND USES.—It exhibits the typical actions of the alkali group, is cathartic, slightly diuretic, febrifuge, and cholagogue.

Unlike the magnesium sulphate, it has no toxic effect when injected into the circulation. Like other saline purgatives, it has a low diffusive power; it impedes absorption of fluids present in the intestines, increases both **secretion** and **peristalsis**, and thus augments the quantity and fluidity of the dejections. Not only does it carry away bile lodged in the duodenum, and thus prevent its reabsorption, but Professor Rutherford, experimenting on fasting dogs, found that, unlike the magnesium sulphate, it acts upon the hepatic cells and **augments secretion of bile**. The **phosphate** has a similar moderate cholagogue action, and both are accordingly with reason used in congested conditions of the liver. While large doses of Glauber salt are removed by the bowels, small doses, freely diluted, pass off, in great part unchanged, by the kidneys. Although seldom used for horses, it is still occasionally prescribed for cattle and sheep, for the same purposes as Epsom salt, with which it is sometimes conjoined. Catharsis is seldom, however, produced within twenty-four hours. It is an antidote for poisoning with carbolic acid. In dogs it acts both as an emetic and purgative. It abstracts heat when treated with either of the mineral acids.

DOSES, &c.—As a purgative cattle take lb. j. to lb. jss., sheep, ℥ij. to ℥iv., given with ginger and treacle, and succeeded by liberal supplies of chilled water.

SODIUM SULPHITE. Neutral or Normal Sulphite. Sodii Sulphis.
 $\text{Na}_2\text{SO}_3, 7\text{Aq.}$

SODIUM THIOSULPHITE. Hyposulphite of Soda. Sodii Hypo-
sulphis. $\text{Na}_2\text{S}_2\text{O}_3, 5\text{Aq.}$

When sulphurous acid gas is passed through a concentrated solution of sodium carbonate, four-sided crystals are deposited

of the **acid sulphite** (NaHSO_3), which is acid in taste and reaction, and has an odour of sulphurous acid. When this acid salt is saturated with sodium carbonate, there is produced the **normal sulphite**, which is soluble, alkaline, and much used as a reducing agent, and for bleaching.

Sodium hyposulphite is prepared in the laboratory by dissolving sulphur in a boiling solution of sodium sulphite and crystallising, but on the large scale is got from the tank waste of the alkali works, which contains calcium sulphide, by exposing it to the air and treating with sodium sulphite. The hyposulphite is very soluble in water, and fusible. It is more permanent than the sulphite. It is used in photography for fixing prints, and as an antichlore in bleaching and paper-making.

ACTIONS AND USES.—The sodium sulphites and hyposulphites are antiseptics, deodorisers, and insecticides. In the presence of acids, without and also within the body, they give off sulphurous acid, which they therefore resemble. They **destroy ferments and bacteria**, and remove offensive smells—properties greatly increased when they are used along with the tar acids. When standing long in contact with water the sulphite decomposes and gives off hydrogen sulphide.

GENERAL ACTIONS.—The sulphites and hyposulphites, when swallowed, are absorbed, remove noisome smell and acidity from unhealthy secretions, and are excreted mostly as sulphates. Professor Polli, of Milan, made upwards of three hundred experiments with acid sulphite, mostly upon dogs, and found that it **materially diminished the effects of animal poisons**. He gave dogs 225 grains daily with impunity for a fortnight; very moderate doses were detectable in twenty-four hours in the blood, liver, and urine; two ounces of blood drawn from dogs, which for five days had received daily with their food thirty grains of sulphite, kept fresh for three weeks; while blood taken from dogs similarly fed, but receiving no sulphite, became putrid within a few days. Full doses, given previous to death, retarded or prevented putrefaction of the body.

Professor Polli injected fifteen grains of fetid pus from an unhealthy abscess into the thighs of two dogs, and next day

repeated this injection. Both dogs were stupefied, reeled, and tottered when made to walk, while their pulse and breathing were much quickened. For five days previously both dogs had been treated exactly alike, with this difference only, that one had received daily thirty grains of sodium sulphite, which was continued throughout the experiment. In four days after the injection this dog was again eating, and the wound in his thigh healing. The other, getting no sulphite, daily became worse, the limb got gangrenous, and in ten days he died, exhausted. Similar results followed injection into the femoral vein of bullock's blood kept for four months, and offensively putrid. Dogs that had previously received the sulphite recovered their appetite, and were almost well in three days; while those managed in the same manner, but not receiving sulphite, died comatose in five days, suffering from low fever, and with the limb gangrenous. Forty-five grains of the mucopurulent discharge from a glandered horse were injected into the femoral veins of two strong, healthy dogs, one of which for several days had received two drachms daily of sodium sulphite, and although at first seeming to suffer most, in a few hours was able to eat, and was next day in tolerable health. The other, however, was fevered and prostrate, the limb became tender, œdematous, and gangrenous, a purulent discharge ran from the nose and eyes, and death occurred on the sixth day.

MEDICINAL USES.—These experiments held out great hopes that septicæmia and pyæmia might be prevented or cured by sulphites. But repeated careful clinical observation has not justified the high expectations formed of them, and their administration does not appear to arrest or materially alter the course of febrile, contagious, or zymotic diseases. Amongst horses they have been given in **febrile attacks**, and in such cases many American practitioners have given me favourable reports of them. Reasoning from their physiological actions, they should be serviceable in inveterate skin disorders, tedious cases of strangles, and rheumatism. They **relieve acidity and flatulence** occurring in badly-fed young calves. Ounce doses of acid sulphite, given thrice daily, I have found lower temperature, and relieve the breathing in contagious pleuro-pneu-

monia in cattle. In cattle plague it has been given both by the mouth and injected into the veins, and although it did not cure, it abated fever, lowered excessive temperature, and prolonged life (Report on Cattle Plague). Mixed with treacle and placed within the lips, it diminishes irritation, smell, and acrid discharge in **foot-and-mouth disease**. Used alone, and occasionally with potassium chlorate, it has been given to young cattle to prevent attacks of black-leg, half-ounce or ounce doses for this object being administered with the ordinary food for three or four days consecutively during every fortnight. It is difficult to estimate the precise value of such preventives, adopted, as they often are, in conjunction with more careful feeding and management. In **distemper in dogs**, ten to twenty grains of sulphite, or hyposulphite, are given twice daily to keep the bowels regular and abate the low fever.

Dr A. J. Harrison, of Clifton, at the British Medical Association Meeting at Nottingham in 1892, reported the successful treatment, in the Clifton Zoological Gardens, of **monkeys suffering from lupus**, by saturating the affected parts, daily or as required, with a solution of forty grains of sodium hyposulphite to the ounce of water, and subsequently applying a solution of five drops of strong hydrochloric acid to the ounce of water. Hyposulphurous and sulphurous acid gases are thus produced. Their nascent condition, it is urged, increases their efficacy. The tuberculous ulceration rapidly heals; one serious case, which had gone too far for operation, was cicatrised over in six months; ten consecutive cases were successfully treated. Further experiments on these lines should be made not only in lupus, but in actinomycosis and other diseases depending upon micro-organisms. Other germicides besides sodium hyposulphite may, moreover, exhibit special potency when their active constituents exert their effects in a nascent state.

Doses, &c.—Of the sulphites, horses and cattle take ℥ss. to ℥j.; sheep and pigs, ℥ss. to ℥ij.; dogs, grs. xx. to grs. lx. Of the hyposulphite, somewhat smaller doses suffice. Either drug is prescribed in powder or solution, and may be repeated several times daily. Having little taste, they may usually be taken mixed with the food. They may be conjoined with ginger, gentian, camphor, or ammonium carbonate.

SODIUM CHLORIDE. Chloride of Sodium. Muriate of Soda.
Common Salt. NaCl.

Salt is found in extensive rock deposits in Poland, Spain, and other parts of Europe, and in this country in Cheshire and Worcestershire. It exists in variable amount in every soil, and hence in every water, is the largest saline constituent of the ocean, and abounds in the tissues and fluids of plants and animals. It is obtained for medicinal and economical purposes by quarrying the solid beds of rock-salt, or by evaporating brine springs or sea-water.

It forms cubical crystals, which vary in size according to the rapidity of their formation. When pure, it occurs in small, white, crystalline grains, or transparent cubical crystals free from moisture, and has a purely saline taste. From the presence of magnesium and calcium chlorides, many samples are deliquescent. It is soluble in about two and three-quarter parts of water at all temperatures. It is rather more than twice as heavy as water.

ACTIONS AND USES.—Salt is an essential article of food; small doses are restorative, stomachic, and antiseptic; larger doses are irritant, cathartic, and emetic; it is used externally as a stimulant, antiseptic, and refrigerant.

GENERAL ACTIONS.—So essential is the regular or frequent use of salt for the maintenance of health, that animals, especially vegetable feeders, in a state of nature instinctively travel many miles to saline springs, the sea-shore, or incrustations or beds of salt. M. Boussingault, experimenting on its dietetic value (*Annales de Chimie et de Physique*, 1847, tome xix.), selected six cattle, as equal as possible in weight and appearance, and fed them in exactly the same manner, except that three received each 1·2 ounce of salt daily, whilst the other three got none. In about six months the skin and hair of those without salt became rough, dry, and staring, presenting a striking contrast to the smooth, shining coats of the others, which, although little heavier than their neighbours, were more lively, and of so much better appearance that they brought a somewhat higher price. The cattle receiving salt exhibited throughout greater appetite and relish for their food, con-

sumed it in a shorter time, and also drank larger quantities of water.

A piece of rock salt should constantly lie in the horse's manger, the ox's crib, and the sheep's trough. It is specially necessary when the diet consists largely of cooked grains or roots, in the preparation of which part of the salt is apt to be dissolved out. The condiment not only gratifies the palate, but also, as indicated, serves important nutritive purposes. It increases secretion of saliva and gastric juice, furnishes hydrochloric acid for the gastric juice, and soda salts for the bile; assists the diffusion of fluids through membranes, while four to six parts per 1000 are present in the blood serum, contributing to the solution of the globulins. Around an inflamed spot, notably in pneumonia, common salt accumulates, and its subsequent increase in the urine often marks the subsidence of the attack (Bartholow). During convalescence from acute disease the chloride and other sodium salts are removed from the body in unusual amount, and most animals then instinctively take salt freely. Besides itself furnishing an essential constituent of the animal fluids and solids, it appears to **assist** in the **assimilation** of nutritive matters. On the absorption of calcium salts it has a marked effect, for when withheld from dogs with fractured limbs repair and union are tardy.

It is **excreted** by the mucous membranes and kidneys.

In common with other cathartic salines, it exerts an **excitosecretory action on the glands of the intestines**; it besides impedes absorption of fluid from the bowels, which thus become mechanically distended with fluid. Their contents are softened and peristalsis is encouraged. The blood not only does not obtain from the bowels its usual supply of fluid, but pours serous secretion into the bowels. Within an hour or two after administration of a saline cathartic the blood becomes concentrated, and thereafter gradually recoups itself from the tissues, thus promoting absorption of fluid and waste materials. Professor Rutherford's experiments on fasting dogs indicate that common salt **slightly increases secretion of bile**, in this respect resembling sodium sulphate rather than magnesium sulphate.

On **horses** the cathartic action of common salt is uncertain,

often violent, and usually accompanied by considerable irritation of the kidneys. On **dogs** it usually operates both as an emetic and cathartic. Small and freely diluted doses increase the secretion of urine and the proportion of urinary solids. On **pigs** it acts as a purgative, but is scarcely so safe or certain as oil, jalap and calomel, or aloes.

Toxic Effects.—In the *Veterinarian* for 1839 and 1862, cases are recorded of **pigs** eating about four and a half ounces, repeated during several days. They suffered from flatulence, diarrhoea, vertigo, convulsions, and paralysis, and died in eight to twenty-four hours. The mucous membrane of the stomach and bowels was found after death highly injected and inflamed. Dr Charles Cameron, Professor of Hygiene, Royal College of Surgeons, Dublin, in 1871 reported the poisoning of thirty-one pigs conveyed by rail in a salt-truck, from the sides of which they had licked the salt. For many hours they had been deprived of water. They appeared in a state of asphyxia; emetics and subsequently stimulants were ordered, and eleven recovered. The carcasses of those that died exhibited "signs of gastro-intestinal inflammation; the brain was greatly congested, and there was considerable extravasation of blood in the cerebellum and medulla" (*Veterinarian*, December 1871). Even **cattle and sheep**, for which it is generally a suitable cathartic, occasionally **suffer from overdoses**. I have seen dangerous effects produced by several ounces given to young and delicate calves, for which oil is a more suitable purge. Mr Dobson, of Ashby-de-la-Zouch, reports that one-pound doses given in four quarts of water to healthy yearlings in half an hour induced irritation, excitement, staggering, paralysed hind-quarters, and death (*Veterinarian*, April 1865).

Nitrate of soda, much used as a manure, has irritant and cathartic properties, somewhat resembling those of common salt; has sometimes injured both horses and cattle that have licked it, or eaten grass strongly saturated by a large, recently applied dressing (see "Nitro," p. 586, and *Veterinarian*, September 1876).

MEDICINAL USES.—For vigorous **adult cattle and sheep** common salt is a **useful purgative**, resembling in its effects Epsom and Glauber salts. It is, however, more soluble,

moderate doses are more quickly absorbed, and hence it is frequently desirable to **conjoin common and Epsom salts**. Full doses of such salines cause thirst, induce the animal to drink water or other bland fluids freely, thus softening and carrying onwards the hard, dry, impacted food, which is apt to accumulate in the first and third stomachs of ruminants. For such patients salt is administered to unload the bowels in distension of the rumen with food, in fardel-bound, as well as in the earlier stages of diarrhœa depending on over-feeding, or kept up by the presence of irritating matters in the canal. It is given to relieve irritation and inflammation of the eyes, brain, respiratory organs, or limbs; and in such cases not only beneficially empties the stomachs and bowels, but frees the blood of peccant matters, and excites counter-irritation. It controls excessive action of silver salts.

Small and repeated doses are **stomachic**, are prescribed for all animals suffering from indigestion and irregular appetite, and may be conjoined with gentian, ginger, or spirits and water. It obviates in some measure the evil effects of damp and badly kept fodder, and, given with nutritive dry food, prevents or retards the progress of liver-rot in sheep. Systematically given, salt lessens the liability to intestinal worms, and an injection of two or three ounces to a pint of water often brings away ascarides from the rectum. It is frequently added to laxative clysters.

Dissolved in ten to twenty parts of water, it proves a serviceable **antiseptic and stimulant gargle** in relaxed and ulcerated sore-throat of horses and other patients; such an application increases the activity of the cilia of the bronchial mucous membrane. Salt-water baths exert curative effects on animals as well as on man (p. 150). For stuping or cleansing wounds, subcutaneous and open, a one per cent. warm watery solution, in virtue of its stimulant and antiseptic properties, is preferable to plain water, and less apt to sodden or weaken the vitality of the parts. Salt solutions are applied cold as **stimulants** and **refrigerants** for strains and chronic inflammation of the joints and feet, particularly amongst cattle and sheep. For a cooling mixture, one part each of salt, nitre, and sal ammoniac is dissolved in thirty to forty parts of water; or one part of salt is

mixed with two of pounded ice. Such freezing mixtures require, however, to be used warily, for their prolonged application dangerously lowers vitality.

For **preventing and arresting putrefaction**, salt is cheap and effectual. Dr Angus Smith preserved with two ounces of salt one hundredweight of night soil for thirty-four days, with scarcely any putrefaction (Cattle Plague Reports). For antiseptic purposes salt is advantageously conjoined with carbolic acid. To disinfect skins and other such animal matters, a pound of salt and two ounces of carbolic acid are used, dissolved in a gallon of water. Waste chlorides, known as Cooper's salts, are used to preserve for manure the meat seized at the Metropolitan markets as unfit for human food.

Doses, &c.—As a purgative the adult ox or cow takes lb. $\frac{3}{4}$ to lb. j.; sheep, \mathfrak{z} j. to \mathfrak{z} ij. Instead of using common salt by itself, I prefer—as more prompt and effectual—half doses of common and Epsom salts, dissolving the mixture in about two quarts of tepid water, and adding two ounces of powdered ginger, anise, or other aromatic, and a pound of treacle. Some cattle readily drink the mixture thus sweetened, and the trouble of putting it over may be saved. To hasten and increase the effects of salines other purgatives are sometimes added. Along with half a pound each of common and Epsom salts, dissolved in water with aromatics and treacle, addition may be made of calomel, \mathfrak{z} i. to \mathfrak{z} ij.; twenty croton beans; or gamboge, \mathfrak{z} ss. to \mathfrak{z} j. Where such a dose fails to act in twenty or twenty-four hours, it may be again repeated, or a pint or two of linseed oil may be substituted for the salts. Frequently reiterated, large doses of drastic physic are, however, to be avoided, for they induce nausea and depression, which prevent purgation. When a patient has had two full doses without effect, he should have frequent clysters, plenty of treacle, and as much salt and water, or simple water, as he will drink of his own accord, but rarely any more active cathartic medicine.

As a **stomachic** and **alterative** for horses or cattle, two or three ounces of salt are given, usually united with aromatics, bitters, or vegetable tonics. As an **emetic** for the dog, the dose varies from one to four drachms, dissolved in tepid water. A still more effectual, readily-obtained emetic for a medium-

sized dog consists of a tablespoonful of salt and half a teaspoonful of mustard flour, dissolved in three or four ounces of water. More prompt results are secured by adding a grain of zinc or copper sulphate, or a grain of tartar emetic.

SODIUM CHLORATA. Chlorinated Soda. *Liquor Sodæ Chlorinatæ.* Hypochlorite of Soda.

Admixture and subsequent filtration of solutions of sodium carbonate and chlorinated lime produce the B.P. **liquor sodæ chlorinatæ**, known also as Labarraque's disinfecting fluid. It is a colourless alkaline liquid, with an astringent taste, and a feeble odour of chlorine. Like the analogous solution of bleaching powder, it contains chlorides, chlorates, and hypochlorites, and, acted on by air or acids, gives off chlorine and chlorine compounds.

ACTIONS AND USES.—It is antiseptic, stimulant, and antacid, and is also used as a disinfectant and deodorant. It is applicable to the same purposes as solution of chlorinated lime and liquor chlori.

It arrests the action of yeast and other ferments, and kills bacteria. When administered internally, it has been credited with the power of oxidising urea and other products of tissue metamorphosis, and of hastening their excretion; and outside the body it certainly oxidises such substances (Dr John Harley; Royle's *Materia Medica*). It has been prescribed in febrile cases and purpura in horses, and as an antidote for poisoning by hydrogen sulphide, the hydro-sulphides, and prussic acid.

It is chiefly serviceable as an **external antiseptic** for stimulating and deodorising foul wounds and ulcers, checking excessive noisome discharges from the skin or mucous surfaces, controlling the earlier stages of eczema, and for douching from an atomiser relaxed and irritable sore-throat. As an antiseptic, although more expensive, it is for some purposes preferable to chlorinated lime, inasmuch as, upon exposure, it becomes converted into common salt—itsself a valuable antiseptic, and more permanent and convenient than the deliquescent, moist calcium chloride, which remains when bleaching powder is used.

Doses, &c.—Of the B.P. solution, which contains about $2\frac{1}{2}$ per cent. of available chlorine, horses and cattle take f ʒj. to f ʒij.; sheep and pigs, f ʒj. to f ʒij.; dogs, ℥ xv. to ℥ xxx., dissolved in water.

SPERMACETI.

CETACEUM. A concrete, fatty substance obtained, mixed with oil, from the head of the sperm whale (*Physeter macrocephalus*). It is separated from the oil by filtration and pressure, and afterwards purified. (B.P.)

Spermaceti is found in the cells of the large quadrangular head of the sperm whale, which inhabits the Pacific and Indian Oceans. It is extracted by openings made through the skull, and occasionally by boiling the cellular and adipose tissues. When purified, it is a translucent, pearly-white, crystalline fat, with the density .940, tasteless, odourless, tough, and difficult to powder, unless moistened with a few drops of rectified spirit. It is insoluble in water, sparingly soluble in cold alcohol, readily soluble in hot alcohol, chloroform, and oils, and melts at 110° to 122° Fahr. Along with a little sperm oil, it consists of cetyl palmitate, which, unlike ordinary fats, is saponified with some difficulty, does not yield glycerine, but forms, when heated with an alkali, the crystalline ethal or cetyl alcohol ($C_{16}H_{33}OH$), and an alkaline palmitate.

ACTIONS AND USES.—It is emollient and demulcent, resembles wax, is rarely given internally, but is used for imparting consistence to ointments and plasters.

SPIRIT OF NITROUS ETHER.

SPIRITUS ÆTHERIS NITROSI. Sweet Spirit of Nitre. A spirituous solution containing nitrous compounds, aldehyd, and other substances. (B.P.) An alcoholic solution of ethyl nitrite ($C_2H_5NO_2$), containing five per cent. of the crude ether. (U.S.P.)

When rectified spirit, sulphuric and nitric acids, with various practical safeguards, are heated with copper wire, the nitric acid radicle (NO_3) is deoxidised by the copper; the resulting nitric

peroxide or nitrous acid radicle (NO_2) displaces the hydroxyl in the alcohol ($\text{C}_2\text{H}_5\text{HO}$), and there is formed ethyl nitrite ($\text{C}_2\text{H}_5\text{NO}_2$), which distils over with a portion of the alcohol. This saline ether, when diluted with about three times its bulk of rectified spirit, constitutes sweet spirit of nitre. As usually prepared, it is unstable, and readily loses strength, but Professor W. R. Dunstan has shown that a good-keeping solution of ethyl nitrite is easily prepared by dissolving it in absolute alcohol containing five per cent. of glycerine (*Year Book of Pharmacy*, 1890).

PROPERTIES AND TESTS.—Sweet spirit of nitre is transparent and nearly colourless, with a very slight tinge of yellow; it is mobile, inflammable, has a peculiar, penetrating, apple-like odour, and a sweetish, cooling, sharp taste. Its specific gravity is $\cdot 840$ to $\cdot 845$. It effervesces feebly, or not at all, when shaken with a little sodium bicarbonate, indicating absence of acid. Agitated in a test-tube with solution of ferrous sulphate and a few drops of strong sulphuric acid, poured down the side of the tube, a deep olive-brown or black zone is produced, owing to the formation and solution of nitrous acid gas. A good, freshly-prepared B.P. specimen should yield seven times its volume of this nitrous gas, and, even when kept, should not yield less than five times its volume. A weaker spirit of nitre, producing not more than five volumes of gas, is sold. Many veterinarians wisely obtain from the wholesale chemist **nitrous ether of guaranteed strength**, and dilute it, as required, with spirit of such sort and strength as they desire.

ACTIONS AND USES.—Sweet spirit of nitre conjoins the actions of the alcohol and ethyl nitrite of which it consists. It is hence a general stimulant, and a relaxer and paralyser of non-striped muscle. It relieves acute fever, and the difficult breathing of bronchitis and asthma. It is antispasmodic, diaphoretic, and diuretic. Large doses are narcotic.

MEDICINAL USES.—Consisting of strong spirit and a saline ether, when swallowed it stimulates the stomach and intestines; is hence **carminative and antispasmodic**, and is prescribed in all animals in indigestion, tympanitis, and colic. It is quickly absorbed, and proves a valuable **cardiac and general stimulant**, serviceable in cases of prostration and convalescence

from debilitating disorders. But its properties as a **diffusible nitrite, relaxing spasm** of involuntary muscles, also come into operation. It dilates arterioles, thus decreases arterial tension, and hence is of special value in the acute stages of fever, whether depending upon specific conditions or local inflammation. It relaxes the muscular fibres of the bronchial tubes, and thus relieves the spasmodic contraction and difficulty of breathing which characterise catarrh, bronchitis, and some forms of asthma. It is specially indicated when the heart action is weak and there is difficulty of breathing—conditions frequently concurring in influenza in horses. During excretion, notably by the skin and kidneys, its twofold constitution is further useful—the alcohol stimulates secretion, while the ethyl nitrite dilates the lumen of contracted vessels, and thus are **diaphoresis and diuresis** beneficially promoted in febrile colds, local inflammations, rheumatism, and other disorders.

Doses, &c.—As a stimulant and antispasmodic horses take fʒj. to fʒiij.; cattle, fʒj. to fʒiv.; sheep, fʒij. to fʒiv.; pigs, fʒj. to fʒij.; dogs, ℥xv. to fʒj. The special action depending on the costly nitrous ether, its percentage should be guaranteed in all purchases, and the drug should be preserved in properly stoppered bottles. As it is readily decomposed, even by water, it should be diluted or mixed with other medicines only immediately before it is administered. It is usually given in cold water, beer, or linseed tea.

For **antispasmodic** purposes it is conjoined with opium, belladonna, hyoscyamus, or chloral hydrate. For colic in horses, two to four ounces are given with two or three drachms of aloes, one to two ounces of laudanum in certain cases being added, and the whole dissolved in a pint of cold gruel, ale, or water. Two to four ounces of the spirit, with about half the dose of laudanum, repeated every hour, counteract the spasmodic pains which occasionally follow parturition. As a **general stimulant**, and for relieving dyspnoea in inflammation of the respiratory passages, and in catarrhal fever in horses, two ounces each of sweet spirit of nitre and ammonium acetate solution are conjoined with a drachm of belladonna extract. The good effects are sometimes maintained by the addition of two ounces of whisky or rectified spirit, and by repeating

the draught at intervals of two or three hours. **To combat serous exudation** in horses or cattle, two or three ounces of spirit of nitrous ether are usefully conjoined with half a drachm each of iodine and potassium iodide. **Diuresis** is determined by combination with nitre or oil of turpentine. **Diaphoresis** is developed when the patient is kept well clothed in tolerably warm quarters, and the medicine given in small and frequently repeated doses.

For **dogs** with catarrh, sore-throat, or distemper, a soothing **febrifuge draught** is made with two ounces spirit of nitrous ether, an ounce spirit of camphor, and three ounces cold linseed tea, treacle and water, or solution of liquorice extract, the dose ranging, according to the size and condition of the patient, from two to four fluid drachms.

SQUILL.

SOILLA. The bulb of *Urginea Scilla*, divested of its dry membranous outer scales, cut into slices, and dried. (B.P.)
Nat. Ord.—Liliaceæ.

The large bulbs of this Mediterranean plant, when sliced and dried, have a faint odour and disagreeable, mucilaginous, bitter, acrid taste. The active principle is a **glucoside—scillain** or scillitoxin—which is soluble in water, acetic acid, and alcohol.

ACTIONS, USES, AND DOSES.—Squill and its active principle, in full doses, are irritants, causing vomiting and purging; absorbed into the blood, they lower the pulse-rate and raise blood-pressure; they are expectorant and diuretic. They resemble digitalis in paralysing voluntary muscle, acting as heart tonics, and producing diuresis. Squills are prescribed chiefly in those catarrhal and bronchial cases in which secretion is profuse. Professor Robertson gave horses the syrup in fʒiv. doses; dogs take ℥ x. to ℥ xv., conjoined, as the exigencies of the case require, with digitalis, ammonium acetate solution, or camphor electuary. The acetate and tincture are used in about half the dose of the syrup.

STARCH.

The farina or flour of seeds, soft cellular roots, and stems (Royle).

Starch is an important member of that dietetic series of **carbo-hydrates**, including gums and sugars, which contain at least six carbon atoms with hydrogen and oxygen in the proportion to form water. Starch is largely present in the cereal grains, in the stems of many plants, and in tubers, being stored in the seeds and tubers for the nourishment of the young plants. **Wheat flour** contains about 70 per cent. of carbo-hydrates, chiefly starch, which receives the special title of amyllum, 10 of proteids with water, and ash. **Oatmeal** contains 63 of starch and about 12·6 of proteids, with traces of a bitter amorphous alkaloid; **barley**, 64 starch, 12 proteids; rice, 83 starch, 5 proteids; **potatoes**, 21 starch, 2·8 proteids. From any of these sources pure starch is got by fine division of the grain or root; sometimes facilitating separation of other plant constituents by fermenting; washing the starch granules from fibrous matters, straining, and drying. The white starch used for medicinal and dietetic purposes is dried in powder or granules. The blue preferred for the laundry is in blocks, splits as it dries into columnar masses, is coloured by addition of a little indigo, and generally contains about 18 per cent. of water.

Arrowroot is the starch of the *Maranta arundinacea*; **sago**, the granular starch from the sago palm; **tous-les-mois**, the large ovular granules from the rhizomes of several species of *Canna*; **tapioca** or cassava is prepared from the expressed juice of the roots of *Manihot utilissima*. **Corn flour** or Oswego is the flour of Indian corn deprived of gluten by a weak solution of soda.

Starch consists of **round or oval granules** comprising a cell-wall enclosing concentric layers of granulose. The large grains from potatoes are about $\frac{1}{300}$ th of an inch in their long diameter; the small rounded grains of rice measure $\frac{1}{3000}$ th of an inch. Starch grains from various sources differ in appearance when examined under the microscope. **Wheat starch** presents a mixture of large and small granules, which are lenticular in

form, and marked with faint concentric striæ surrounding a nearly central hilum. The maize granules are more uniform in size, frequently polygonal, smaller than those of wheat, having a very distinct hilum, but without evident concentric striæ. Rice granules are extremely minute, and nearly uniform in size, polygonal, the hilum small and without striæ. (B.P.)

Starch is insoluble in cold water, has the specific gravity 1.5, and hence is deposited when mixed with water. The cell-wall consisting of cellulose and the contained granulose are isomeric, having the formula usually given as $C_6H_{10}O_5$. When mixed with water above 120° Fahr., the starch grains burst; the granulose, escaping, occupies twenty to thirty times its previous volume, and forms the viscid gelatinous mucilage used by the laundress. A solution of starch when cold gives the characteristic **blue compound with iodine**. Starch, when boiled with diluted sulphuric or nitric acid, is converted into the isomeric but more soluble **dextrin** or British gum, one variety of which is coloured red by iodine. With further action of a weak acid and heat, dextrin takes up water and is converted into **maltose** ($C_{12}H_{22}O_{11} \cdot H_2O$), and eventually into **dextrose** ($C_6H_{12}O_6$) (p. 640).

When starch foods are eaten the unorganised salivary and intestinal ferments gradually crack the granules, and quickly convert the starch through several forms of dextrin into maltose, and eventually into dextrose. These changes are also readily produced by mixing starch paste with crushed malt, the diastase of which develops the fermentative changes. **Animal starch**, or glycogen ($C_6H_{10}O_5$), present in the liver, in blood, and in muscle, exhibits most of the characters of vegetable starch.

ACTIONS AND USES.—**Starch foods** are rapidly digested, especially when cooking or fermentation has cracked the starch cells, or when they have been thoroughly insalivated. Like other such proximate principles, pure starch cannot, however, alone support life for any lengthened period. A **properly balanced dietary** for horses or cattle should contain one part of proteids and five to eight parts of starch or other carbo-hydrates. Active exertion, as in the case of hard-worked horses, or abnormal secretion, as of heavily-milking cows, cause heavy

expenditure of albuminoids, which must be replaced by the food. Growing animals, in order to build up their tissues, require relatively larger supplies of albuminoids than suffice for adults. The starches—mostly converted into sugar—are consumed in the body more quickly and fully than fats. During their oxidation they are the great **source of animal heat**, especially in herbivora. They prevent wasteful consumption of the more costly albuminoids and fats. Under favourable conditions carbo-hydrates in excess are also believed to be directly concerned in the **formation of fat**, and Pasteur states that they furnish glycerine—the basis of neutral fats. For nutritive purposes 17 parts (Voit) to 23 parts (Rubner) of carbo-hydrates are equivalent to 10 parts of fat.

As a **demulcent and emollient**, starch mucilage protects and softens irritable surfaces. In diarrhoea and dysentery it is used about the consistence of cream, at the temperature of 100° Fahr., either alone or with laudanum, sugar of lead, or other astringents, and is given both by the mouth and rectum. It is an antidote for excessive doses of iodine. **Dry starch** readily absorbs water, and hence is a desiccant for wounds and open joints, forming thereon a protective covering. Mixed with equal parts of zinc oxide, it dries and soothes the weeping earlier stages of eczema. Conjoined with carbolic acid or "Sanitas" oil, it forms convenient desiccant antiseptics. One part of starch, heated with five of glycerine and three of water, makes a soothing demulcent. Starch is used for mixing and subdividing medicines, and as a vehicle for their administration. It is employed to stiffen bandages for surgical purposes.

STAVESACRE SEEDS.

STAPHISAGRIÆ SEMINA. The dried ripe seeds of *Delphinium Staphisagria*. (B.P.) *Nat. Ord.*—Ranunculaceæ.

Stavesacre, or larkspur, is a stout biennial herb, two to four feet high, growing throughout the south of Europe. Its officinal oily seeds are brown, wrinkled, irregularly triangular, about a quarter of an inch long and scarcely so broad, and have a bitter, acrid, and nauseous taste. They contain about one per cent. of several alkaloids, soluble in ether and acetic acid, the

most important being **delphinine**, which resembles aconitine and veratrine, slows the pulse and respiration, and paralyzes the spinal cord; and **staphisagrine**, resembling curare, paralyzing the motor nerves and arresting respiration.

ACTIONS AND USES.—The seeds are used for the **destruction of lice**, and hence have been popularly termed louse seeds. Their action is also exerted on the acari of mange and scab. For such purposes one part of bruised seeds is boiled for two hours with twenty to thirty parts of water, making up the water to the quantity originally used. Such a solution rubbed into the skin not only kills pediculi, but also destroys their eggs. Ointments and liniments are made with one part of powdered seeds heated with six or eight of fatty matters. Strong preparations too freely applied, absorbed from denuded surfaces, or licked, as they are apt to be by dogs, are liable to nauseate and prostrate. Occasionally they are conjoined with sulphur and tar.

STROPHANTHUS.

The mature ripe seeds of *Strophanthus hispidus*, freed from the awns. (B.P.) *Nat. Ord.*—Apocynaceæ.

The ripened follicles contain upwards of a hundred oval acuminate seeds, about three-fifths of an inch long and one-sixth of an inch broad, covered with silky hairs. They contain eight to ten per cent. of an active, bitter, crystalline glucoside, **strophanthin**, which is soluble in water and rectified spirit. Similar seeds are got from the *S. Kombé*. A paste prepared from strophanthus seeds is used in Africa as an arrow poison.

ACTIONS AND USES.—The seeds and their active principle are muscle poisons. They augment the contractile power, especially of striated muscles. They resemble digitalis and the bodies of that group (p. 406). They are prescribed as cardiac tonics and diuretics.

Professor Thomas Fraser has carefully investigated the actions of strophanthus and digitalis. The former, he reports, is more soluble, and hence more rapid in its actions; but it is also more quickly eliminated, and its effects are hence less durable, and the cumulative results credited to digitalis are not observed. Its efficacy does not, however, seem to be im-

paired by repetition. Full doses produce less gastro-intestinal disorder and less marked vascular contraction. Both increase the length and power of the heart systole, and hence **strengthen and co-ordinate enfeebled or irregular action**. Both are **diuretic**. Comparing the alkaloids, Professor Fraser found that a solution of one four-thousandth of digitalin paralysed the heart of a frog, but one six-millionth of strophanthin was equally powerful. Strophanthin is therefore the most potent known heart tonic.

Fröhner has experimented on various animals, and concludes that the lethal dose of strophanthus tincture is about half a gramme ($7\frac{1}{2}$ minims) per kilogramme of body-weight. Horses tolerate 100 grammes, dogs 10 to 20 minims of the tincture. Full doses, he states, are **irritant, narcotic**, producing hæmorrhagic gastro-enteritis, colic, diarrhœa, cramp, with some stupor. The cardiac action manifests two stages—(1) diminution of pulse-rate, with rise of temperature; (2) increase of pulse-rate, with diminution of temperature.

MEDICINAL USES.—Strophanthus is prescribed to slow, strengthen, and steady feeble or faulty heart action. Combining cardiac tonic and diuretic effects, it is commended by Fröhner in valvular diseases, hydrothorax, hydropericarditis ascitis, and chronic interstitial nephritis.

DOSES.—Of the tincture, made of one part of seed to twenty of rectified spirit, horses and cattle take $f\text{ʒj.}$ to $f\text{ʒij.}$, and dogs ʒi. to ʒv.

SUGAR.

Sugar is present in many plants; is prepared in France and Germany from **white beet**, in Asia from various **palms**, and in America from **sugar maple** (*Sorghum saccharatum*), and **maize**. The sugar used in this country is chiefly got from the **sugar-cane** (*Saccharum officinarum*), which is extensively cultivated in the West Indies, has a perennial root, and a jointed annual stem six to twelve feet high. These canes are crushed between heavy rollers; the pale green expressed juice, which contains nearly twenty per cent. of sugar, is mixed with a little slaked lime to neutralise acids and precipitate albuminoids, and concentrated in shallow vacuum pans at a temperature not exceed-

ing 140° Fahr. ; the coagulating albumin, entangling impurities, is skimmed off; the syrup is cooled in wooden vats, and dried in the sun, yellow dark-brown crystals of raw sugar are formed, and there drains away a variable quantity of brown uncrystallised molasses.

The raw brown or Muscovado sugar, as imported, sometimes contains forty per cent. of water and impurities. It is **refined** by solution in steam-heated water, mixed with a little milk of lime, animal charcoal, and occasionally with the serum of bullocks' blood. Impurities thus coagulated rise to the surface and are removed; colouring matters are further got rid of by filtration through animal charcoal; the clear syrup is concentrated in vacuum boilers at about 170° Fahr., quickly dried in small crystals, or poured into conical moulds and crystallised as loaf sugar. A hundredweight of raw sugar yields about 80 pounds refined sugar and 16 pounds treacle.

There are two classes of sugars—(1) the **Sucroses** or Saccharoses, which, when dry, have the formula $C_{12}H_{22}O_{11}$, and (2) the **Glucoses**, with the formula $C_6H_{12}O_6$.

Sucrose, saccharose, or cane sugar ($C_{12}H_{22}O_{11}$), like sulphur and arsenious acid, has an amorphous and a crystalline form; its crystals are monoclinic prisms; its specific gravity 1.606; it phosphoresces in the dark, and is dextro-rotatory. It is hygroscopic, soluble in one-third of its weight of water at 60° Fahr., but insoluble in absolute alcohol. When slowly crystallised at about 170° Fahr., by suspending threads in a strong watery solution, to which a little alcohol is generally added, bold prisms of sugar-candy are formed. A strong solution, evaporated and heated to 320° Fahr., fuses, and the vitreous mass can be moulded into barley-sugar. Between 356° and 374° Fahr. sucrose parts with two molecules of water, loses its sweet taste, acquires a dark colour, and becomes caramel, which is used by confectioners and distillers as a colouring agent.

Sucrose in plants is gradually built up from the simpler glucose ($C_6H_{12}O_6$), and, conversely, when acted on by dilute acids or by ferments, such as diastase or yeast, it is again converted into glucose. Sucrose undergoes this change before it yields alcohol.

Maltose ($C_{12}H_{22}O_{11} \cdot H_2O$) is prepared by grinding starch with water, warming it until it gelatinises, and heating with crushed malt, the diastase of which sets up fermentation, causing three molecules of starch to appropriate one of water, and yield one molecule of maltose and one of dextrin. Maltose is also formed during the digestion of starch by the ferments of the salivary, intestinal, and pancreatic juices. It is soluble and readily fermented.

Lactose, or **milk sugar** ($C_{12}H_{22}O_{11}$), is prepared by **evaporating whey** to a syrup and crystallising. It occurs in translucent, greyish-white, hard cylindrical masses of rhombic prisms. It is gritty, and, being less soluble, is not so sweet as the vegetable sugars. It is not directly fermentable. The homœopathic chemists use it for subdividing their medicines.

Glucose, **dextrose**, or **grape sugar** ($C_6H_{12}O_6$), is the variety present in **grapes and other fruit**, and in honey. It is obtained by boiling cane sugar, or acting upon it with alcoholic solution of hydrochloric acid, is formed when starch is boiled with water acidulated with sulphuric acid, and is the variety occurring in blood and urine. It is produced when glucosides, such as salicin, amygdalin, digitalin, &c., are boiled with diluted acid. It is neither so sweet nor so soluble as sucrose, crystallises in six-sided scales, is not charred by sulphuric acid, but forms with it sulphosaccharic acid. It produces a readily crystallisable compound with common salt. Its **distinctive test** is a few drops of cupric sulphate solution, and enough caustic potash to make the liquid blue. When the mixed solutions are gently heated, a red precipitate of copper suboxide goes down if glucose is present, but no reddening or precipitation occurs with pure sucrose unless the solution is boiled.

Lævulose, also termed fructose, is isomeric with dextrose, and is associated with it in most fruits. By keeping, and especially by exposure to light, the more soluble lævulose in fruits and syrups is gradually converted into the more crystalline dextrose. These two sugars are distinguished by the manner in which they turn a ray of polarised light. Lævulose is sweeter than dextrose, is not so readily fermentable, nor does it so easily reduce alkaline and cupric solutions.

Molasses, treacle, theriaca, or sacchari fæx, is the uncrystallised, fermentable, syrupy residue from the preparation and refining of sugar. It has a brown colour, a pleasant sweet taste, and a specific gravity of about 1·4. Molasses is the drainings from the raw sugar; treacle the darker, thicker residue from the moulding process.

Honey or mel, the saccharine secretion deposited in the honeycomb by the hive bee, when first collected is yellow, translucent, and viscid, and consists of variable proportions of sucrose and lævulose. The popular household expectorant **oxymel** is made of eight parts of honey, liquefied by heat, and mixed with one part each of acetic acid and water.

ACTIONS AND USES.—The sugars are members of the **carbohydrate series of dietetic substances** (p. 634), are digestible and nutritive; their important function in all the higher animals is the support of animal heat; they moreover economise the proteids and fats, and directly contribute to the deposit of fat. They are laxatives, demulcents, and antiseptics, and used pharmaceutically as excipients. One or two pounds given to horses or cattle, eight to twelve ounces to sheep or dogs, eight to ten drachms to poultry, increase slightly the amount and fluidity of the fæces, and usually also augment secretion of urine. As a **demulcent** sugar is used in the dry stages of catarrh, in poisoning with salts of mercury and copper, and as a domestic remedy for wounds, and removing specks from the cornea. Its **antiseptic** properties recommend it for preserving many vegetable and some soft animal substances, and for making up various medicines. It increases the solubility of calcium salts (p. 317), and retards oxidation of ferrous compounds (p. 462). The **syrupus simplex**, used for flavouring, preserving, and suspending medicines, is made by dissolving, with the aid of gentle heat, five pounds refined sugar and two pints water, and adding after cooling sufficient water to make the weight of the product $7\frac{1}{2}$ lbs. The specific gravity is 1·330. (B.P.)

Molasses and treacle are often substituted for sugar. They are palatable, digestible, laxative articles of diet, useful for sick and convalescent animals. They are convenient **auxiliary purgatives**, and valuable for hastening the action, preventing

the nausea and covering the disagreeable flavour of active cathartics. Where full doses of physic have been previously given, and their repetition is inexpedient, large and repeated doses of treacle often encourage the action of the bowels, especially in cattle and sheep. As a soothing **antiseptic gargle** for horses, three or four ounces of treacle and an ounce of borax or of potassium nitrate or chlorate are dissolved in a pint of water, and a few ounces slowly administered every hour or two. When cough is troublesome an ounce of belladonna extract may be added. Treacle is a convenient antiseptic excipient for ball masses, imparting a proper consistence, and preventing their becoming dry, hard, or mouldy. The common mass, so largely used as an excipient, is made by thoroughly mixing with gentle heat equal weights of treacle and linseed flour.

Doses, &c.—Of sugar and treacle, as laxatives, horses and cattle take lb.j.; sheep, ℥v. or ℥vj.; pigs, ℥ij. to ℥vj.; dogs, ℥i. to ℥ij., administered with aromatics and salines, usually dissolved in water, milk, or gruel, or mixed with a mash.

SULPHONAL.

DIETHYLSULPHON-DIMETHYL-METHANE $(\text{CH}_3)_2\text{C}(\text{SO}_2\text{C}_2\text{H}_5)_2$

Sulphonal is a complex solid of the methane series, crystalline, colourless, inodorous, nearly tasteless, neutral, melting at 258° Fahr., sparingly soluble in cold water, soluble in fifty parts of cold rectified spirit, in boiling alcohol, and in ether.

ACTIONS AND USES.—In man it is “a useful **hypnotic**, producing sleep, and in most cases having no disagreeable after effects, even when used continuously for a length of time” (Brunton). In men and dogs it is more effectual as a sleep producer than paraldehyde, but less so than morphine. Dogs, whether healthy or sick, taking it either by the mouth or subcutaneously, sleep quietly for six to ten hours (Fröhner). Kaufmann hypodermically injected dogs weighing ten kilogrammes with two grammes, and reports ataxia, shortly followed by calm and profound sleep, and without any untoward effects. He recommends it in canine subjects in neuroses characterised by agitation and hyper-excitability (*Traité de*

Thérapeutique). Horses and cattle resist the hypnotic action as they do that of opium. Instead of calming and paralysing their higher cerebral centres, it primarily and prominently stimulates their motor centres. Fröhner has given it to horses, cattle, and sheep without observing any definite hypnotic action. Large doses (150 to 200 grammes), he states, produce in horses excitement, muscular trembling, spasmodic movements, paresis of the spinal cord and muscles, and are excreted uncombined in the urine. Death is caused by hæmorrhagic ulcerous gastro-enteritis. He records that, while 0·5 gramme per kilogramme of body-weight killed horses and cattle, dogs stood one gramme per kilogramme of body-weight. Horses and cattle receiving 25 to 75 grammes suffered from weakness and trembling, but without narcosis; sleepiness was apparent for a day, but was alternated with greatly increased reflex activity, and even with fits, while numbness sometimes lasted a week.

Doses, &c.—Dogs, the only patients for which it is likely to be used, take grs. x. to grs. xl, prescribed in pill, hot milk, or soup. Owing apparently to its insolubility, its effects are sometimes deferred for twelve or fifteen hours; to ensure hypnosis a couple of doses are accordingly given, at intervals of four or five hours.

S U L P H U R.

Sulphur, or brimstone, is a chemical element, and one of the most ancient articles of the *Materia Medica*. It occurs in many animal substances as sulphates, and notably in bile and the albuminoids; in the strong-smelling volatile oils of the *Cruciferae* and *Umbelliferae*; in various mineral waters as hydrogen sulphide, and in the pyrites or metallic sulphides, from which it is extracted by roasting. The extensive supplies of sulphur required in the manufacture of sulphuric acid, sulphurous acid, gunpowder, lucifer matches, and vulcanised indiarubber, are, however, chiefly obtained from the **native sulphur**, occurring as a product of volcanic action in beds of blue clay in Sicily and Italy.

The crude sulphur is purified by distillation, and when run into wooden moulds forms the stick or **roll sulphur**, which is

yellow, crystalline, and so bad a conductor of heat that it often cracks when held in the warm hand.

Flowers of sulphur, also called sublimed sulphur, are prepared by distilling the crude sulphur, and conducting it in the state of vapour into large chambers, where it condenses in a fine yellow powder consisting of spherical granules.

Precipitated sulphur, or milk of sulphur, is prepared by boiling sublimed sulphur with slaked lime, when calcium sulphide and hyposulphite are formed, and when treated with diluted hydrochloric acid are decomposed, sulphur being precipitated in a finely divided white powder.

Sulphur vivum, caballum, or horse sulphur, the residue left in the subliming pots, must be used with caution, for besides other impurities, it contains arsenic.

PROPERTIES.—Sulphur occurs in six allotropic forms, manifesting differences in physical condition, specific gravity, fusing point, solubility in carbon disulphide, and electric affinities. Most varieties have a yellow colour, a specific gravity of about 2; have little or no taste, until heated are insoluble in water and cold alcohol, and are freely soluble in benzol, carbon disulphide, fixed and volatile oils. All varieties melt at 240° Fahr., are entirely volatilised by heat, inflame at 500° Fahr., burning with a pale blue flame, and giving off suffocating fumes of sulphurous anhydride (SO₂). As it is raised from the melting to the boiling point it exhibits various curious changes.

ACTIONS AND USES.—Sulphur applied to skin or mucous surfaces is a feeble, mechanical stimulant, and hence relieves chronic passive congestion. It destroys parasites infesting the skin. Administered internally it is laxative and alterative.

GENERAL ACTIONS.—It **destroys** the odium **fungus** on vines, and kills similar **parasites** affecting plants and animals. How much of this toxic effect depends on the sulphur acting as sulphur, and how much on the alkaline sulphides, sulphuretted hydrogen, and sulphurous acid, into which it is gradually converted, has not been determined. Sulphur when swallowed is slowly acted upon by the alkaline secretions of the intestines, and small quantities are converted into sulphides, which stimulate the intestinal mucous membrane. A further change is made into sulphuretted hydrogen, which imparts its disagree-

able smell to the secretions of the skin, lungs, and bowels. The mutton of sheep receiving daily several ounces of sulphur is stated to acquire a distinct sulphurous flavour. The greater part of the sulphur swallowed is removed unchanged by the bowels, but a portion is excreted in the urine as sulphates. The alkaline sulphides are sometimes substituted for sulphur, and, like it, are laxative and parasiticide (p. 582).

Toxic Actions.—One pound given to **horses** causes colic, purging, prostration, and sometimes fatal gastro-enteritis (Moiroud). A horse affected with glanders received doses beginning with an ounce, and gradually increased by addition of an ounce daily until the sixteenth day, when he had got 136 ounces. Diarrhœa supervened on the seventh day; but appetite remained throughout unimpaired, the urinary secretion unaffected, the pulse and breathing normal. By the third day the perspiration had a sulphurous smell, and a piece of paper, moistened with lead acetate and laid on the skin, became grey. The muco-purulent discharge from the nostrils increased daily; the patient, though well fed, became gradually emaciated, and so debilitated that by the seventh day he was unable to rise. After the tenth day, the blood, even in the arteries, became dark-coloured, thin, and slow to coagulate. On the seventeenth day the animal was destroyed. The mucous lining of the stomach, colon, and cæcum was reddish-blue, soft, and easily torn. The lungs, muscles, and intestinal contents smelt strongly of hydrogen sulphide, but the blood had no such odour (Hertwig).

MEDICINAL USES.—Sulphur is given to the several domestic animals as a **laxative** where more powerful purgatives might irritate—as in pregnancy, convalescence from acute diseases in young animals, and in piles. Its **alterative** and **stimulant** effects on the skin have led to its use in rheumatism, eczema, and other cutaneous diseases. Some practitioners affirm that it benefits dry, congested conditions of the respiratory membrane by stimulating its epithelial cells and increasing movements of the cilia (Ringer). It has no special vermicide action. The piece of roll sulphur frequently placed in the dog's trough, being insoluble in water, has no effect in preventing, as is popularly believed, distemper and other canine disorders.

Sulphur dusted on the skin slightly stimulates, but when dissolved by admixture with an alkali or oil, and smartly rubbed in, it more actively stimulates the cells of the rete Malpighii, and thus hastens desquamation; while it also increases contractility of the muscular textures, and hence overcomes passive cutaneous hyperæmia (Dr W. Allan Jamieson, *Practitioner*, September 1881). It thus promotes a healthier action in chronic eczema and psoriasis, and in such cases sulphur dressings are with benefit conjoined or alternated with iodine or tar acids, and are aided by the internal use of sulphur and arsenic. Infriction of sulphur ointment is stated to relieve the pain of rheumatic muscles and joints.

For the prompt and effectual cure of **mange and scab** it is essential to reach the female sarcoptes in their burrows. Hair or wool must be closely clipped or shaved; the affected parts freely rubbed with soft soap, allowed to remain on for twenty minutes or half an hour; crusts and scales are thus softened, and removed by subsequent thorough scrubbing with warm water. These preliminary measures are requisite to enable any parasiticide to reach the sarcoptes. But sulphur alone is not a very effectual antisporic. Kückenmeister, however, demonstrated that the parasites, although they lived for several days in sulphur ointment, perished in fifteen minutes in mixtures of sulphur and potash solution. This combination quickly produces hydrogen and other toxic sulphides. Numerous formulæ are in use. Two parts sulphur and one part potassium carbonate are dissolved, with the aid of gentle heat, in ten or twelve of lard or oil. A still more effectual sarcopticide is made by addition of two parts of benzine. Sulphur iodide is very useful for such cases (p. 453). In long-standing mange and scab a second or third soaping, scrubbing, and dressing, at intervals of a week, may be requisite; and in inveterate cases some of the penetrating tar oils, or a mercurial, may be used.

DOSES, &c.—As a **laxative** horses take ℥j. to ℥iv.; cattle, ℥iij. to ℥vi.; sheep and pigs, ℥iv. to ℥j.; dogs, ℥j. to ℥iv. As an **alterative** one-fourth of these doses suffices. The precipitated being more finely divided than the sublimed sulphur, is somewhat more certain and active as a laxative. Sulphur is conveniently administered suspended in gruel, or treacle and

water or dissolved in milk or oil, and is often conjoined with aromatics, salines, or mercurials. For horses or cattle a laxative mixture is made with one to two ounces each of sulphur and cream of tartar, dissolved in water, with half a pound of treacle; one-third of this dose suffices for sheep and pigs; one-sixth part for dogs. A convenient alterative for horses or cattle consists of an ounce each of sulphur and ginger, and half an ounce of nitre, repeated once or twice daily.

The **ointment** usually consists of one part of sulphur and four of vaselin or lard; one-fourth part mercurial ointment is sometimes added. A **liniment** is made with one part of sulphur and six or eight of linseed or other fixed oil; one part of tar oil or of Barbadoes tar is often added. Inveterate cases of grease Professor Williams treats with eight parts of sulphur, four of potassium carbonate, one of carbolic acid, with thirty-two each of lard and olive oil. The dressing is freely rubbed in, allowed to remain on for two or three days, and then washed off with soap and warm water. For itch papules and vesicles in human patients, Dr Tilbury Fox recommends a drachm of sulphur, eight grains each of ammoniated mercury and creosote, twenty minims chamomile oil, thoroughly mixed with two ounces lard. This prescription answers well for similar cases in dogs.

SULPHURETTED HYDROGEN. Hydrogen Sulphide. H_2S .

This colourless, inflammable gas, characterised by its smell of rotten eggs, is given off from various mineral springs, from sewage, and from the putrefaction of organic matters. It is prepared by the action of diluted sulphuric acid on iron sulphide, and if the gas thus evolved is conducted into cold water a solution is obtained which is in constant use as a chemical test.

Toxic Actions.—Like other sulphides, it is destructive both to plant and animal life. Its admixture in the air, arising not infrequently from the burning of imperfectly purified coal-gas, causes the leaves of plants to droop and become flaccid, and from such poisoning they never recover. Animals breathing such an atmosphere, resulting frequently from foul drains, undoubtedly suffer in general health. The soluble gas is liable

to become **absorbed** by any of the mucous surfaces or the skin. In concentrated form the gas reduces and **decomposes the hæmoglobin** of the blood, causing asphyxia, and leading to paralysis of the nervous centres and muscles. In rapidly fatal cases the notable symptoms are those of asphyxia. Artificial respiration and douches, alternately of cold and warm water, with cautious inhalation of chlorine, are the fitting antidotes.

The **soluble alkaline sulphides** in full doses break down blood corpuscles and paralyse the nervous centres. Medicinal doses stimulate the liver, bronchial and mucous glands, increasing their secretions, quicken cardiac action, and are active **parasiticides**.

SULPHUROUS ACID.

ACIDUM SULPHUROSUM. A solution in water of five per cent. by weight of sulphurous anhydride. SO_2 .

When sulphur is burned in air or oxygen, or when sulphuric acid is heated with charcoal, iron, copper, or other deoxidising bodies, there is given off a heavy, colourless, liquefiable, suffocating gas—sulphurous anhydride (SO_2). This gas, in presence of moisture, or when passed into water, evolves heat, and is believed to become true sulphurous acid (H_2SO_3), which is crystallisable ($\text{H}_2\text{SO}_3 \cdot 14\text{H}_2\text{O}$), unstable, and dibasic, forming two classes of sulphites.

The B.P. watery solution contains five per cent. of the gas, is colourless, has a pungent sulphurous odour, reddens litmus, bleaches colouring matter, leaves no residue when heated, and has the specific gravity 1.04. It is distinguished by its pungent odour; when in combination it is liberated by hydrochloric acid. Both the gaseous and liquid forms are used as bleaching agents, especially for woollen and silk goods. Unlike chlorine, they do not destroy colouring matters, but form with them colourless compounds. They have a marked affinity for oxygen, undergoing conversion into sulphuric acid.

ACTIONS AND USES.—Sulphurous acid is antiseptic, disinfectant, and deodorant, and is used as a parasiticide. Concentrated doses, whether in the gaseous or liquid state, are irritant.

GENERAL ACTIONS.—Its value in medicine depends on its affinity for oxygen, and its arresting the growth of micro-organisms. A solution of one part in 8000 of water **destroys diastase and ptyalin**; but although smaller quantities arrest the action of emulsin and myrosin, one part in 1317 is required to destroy pepsin. Developed **bacteria are killed** by one part in 2000 of water; but to prevent reproduction of the spores one part in 325 is needful. Sir Robert Christison found that one-fifth of a cubic inch, diluted with 10,000 volumes of air, destroyed the leaves of plants in forty-eight hours. It prevents putrefaction of the gelatin used in paper-making, and destroys the effluvia of the cochineal dye manufacture. Its antiseptic properties are shared by the sulphites and hyposulphites.

MEDICINAL USES.—Dr Dewar, of Kirkcaldy, greatly extended its applications in human medicine and surgery. With solution, fumigation, and spray, he successfully treated colds in the head, sore-throat, bronchitis, typhoid fever, as well as wounds. In rheumatism he directed the bed-clothes to be exposed to the vapours of burning sulphur, and laid over the patient, when refreshing perspiration was evoked. In analogous cases amongst the lower animals, sulphurous acid has also proved useful. Professor Robertson employed it at Camden Town to check the muco-purulent discharge of equine **influenza**. Professor Williams recommends its inhalation in nasal gleet. It is serviceable in **catarrh, pharyngitis** and laryngitis in horses when the membrane is irritable and relaxed, and the discharges are profuse and noisome. It has been prescribed in hoven in cattle and tympanitis in horses; but two ounce doses of the B.P. solution do not yield the prompt relief which usually follows ammonia or ethereal solutions. In young calves, tympanitic from hasty or careless feeding, ounce doses usually, however, arrest undue fermentation. For dogs, ℥ xxx. to ℥ lx., in water, **check gastric irritation** and vomiting. The **strongulus micrurus** of calves and lambs is usually destroyed by two fumigations, at intervals of a few days. The affected subjects are placed in a loose box; sulphur is burned six feet distant from them, which sufficiently dilutes the gas before it is breathed; unless bronchial irritation is excessive, they may remain in the medi-

cated atmosphere ten to fifteen minutes. The solution, used alone or with "Sanitas" fluid or glycerine, is a good **antiseptic dressing for wounds**. It is useful in the early irritable stage of eczema, especially in dogs. In mange and scab the B.P. solution is used as a parasiticide.

Officers of health, both in Britain and America, bear testimony to the efficacy of sulphurous acid as a **disinfectant**. Its free use is stated to have stamped out smallpox in Iceland in 1871, and arrested scarlet fever at Marlborough College in 1875 (*Practitioner*, May 1877). It appears to destroy more readily the contagium of smallpox and scarlet fever than of diphtheria. Outbreaks of foot-and-mouth disease are believed to have been stayed by it. The gas is readily evolved in the stable or premises to be disinfected by scattering flowers of sulphur over a few embers in a shovel, iron basin, or brazier. It burns best when previously mixed with about one-fourth part of finely-divided charcoal, or when each charge of one and a half pounds of sulphur is treated with an ounce of alcohol, which in burning furnishes a large amount of steam, and thus increases the penetrating and disinfectant power of the gas. Sulphurous acid in concentrated form causes irritation and coughing when breathed either by men or animals, and consequently for thorough disinfection of infected premises animals must be removed, doors and windows closed, and one and a half pounds sulphur burned for each thousand feet of cubic space. Articles of saddlery and clothing should be cleansed by steam-heat, or washed with corrosive sublimate solution. Such articles, freely exposed to sulphurous gas, are bleached, and eventually rotted, from condensation of sulphuric acid. During the prevalence of cattle plague, pleuro-pneumonia, or foot-and-mouth disease, of influenza or glanders in horses, or of distemper amongst dogs, healthy animals, in the same or adjacent premises, should daily breathe for half-an-hour the diluted acid, and be sponged with a weak solution, which will be rendered still more destructive to disease germs if mixed with a little carbolic acid.

DOSES, &c.—Of the B.P. solution horses and cattle take ℥i. to ℥ij. ; sheep and pigs, ℥ss. to ℥j. ; dogs, ℥xx. to ℥lx., given every three or four hours, diluted with water or other

cold bland fluid. It may be continued until the system is saturated and the skin gives off its odour. It is conjoined as required with aromatics, alcohol, ether, or opium. Dr Dewar believed it to be a more effectual antiseptic than either the sulphites or hyposulphites. But it must be freshly prepared and kept in well-stoppered bottles; when exposed to the air it oxidises and becomes irritant from formation of sulphuric acid. For surgical purposes it is diluted usually with three or four parts of water; with this the lint or other dressings are kept saturated; admixture with glycerine renders it more soothing. Baths are readily made by conducting the vapour of burning sulphur into water. In the treatment of mange and other skin complaints, baths or strong solutions are more effectual than fumigation. For disinfectant purposes it may be used with carbolic acid, but not with chlorine or bleaching powder, which neutralise it. **Macdougall's disinfectants** contain sulphites and carbolic acid.

T A R A X A C U M.

TARAXACI RADIX. Dandelion Root. The fresh and dried roots of *Taraxacum officinale*, collected in the autumn from indigenous plants. (B.P.) *Nat. Ord.*—Compositæ.

The dandelion abounds on British roadsides and waste places. The tap-shaped root is about six to twelve inches long, half an inch to an inch thick, is dark-brown externally and white within; it is inodorous, but has a bitter taste. Its active principle is the bitter **taraxacin**.

ACTIONS, USES, AND DOSES.—*Taraxacum* has had a popular reputation as a blood purifier, liver stimulant, and remedy for jaundice. But Professor Rutherford's experiments accord to it only "a feeble hepatic, stimulant action." In virtue of its bitterness, it is a mild gastric tonic, although seldom so serviceable as either gentian or calumba, and it has also slight laxative and diuretic effects. The fresh succus is the best preparation, and the dose for the horse is about fʒi., and for dogs, fʒss. to fʒij.

THYME—THYMOL.

THYME—the fresh leaves and twigs of *Thymus vulgaris*. *Nat. Ord.*—Labiatae.

THYMOL—a stearoptine obtained from the volatile oil of thyme and other Labiatae, and from various aromatic Umbelliferae.

The *Thymus vulgaris* is a bushy evergreen shrub found in dry situations throughout Southern Europe. It derives its aroma from an **essential oil** separable into two parts—(1) the fluid **thymene**, which is isomeric with oil of turpentine ($C_{10}H_{16}$); and (2) the solid **thymol** ($C_{10}H_{18}HO$, or $C_6H_5.C_3H_7.CH_3.OH$).

Thymol is also got from the umbelliferous plant *Carum Ajowan*, and from its several sources may be obtained either by fractional distillation and exposure of the distillate at a low temperature, or by saponifying the volatile oil with caustic soda, and treating the resulting soap with hydrochloric acid. Thymol occurs in large oblique prisms. It requires for solution a thousand parts of water; but is more soluble in alcohol, glycerine, and alkaline solutions. It sinks in cold water, but heated to 110° to 125° Fahr., it melts and floats on the surface. A solution in half its bulk of glacial acetic acid, warmed with an equal volume of sulphuric acid, assumes a red violet colour.

ACTIONS AND USES.—Thymol is antiseptic and disinfectant, diaphoretic and diuretic. Large doses paralyse the nerve centres of the cord and medulla. It has most of the characteristic properties of a volatile oil. Dr Lauder Brunton states that its physiological actions place it between oil of turpentine and carbolic acid.

Solutions of one per cent. **destroy bacteria** and prevent reproduction of their **spores**. Applied to the skin or mucous surfaces it causes irritation, followed by anæsthesia. When swallowed it is slowly absorbed. Dogs weighing 20 pounds and rabbits weighing 7 pounds, receiving respectively 60 and 30 grains injected hypodermically, exhibited lowered blood-pressure and muscular weakness, paralysis of respiration, and coma; but the fatal effect of full doses was frequently averted by artificial respiration. The respiratory mucous membrane

was congested, the lungs were congested and sometimes consolidated, the kidneys inflamed, the urine albuminous, occasionally bloody. In **chronic poisoning** tissue metabolism appears to be impaired, and there is fatty degeneration of the liver, as in phosphorus poisoning. It is **excreted** chiefly by the lungs and kidneys, imparting to the urine a green colour by direct, a brown by transmitted light. **Compared with carbolic acid**, thymol is not so irritant, caustic, or poisonous; when absorbed it does not cause preliminary excitement, but from the first paralyses the nerve centres; as a disinfectant it is stated to be more powerful and permanent.

MEDICINAL USES.—It has been prescribed in vesical catarrh, horses taking grs. x. to grs. xxx.; dogs, gr. ss. to grs. v. But its chief use is in **antiseptic surgery**. Notwithstanding its greater cost, it is sometimes substituted for carbolic, salicylic, or boric acids. For allaying irritation and removing scales in chronic eczema and lichen, one to two grains are dissolved in an ounce of diluted spirit, or of potassium carbonate solution. For such purposes an ointment is also used, made with ten to forty grains to the ounce of vaselin. As a stimulating antiseptic in sore-throat and ozæna, it is used in the form of gargle, spray, or inhalation. It is the active constituent of **Volckmann's antiseptic fluid**, which, with one part thymol, contains ten of alcohol, twenty of glycerine, and a hundred of water.

T O B A C C O.

TABACI FOLIA. Leaf Tobacco. The dried leaves of *Nicotiana Tabacum*. (B.P.) *Nat. Ord.*—*Atropaceæ*.

Tobacco derives its name from *tabac*, the instrument used by the American aborigines for smoking the leaf, from the island of Tobago, or from the town of Tobasco in New Spain. It appears to have been cultivated from time immemorial in America, and is now grown largely in the region watered by the Orinoco, in the United States, and in many temperate and sub-tropical countries of both hemispheres. It was unknown in the Old World—at all events in Europe—until after the discoveries of Columbus; and was first introduced into England

by Sir Francis Drake in 1586. Upwards of sixty million pounds are annually imported into the United Kingdom, more than one-half being from the United States.

The *Nicotiana Tabacum*, which yields the Virginian and several commercial tobaccos, is an herbaceous plant, three to six feet in height, with a branching fibrous root, a tall annual stem, funnel-shaped, rose-coloured flowers, and large, moist, clammy, brown leaves, mottled with yellow spots, covered with glandular hairs, and distinguished by a strong, peculiar, narcotic odour, and a nauseous, bitter, acrid taste. The leaves readily communicate their properties to hot water and alcohol. The plant is cut down in August, and the leaves dried, twisted, and carefully packed, with great compression, in hogsheads. For many purposes the midrib is removed, and occasionally the leaf is fermented, in order to remove albuminoids, which, when smoked, give rise to oils and unpleasant products. Sugar and liquorice are sometimes added to impart mellowness and pliability.

The several manufactured tobaccos owe their peculiarities chiefly to the manner in which they are prepared; the unmanufactured Virginian, being strongest, is generally preferred for medicinal purposes. The leaves for making **cigars** are moistened with salt before being rolled into cylinders. **Snuff** is prepared by cutting tobacco into small pieces, piling it in heaps, and freely wetting it to encourage fermentation. The process continues during eighteen to twenty months; the albuminoids of the leaf meanwhile undergo decomposition, with production of ammonium carbonate, volatile oil, as well as ethers and acids of the acetic series. The fermented product is ground and sifted.

Commercial tobaccos **contain** about 12 per cent. of moisture, 20 to 25 of lignin, and about the same amount of inorganic matters, chiefly salts of potassium and calcium. The chief active principle is **nicotine** ($C_{10}H_{14}N_2$)—a colourless, volatile, inflammable, oily alkaloid, with an acrid odour and taste. It occurs in combination with malic and citric acids, constituting 5 to 7 per cent. of the dried leaf. It is soluble in water, alcohol, ether, the fixed and volatile oils. It is coloured red by sulphuric acid, violet by hydrochloric acid, yellow-orange by

nitric acid. Tobacco also yields, when distilled with water, a crystalline volatile oil—**nicotannin**, or tobacco camphor—produced from oxidation of the nicotine. Tobacco slowly burned, as when smoked, is decomposed, and **the smoke** contains volatile fatty acids and ethers, traces of hydrocyanic acid and ammonia, while the nicotine in great part is converted into two alkaloids of the benzene series—pyridine, C_5H_5N , and collidine, $C_8H_{11}N$ (p. 300).

ACTIONS AND USES.—Tobacco and nicotine are in-contact irritants. They stimulate and then paralyse the spinal cord, the motor nerves of muscles, especially of involuntary muscles, and the nerves of secreting glands. They enfeeble circulation, cause trembling, staggering gait, convulsions, and death from respiratory failure. Tobacco is rarely prescribed internally, but is used externally as an antiparasitic.

GENERAL ACTIONS.—Strong solutions are in-contact irritants of mucous and denuded skin surfaces. Partly from this topical irritant action and partly from stimulating motor nerves they cause vomiting in carnivora. Fuller doses in all animals induce gastro-enteritis with collapse. Nicotine is quickly taken up from absorbing surfaces. Dogs dressed with concentrated decoctions frequently suffer from nausea and vomiting, while human patients have been poisoned by enemata. Small doses cause **muscular tremors**; larger, produce strychnine-like **clonic spasms**, affecting especially the involuntary muscles of the intestines, bladder, and uterus; still larger doses are followed by **muscular paralysis**; death results from paralytic asphyxia. Small doses stimulate the sensitive fibres of the vagus roots, and also its endings in the heart and lungs, slowing the pulse, reducing blood-pressure, and causing dyspnoea. But larger doses both peripherally and centrally paralyse the vagus, quickening the pulse, and increasing blood-pressure. The cardiac ganglia, however, are not paralysed as by atropine. Twofold stimulant and paralytant effects are likewise exerted on the vaso-motor and secretory systems. Small to moderate doses increase the secretions of the skin, bowels, and kidneys.

TOXIC EFFECTS are produced in horses by 9 ounces of tobacco; in cattle by 1 lb.; in sheep by 1 ounce; in dogs by 1 to 2 drachms. The poisonous dose of nicotine for horses

and cattle is 5 to 6 minims, for dogs 1 to 3 minims. One-tenth part of these doses used hypodermically are dangerous (Fröhner and Kaufmann). Hertwig gave **horses** half an ounce to an ounce of the powdered leaves, with the effect of lowering the pulse three to ten beats per minute, and rendering it irregular and intermittent; while a repetition of such doses increased evacuation both of fæces and urine. Large doses, especially intravenously injected, accelerated the pulse, increased action of the bowels and kidneys, and caused irritability and restlessness. A healthy middle-aged **cow** received two ounces dissolved in water, in divided doses, but given within two and a half hours. The temperature of the skin was heightened; the pulse raised from 65 to 70; the breathing quickened and somewhat oppressed; the pupil dilated, while perspiration was abundant. Next day the animal continued dull, but by the third day she was perfectly well. An **ox** consumed about four pounds of tobacco leaves, and speedily became very restive, ground his teeth and groaned, lay with outstretched limbs and distended rumen, passed quantities of thin foetid fæces, and died in eleven hours in convulsions. The leaves were found in the alimentary canal, and the mucous membrane, especially of the fourth stomach, was red and eroded, particularly where in contact with the tobacco. Hertwig further mentions that **goats** are similarly affected by one or two ounces, and generally die in about ten hours.

Orfila administered to a **dog** five and a half drachms powdered tobacco (rappee), ensuring its retention by ligature of the œsophagus. There ensued violent efforts to vomit, nausea, purging, tremors of the extremities, giddiness, accelerated respiration, quickened pulse, convulsions, stupor interrupted by spasms, and dependent on imperfect oxygenation of the blood, and in nine hours death. A decoction containing half a drachm, injected into the rectum of a dog, produced similar symptoms, but was not fatal. Two and a half drachms, applied to a wound, destroyed a dog in an hour. The pupils are contracted, and in fatal cases are insensible to light. A single drop of **nicotine** destroys small dogs and rabbits in five minutes, producing convulsions and general paralysis.

Post-mortem discloses appearances of asphyxia; and in cases

where the crude drug has been swallowed, and has not been immediately fatal, the gastro-intestinal tract exhibits evidences of irritation.

The **treatment of poisoning**, when the crude drug has been swallowed, consists in the use of the stomach-pump or emetics. Tannin renders nicotine insoluble. Keeping the patient warm, and the cautious administration of stimulants, antagonise nausea and depression; while artificial respiration, and the careful hypodermic injection of strychnine, overcome the tendency to death by asphyxia.

Tobacco is **allied to several other motor depressors** of the Solanaceæ, notably to dulcamara and belladonna; but it does not produce that peculiar disturbance of the locomotor centres, and consequent irregular movements, which characterise belladonna, while it increases, instead of diminishing, cutaneous and other secretions, and contracts instead of dilating the pupil. It resembles lobelia or Indian tobacco—the dried flowering herb of *Lobelia inflata*, which is sometimes prescribed for the relief of spasmodic asthma in dogs as well as in human patients. Tobacco is more limited in its paralyzant effects than hemlock, prussic acid, or physostygmine.

MEDICINAL USES.—Tobacco is not now administered internally. There are much better and safer emetics than the quid of tobacco sometimes given to the dog, and numerous more effectual remedies for intestinal worms. Tobacco **smoke enemas**, conveniently given by filling a common barrel syringe by smoke drawn from a well-charged lighted clay pipe, were formerly used to relieve the spasms of colic, of strangulated bowels, as well as contraction of the neck of the bladder, and occasionally of tetanus; but chloroform, chloral hydrate, opium, and other anodynes are more effectual. A one to two per cent. decoction, used as an enema, brings away ascarides lodged in the rectum.

Externally, it is used to **kill** the **acari** of mange and scab, and also **lice**, **fleas**, and **ticks**, but it does not effectually destroy the ova of these parasites. Strong solutions, liberally applied, are apt to cause nausea, trembling, tetanic spasms, and sometimes death, but there is no danger in the careful use of decoctions made with thirty or forty parts of water. For such

purposes the leaves are boiled for half an hour with a limited quantity of water, and the decoction diluted as required. For sheep dips and washes five per cent. solutions are used, their efficacy being increased by addition of soft soap, potashes, tar oils, and occasionally arsenic or corrosive sublimate. Unless, however, the refuse juice of the manufactory can be procured, tobacco is too costly for sheep dips.

TURPENTINES.

TEREBINTHINÆ. *Nat. Ord.*—Coniferæ.

The Coniferæ yield the following drugs—

I. **Oleo-resinous juices** exuding spontaneously or from incisions made into the trunks or branches, consisting of common and Venice turpentine, Canada balsam, frankincense, and Burgundy pitch.

II. **Oil of turpentine** ($C_{10}H_{16}$)—the volatile or essential oil procured from turpentine by distillation.

III. **Resins**—the residue of the distillation of turpentine.

IV. **Tar and pitch**—got by subjecting the roots and wood to destructive distillation.

I. THE TURPENTINES OR CONIFEROUS OLEO-RESINS.

The terebinthinate juices while recently exuded are fluid, or nearly so; but exposure to the air volatilises and oxidises their essential oil, and they solidify. They have a peculiar, pungent, bitter taste and odour, are scarcely soluble in water, are partially soluble in rectified spirit, are soluble in oils, ether, and alkaline solutions; are inflammable, and leave when burnt a finely-divided residue of carbon or lamp black. Several of the more important varieties demand notice.

COMMON OR HORSE TURPENTINE is obtained throughout the Southern States of America, from Virginia to the Gulf of Mexico, chiefly from the *Pinus Tæda* and *P. palustris*, *australis*, or swamp pine, a tree 60 or 70 feet high, having bright green linear leaves about a foot in length, and collected into bundles like those of the *Pinus sylvestris*, or Scotch fir, from which, throughout Northern Europe, turpentine is also procured. During

winter or early spring one to four holes are cut in the bark of each tree, and pockets or boxes are attached capable of holding about a quart of juice. Between May and September the bark above each box is hacked every eight or ten days, in order to tap the oleo-resin cavities and ducts, which in this species lie chiefly between the wood and bark.

BORDEAUX TURPENTINE, chiefly produced in the south-west of France, from *Pinus maritima* and *P. pinaster*, is got by bleeding or hacking the bark, and conducting the juice into suitable vessels placed at the foot of the tree. The trees continue productive for upwards of fifty years, and each yields annually twelve to twenty pounds (Flückiger and Hanbury).

Turpentine from different sources differs somewhat in appearance; the American is dextrogyrate, the German lævogyrate; it is semi-fluid; its consistence varies with the temperature; it gradually solidifies from escape and oxidation of the volatile oil; it has a yellow colour, an aromatic odour, and a warm, pungent taste. Unless melted and strained, it usually contains leaves, twigs, and other impurities. Water acquires its flavour, but separates only traces of its active principles. Rectified spirit and ether dissolve it; eggs and mucilage form with it emulsions convenient for administration. The crude American variety, when recent, yields 15 to 25 per cent. of volatile oil.

VENICE TURPENTINE (*Terebinthina Veneta*) is chiefly obtained in the Tyrol, Switzerland, and Piedmont, from the common larch, the *Abies*, or *Larix Europæa*—a lofty tree with graceful drooping branches, and leaves at first in fasciculæ, like the pine tribe, but afterwards becoming solitary by elongation of the twigs. In winter or early spring a hole is bored reaching the heart-wood, in which the turpentine mostly occurs; the hole is then plugged, and when opened in autumn about a pound of honey-like juice is removed and purified by filtration. It is tenacious, rather opaque, and fluorescent; less apt than common turpentine to concreate with keeping; has a pale yellow colour, an acrid, bitter taste, a disagreeable terebinthinate odour, and contains 15 per cent. of oil of turpentine. The Venice turpentine of the shops almost invariably consists of about three parts of black resin dissolved in one part of oil of turpentine. This artificial mixture is distinguished by its strong

odour, and its more quickly evaporating, and leaving a varnish on a sheet of paper, on which the natural Venice turpentine remains viscid.

CANADA BALSAM, chiefly brought from Lower Canada, is obtained by puncturing the vesicles lying between the bark and wood of *Pinus* or *Abies balsamea*. It is a pale greenish-yellow oleo-resin of the consistence of thin honey, has an agreeable balsamic terebinthinate odour, and a slightly bitter, feebly acrid taste. On exposure it dries slowly into a transparent adhesive varnish, and solidifies when mixed with one-sixth of its weight of magnesia (B.P.) It contains 15 to 18 per cent. of oil, is much used by varnish-makers, opticians, and microscopists, and, with collodion and castor oil, constitutes **flexible collodion**. It is sometimes improperly termed **Balsam of Gilead**, which, however, is derived from an Arabian balsamodendron. **Strasburg turpentine** is a fluid, citron-smelling oleo-resin obtained in the vicinity of the Alps from *Abies picea*. **Chian or Cyprus turpentine**, from the island of Scio, nearly resembles Canada balsam in its properties and uses; it is a greenish-yellow, liquid oleo-resin from the *Pistacia terebinthus*, a tree of the mastic order.

FRANKINCENSE (gum thus or *Thus Americanum*) is the semi-opaque, soft, concrete turpentine scraped from the hacked bark of the *Pinus palustris*, *P. Tæda*, and other American Coniferæ, and which by exposure has lost a portion of its volatile oil. A similar concrete turpentine comes from the south of France under the name of gallipot or barras.

BURGUNDY PITCH is the resinous exudation from the stem of the *Pinus picea* or spruce fir, melted and strained. It consists of an amorphous resin, oil of turpentine, and other isomeric oils, and abietic acid. It occurs in semi-opaque red-brown masses, breaks with a shining conchoidal fracture, and has an empyreumatic turpentine odour and aromatic taste. The substance sold as Burgundy pitch is generally made by melting resin and palm oil and stirring in some water. True Burgundy pitch and its imitations spread upon leather are used for stimulant and adhesive plasters, applied in swellings of joints, chest affections, and rheumatism.

ACTIONS AND USES.—The turpentine are **topical irritants**.

When swallowed they are speedily absorbed, act as **general stimulants**, and are discharged by the kidneys, bronchial membrane, and skin, stimulating the channels of excretion. Their uses resemble those of their more active constituent, oil of turpentine (p. 662). In percentage of oil, and hence in activity, they stand as follows: Canada balsam, Venice turpentine, common turpentine, and frankincense. They are occasionally **used as stimulants** in indigestion, colic, and general debility; as **laxatives**, especially when in combination; and as **anthelmintics**, **diuretics**, and **inspissants** of mucous discharges.

Externally applied, they are **stimulants**, **astringents**, and **antiseptics**, and are used for making up diuretic and stimulant balls. In the south of France the resinous vapours of the Coniferæ have been successfully employed for the relief of bronchitis, phthisis, and rheumatism in human patients. The growing pine forests, and the oleo-resins extracted from them in presence of oxygen, evolve antiseptic camphorous oils and peroxide of hydrogen, which purify the air and destroy disease germs (p. 607).

Doses, &c.—Horses and cattle take ℥j. to ℥iij.; sheep, ℥j. to ℥iij.; pigs, ℥j. to ℥ij.; dogs, grs. xx. to grs. lx. The maximum doses are stimulant and antispasmodic; the minimum, frequently repeated, are diuretic and inspissant. They are administered with milk, oils, linseed gruel, mucilage, eggs, or about one-twentieth part of magnesia. For external purposes they are made into liniments and ointments.

II. OIL OF TURPENTINE. *Oleum Terebinthinæ.*

The crude turpentines when heated, as they usually are, by steam, yield 15 to 25 per cent. of oil of turpentine, sometimes improperly called spirits of turpentine. It is a **mixture of several hydrocarbons** having the composition $C_{10}H_{16}$. It is limpid, with a strong, peculiar odour and a pungent, bitter taste. It commences to boil at about 320° Fahr. According to its source, it varies in its odour, specific gravity, boiling point, and effect on polarised light. It is very inflammable, burning with a heavy yellow flame and producing much smoke. It is

very sparingly soluble in water, more soluble in alcohol, and readily dissolved in ethers, fixed and volatile oils. It is a valuable solvent for resins, fats, many alkaloids, indiarubber, and guttapercha.

It is the representative of a large group of terpenes, including the volatile oils of chamomile, caraway, juniper, lemons, pepper, savin, thyme, tolu, and valerian—all of which have the formula $C_{10}H_{16}$. In common with other terpenes, it is convertible into isomerides, oxidises on exposure to air, forming camphoric peroxide (p. 607); with water produces crystalline hydrates; and with hydrochloric acid forms crystalline compounds. By this action of hydrochloric acid on turpentine artificial camphor is produced.

Terebene ($C_{10}H_{16}2H_2O$) is obtained by the oxidation of turpentine by sulphuric acid; is less disagreeable and acrid to the taste, and optically inactive. It has the same medicinal properties.

ACTIONS AND USES.—Oil of turpentine has the group actions of a volatile oil (p. 243). It is an antiseptic topical irritant, and is used as a rubefacient and vesicant. Large doses are irritant and narcotic. Medicinal doses are antiseptics, stimulants, especially of mucous and skin surfaces, antispasmodics, hæmostatics, anthelmintics, and antiparasitics. It is also prescribed as an adjuvant cathartic, diaphoretic, and diuretic.

GENERAL ACTIONS.—Like other volatile oils, it is an active antiseptic. In destroying bacteria spores, Koch found it more effective than alcohol, ether, chloroform, or benzol. No spores germinated after being wetted with it for five days. It poisons lice acari and other entozoa, whether lodged in the skin, bronchial tubes, or bowels. Applied to the skin it irritates, and, if evaporation be prevented, vesicates, and even ulcerates.

When swallowed it is rapidly absorbed, diffused, and excreted, and may be speedily detected in the chyle, breath, and perspiration, which acquire a strong terebinthinate flavour, and in the urine, to which it imparts the odour of violets. Small doses stimulate, large doses weaken heart action. Full doses first stimulate and then paralyse vaso-motor centres. According to dosage and stage of action, it thus produces a rise or fall of blood-pressure, quickening or slowing of the pulse,

rise or fall of temperature; but respiration throughout is generally quickened. It is **eliminated** by the lungs, acting as a stimulating antiseptic expectorant; by the skin, promoting diaphoresis; by the kidneys, inducing diuresis; while full doses, especially in combination with laxatives, are cathartic.

Toxic Effects.—Large doses when inhaled irritate the respiratory mucous membrane, and reflexly cause difficult breathing. Large doses when swallowed cause gastro-enteritis, and occasionally ulceration of the bowels. A large dose quickly swallowed, as in the case of alcohol, produces brief primary stimulation and prolonged subsequent paralysis of the central nervous system. Rabbits and kittens were paralysed by injection of turpentine emulsion into the stomach. The motor centres are implicated in the same order as in poisoning with members of the alcohol series, those of the brain being first affected, those of the cord later, and those of the medulla last (p. 210). A dog receiving two drachms intravenously staggered, was convulsed, circulation and respiration failed, and death occurred in three minutes (*Christison On Poisons*). During excretion large doses cause congestion and irritate the urino-genital organs, diminish or arrest secretion of urine, and induce strangury and sometimes hæmaturia.

MEDICINAL Uses.—In indigestion, flatulence, and atonic diarrhœa, it checks undue fermentation and acts as a **carminative** and gastro-intestinal **stimulant** and **astringent**. Although an uncertain cathartic when given alone, like many other volatile oils it promotes the action of cathartics, with which it is usefully conjoined in flatulent colic, and in such cases it is also used in enemata. Alike in flatulent and spasmodic colic in horses, it is frequently given combined either with linseed oil or with mucilage and aloes, and in spasmodic cases is conjoined with opium.

As a **cardiac and general stimulant** it is not so effective as alcohol or ether. But stimulating vaso-motor centres and contracting arterioles, it **checks** excessive or faulty **mucous discharges**. Thus, in chronic bronchitis and nasal gleet, terebene gargles and turpentine emulsions and inhalations prove useful, sometimes seconded by turpentine liniments applied externally. The **astringent hæmostatic** effects are also serviceable in

purpura, scarlatina, and in passive hæmorrhages from the lungs, stomach, and bowels, as well as from the kidneys, although in renal cases the drug must be used cautiously and in small doses. In **purpura** in horses, ounce doses are prescribed, with the same quantity of ferric chloride tincture, twice or thrice daily. This prescription, with two drachms potassium chlorate, sometimes benefits farcy subjects, and is useful in many cases of hæmoglobinuria. Chronic rheumatism in all classes of patients is frequently relieved by conjoining turpentine with salines, and in such cases it is also usefully applied externally.

Turpentine, well kept and fully oxidised, as the French variety generally is, contains formic, acetic, and carbonic acids, and is an **antidote for poisoning with phosphorus**. Diffused in the atmosphere of rooms in which phosphorus is prepared for lucifer matches or other purposes, it diminishes the prevalence of necrosis of the jaw and other serious disorders which affect persons working with the yellow phosphorus (Dr Letheby). Phosphorus in repeated doses produces in animals fatty degenerations; but neither this nor other forms of phosphorus poisoning occurred when the drug was given with French turpentine (Köhler). Personne gave phosphorus to five dogs, and all died. To five others, an hour or two after similar lethal doses, he gave turpentine, and only one died. Of five dogs to which he gave turpentine immediately after deadly doses of phosphorus, only one died (Dr. Ringer's *Handbook of Therapeutics*).

In cattle practice full doses are valuable in hoven. Chronic **diarrhœa** and **dysentery**, especially when accompanied by flatulence, are usually benefited by small doses conjoined with lime-water, aromatics, or opium. When contagious pleuropneumonia was subjected to curative treatment, two ounces were sometimes prescribed several times daily. In **puerperal apoplexy** it is given with ammonia carbonate; in **puerperal peritonitis** with laudanum, and in such cases it is also applied as an external stimulant. Mr A. G. Macgillivray, Banff, in **post-partum hæmorrhage** in cows, gives three to five ounces, with six eggs and ginger (*Veterinary Journal*, June 1888). Frequently repeated doses, conjoined with iron salts, check that form of hæmaturia in cattle popularly known as **red-water**.

For the **destruction of intestinal worms** oil of turpentine is generally conjoined with a laxative, and given after the bowels have been emptied by a cathartic, and the patient has been fasted. Although it removes lumbrici and stronguli, it is not in horses a certain remedy for tape-worms, but its efficacy is increased by combination with male shield fern. A tolerably good tænicide for the horse consists of two ounces of turpentine and one ounce of male shield fern extract, dissolved in a pint of linseed oil. For tape-worms in dogs, areca nut and santonin are more effectual and safe than turpentine.

For destroying the strongulus micrurus infesting the air-passages of calves and lambs, turpentine has been widely used. In some sheep-breeding districts of England, thriftless, coughing lambs throughout the summer months, at intervals of a week or ten days, have terebinthinate drenches, given with the view of preventing and curing both thread and tape worms; and such treatment certainly greatly diminishes the scouring and mortality to which lambs in some localities are liable. Six-month calves take half an ounce, lambs of the like age a drachm, of oil of turpentine, conveniently mixed with milk, and administered by the mouth. Two or three doses, at intervals of two or three days, usually effect a cure. Some stock-owners senselessly pour the irritant draught into the nostrils, running much risk of choking the patient. Turpentine inhalations, although fairly effectual, are troublesome to manage. For calves **intratracheal injection** of turpentine has recently been successfully introduced by Mr J. Hutton, of Kelso, who makes a small incision with a knife through the skin, half-way down the neck and between the rings of the trachea, and with a suitable syringe—which any instrument-maker can furnish—injects ℥i. to ℥ij. oil of turpentine, with ℥ss. each of carbolic acid, chloroform, and glycerine, which ensures solution of the carbolic. No serious irritation results. A few paroxysms of coughing occasionally occur. Brought into actual contact with the parasites, the vermicide promptly destroys them (*Veterinarian*, January 1885).

Gapes in poultry, caused by the *Syngamus trachealis*, is successfully treated by a similar mixture, used diluted with four or five parts of milk or bland oil, two or three drops being

placed in the mouth of the ailing fowl. A similar dressing is sometimes applied around the throat, but, although in part absorbed, is not so effectual as when swallowed.

Externally, oil of turpentine is used as an antiseptic, stimulant, and counter-irritant. Rubbed undiluted into the skin of horses, it quickly causes topical irritation, restlessness, and excitement, continuing for twenty or thirty minutes, and, if used largely and repeatedly, it vesicates, and may blemish. Cattle are not so sensitive to its irritant effect, and for them it is sometimes employed to increase the activity of other vesicants. A piece of flannel wrung out of hot water, and sprinkled with turpentine oil, is frequently applied as a **counter-irritant**. A continuous moderate action is more serviceable than a single violent effect. For inveterate eczema and psoriasis, after removal of the scales with soft soap and water or alkaline dressings, turpentine, diluted with one or two parts of bland oil or glycerine and water, sometimes beneficially stimulates the hypertrophied weakened skin, and promotes cure.

It is used as a **stimulant** for rheumatic swellings, more particularly of cattle and sheep; for sprains and bruises after the first pain and tenderness have been subdued by fomentation; for controlling congestion arising from frost-bite, which is not uncommon in the limbs of horses used for night work; for promoting absorption of sitfasts; for healing the troublesome chronic abscesses occurring about the heels of heavy draught horses; for arresting dry gangrene of dogs' ears; and for relieving tedious foot-root in sheep. For such cases it is usually mixed with two or three parts of vaselin, bland oil, or glycerine. A similar mixture destroys lice and other skin vermin, as well as the cryptogamic growths of ringworm. An occasional sprinkling over dogs' beds keeps them free of fleas. It is often added to stavesacre, tobacco, and other antiparasitic dressings. It enters into the composition of various mixtures used by shepherds to protect their flocks from flies and to kill maggots. For such purposes three ounces oil of turpentine, one ounce each of oil of amber, common salt, and mucilage, and one drachm corrosive sublimate, are mixed in a quart of water.

Doses, &c.—For horses and cattle, as a stimulant and anti-

spasmodic, the dose is $f\text{ʒj.}$ to $f\text{ʒij.}$; as a diuretic, $f\text{ʒss.}$ to $f\text{ʒj.}$ As an adjuvant cathartic or anthelmintic the dose is about $f\text{ʒij.}$, combined with aloes in solution, with castor or linseed oils, with iron salts, quassia, gentian, or other bitters. Big adult cattle with impunity take double these doses. Sheep and pigs receive $f\text{ʒj.}$ to $f\text{ʒiv.}$; dogs, ʒxx. to $f\text{ʒj.}$ It is administered dissolved in bland oils, shaken up with linseed gruel or milk, or made into an emulsion with mucilage or eggs. Aromatics, bitters, or ethers are sometimes added.

For **inhalation** half a bucket of boiling water is placed under the patient's nostrils, and an ounce of turpentine placed in it; or, better still, it may be introduced into the steam-kettle, which is almost as serviceable in the treatment of bronchitis in animals as in man. For **enemata**, turpentine is usually diluted with fifty or sixty parts of bland oil; or it is mixed with two or three parts of oil or mucilage to ensure solution, and the requisite proportion of soap and water then added. In diarrhoea or dysentery it is conjoined with laudanum and starch gruel.

For **external purposes** it is usually applied with linseed oil, soft soap, or ammonia liniment. Convenient **stimulant dressings** are made with equal quantities of oil of turpentine, bland oil, and soft soap, or two to three ounces of oil of turpentine are added to a pint of soap liniment. As a stimulant for rheumatism, one part each of oil of turpentine and laudanum is mixed with two or three of linseed oil or soft soap. For dogs, an active embrocation is prepared with an ounce each of oil of turpentine and medicinal ammonia, and six to ten ounces of any bland oil.

OIL OF SCOTCH FIR (*oleum pini sylvestris*) is prepared by distilling the fresh leaves of the Scotch fir or *Pinus sylvestris*. It has most of the properties, and is applied to many of the uses of oil of turpentine.

TEREBENE (p. 662), being less acrid than oil of turpentine, and less liable to act on the kidneys, is sometimes substituted for it, especially as an internal stimulant and antiseptic in excessive mucous discharges, and for relieving flatulence. Externally, it is applied as a stimulant, antiseptic, and deodoriser for many of the purposes for which carbolic acid is used.

III. RESIN, ROSIN, RESINA.

The crude turpentine contains 75 to 90 per cent. of **resin** or **colophony**, developed by a process of oxidation. Crude turpentine, when distilled with a little water, which the resin retains, leaves a residue of yellow or white resin. When the water is removed, the resin becomes transparent, and when more strongly heated is still clearer, and is known as black or fiddler's resin. These turpentine resins are the type of a considerable group of resins, derived chiefly from the vegetable kingdom, distinguished by their appearance, fusibility, inflammability, acidity to test-paper; burning with a smoky flame; insoluble in water, and soluble in alcohol, volatile oils, and alkalis. They unite with fats, wax, and spermaceti, and are largely used in the manufacture of yellow soap. Resin has the formula $C_{44}H_{62}O_4$. Coarsely powdered, and shaken with warm dilute alcohol, it undergoes hydration, and yields 80 to 90 per cent. of abietic or silvic acid ($C_{44}H_{64}O_6$). **Bordeaux resin** or gallipot contains, besides the isomeric, pimaric acid.

ACTIONS AND USES.—Resin is a gentle stimulant, astringent, and diuretic. Two to four ounces, swallowed by horses or cattle, cause diuresis. It is added to diuretic masses to increase their consistence. Externally, it is used as a stimulant, astringent, and styptic. In castration, a few grains applied to the severed spermatic cord, when melted by contact of the hot iron, help to seal bleeding vessels. It is largely used to impart firmness and adhesiveness to stimulant plasters. The simple **digestive ointment** is made with equal weights of resin, yellow wax, lard, and almond oil, melted with gentle heat, strained while hot through flannel, and stirred constantly while it cools. This simple ointment is much used as a lubricant and mild stimulant for wounds, ulcers, blistered surfaces, and for giving bulk and consistence to other ointments.

IV. TAR, OIL OF TAR, AND PITCH.

Tar, or *Pix liquida*, is a thick, viscid, brown-black, aromatic liquid, obtained from the wood of *Pinus sylvestris* and other

pinus by destructive distillation. Mineral or Barbadoes tar has already been noticed (p. 569). Coal tar, obtained from the destructive distillation of coal, is a by-product in the manufacture of gas (p. 569). Two descriptions of wood tar are in use—(1) that got from hard exogens, such as oak, birch, and ash, as a residual product in the making of charcoal for gunpowder; and (2) that more empyreumatic variety imported from Stockholm, Archangel, and America, got by roasting billets of the roots, branches, and refuse coniferous timber stacked in shallow pits dug on a bank or inclined plane. The heaps are closely covered with turf, fire is applied, smothered combustion proceeds, tar runs into iron pots placed at the bottom of the pit, and thence by spouts into the barrels in which it is exported. This old process is being superseded by distillation of the refuse wood in cast-iron stills, whereby nearly double the yield of tar is obtained; 14 per cent. is got from air-dried stems, 16 to 20 per cent. from roots. When wood is thus distilled the condensed products separate into two layers, the upper a mixture of methyl-alcohol, pyroligneous acid, acetone, &c., in water (p. 203); the lower wood tar.

Tar is soluble in ether, oils, and alkaline solutions, but not in water, which, agitated with it, acquires, however, its odour, taste, and brown colour, and constitutes **tar water**, once regarded a valuable medicine. Tar consists of pyroligneous acid, methyl-alcohol, creosote, and various phenols, with toluene, xylene, and other hydrocarbons.

Tar when distilled yields **oil of tar** (*oleum picis liquidæ*), an empyreumatic acid liquid, which, although colourless when first distilled, speedily becomes yellow or brown, and is soluble in alcohol. It contains the more volatile hydrocarbons of the tar. There remains in the retorts **pitch**, or *pix nigra*, a black, bituminous substance, solid and brittle, with a shining fracture, dissolved by the same solvents as tar, and consisting of modified resin, and a colourless, inodorous crystalline substance, melting at 194° Fahr., called *retine* ($C_{18}H_{18}$) (*Flückiger*).

ACTIONS AND USES.—Tar is antiseptic, stimulant, diuretic, diaphoretic, expectorant, and parasiticide. Its active principles being diffusible phenols, it acts not only when applied externally, but produces most of its effects when given internally.

The urine of horses getting tar water keeps unchanged for several days. It is still occasionally prescribed for horses in chronic cough and bronchitis, where the discharges are copious. It is used both internally and externally as a **cutaneous stimulant and antiseptic** in the squamous stages of grease and other forms of eczema, in psoriasis, and in pityriasis, the scaly surfaces being coated daily with undiluted tar, the dressing after several days washed off with soft soap and water, and any refractory spots dressed with mercurial ointment. In chronic eczema one part of tar is usefully added to four of zinc oxide ointment. Tar water is a popular but serviceable lotion for indolent ulcerations and hæmorrhoids. For thrush and canker of the horse's foot tar is used either alone or with copper sulphate, sulphuric or nitric acid.

Mixed with equal parts of fatty matters or soft soap, to impart proper consistence, it forms an excellent **stopping for horses' feet**, keeping the hoof moist and soft, and stimulating secretion of horn. For maintaining the horn in a tough, elastic, and healthy state, Mr Miles, in his useful pamphlet on the *Foot of the Horse*, recommends a quarter of a pound each of tar, bees' wax, and honey, a pound and a half lard, and three ounces glycerine; the lard and bees' wax are melted together, the lard, tar, and glycerine stirred in, and stirring continued until the mass begins to set. For **foot-rot in sheep**, tar has the several advantages of stimulating and deodorising unsound noisome textures, and preventing attacks of flies. It is used for securing wounds, binding up broken horns, and making adhesive plasters.

Oil of tar is sometimes used instead of oil of turpentine. Its empyreumatic constituents confer antiseptic properties: it cures mange and scab, destroys other parasites, is sometimes added to sheep dips, but has the disadvantage of discolouring the wool, does not mix well with the other ingredients, while large doses or strong solutions are apt to become absorbed and cause pulmonary congestion. It is applied for both favus and tinea tonsurans, but is seldom so successful as iodine.

Pitch is used as a mild stimulant in thrush, canker, and sand-crack in horses; in foot-rot in sheep; for giving adhesiveness to plasters; while as a domestic air purifier its empyreu-

matic fumes are occasionally disengaged by inserting a red-hot poker into an iron pot containing pitch.

VALERIAN.

VALERIANÆ RADIX. The dried rhizome and rootlets of *Valeriana officinalis*. Collected in autumn from plants growing wild or cultivated in Britain. (B.P.) *Nat. Ord.*—Valerianaceæ.

The officinal valerian consists of a short yellow-brown tuberous rhizome about the thickness of the little finger, with attached radicles, shrivelled, brittle, and of an earthy-brown colour. It has a penetrating odour, becoming strong and even fœtid by keeping, and a camphorous, unpleasant, rather bitter taste. It contains one to two per cent. of a strong-smelling, active **volatile oil**, isomeric with oil of turpentine ($C_{10}H_{16}$), and the oily, acrid **valerianic acid** ($C_4H_9CO_2H$), which is also present in the berries of the guelder rose, in whale oil, and decaying cheese, and may be obtained artificially by distilling amyl-alcohol with sulphuric acid and potassium dichromate, and treating the distillate with caustic alkali.

ACTIONS AND USES.—Valerian and its volatile oil are topical irritants, stimulants, and antispasmodics. In large doses they paralyse the brain and spinal cord, lower blood-pressure, and slow the pulse. Valerianic acid has no special stimulant action, but is said to resemble acetic acid (Royle). The valerianates accordingly do not exhibit the action of valerian or of the volatile oil.

MEDICINAL USES.—Valerian resembles asafoetida, the other gum-resins, camphor, and the sumbul or musk-root imported from Russia and India, and produced by an umbelliferous plant. It has little effect on horses or cattle, even in doses of several ounces. It is occasionally given to dogs to allay nervous irritability, and relieve chorea and epilepsy; but little dependence can be placed on it. It attracts and excites cats, developing by its suggestive odour their amatory propensities. The volatile oil abates the convulsions of strychnine poisoning, is an anthelmintic, and is excreted by the lungs, skin, and kidneys.

DOSES, &c.—Used for horses or cattle, valerian may be

given in quantities of ℥j. to ℥ij.; for dogs, grs. x. to ℥j.; for cats, grs. v. to grs. l., given in powder or infusion several times daily, conjoined with ginger, gentian, or camphor, or dissolved in spirit of ammonia.

THE VALERIANATES, as above indicated, exhibit the actions of their bases, but not those of valerian. Where it is desired to conjoin the physiological action of valerian with iron, zinc, or other metallic salts, or with quinine, the oil of valerian should be prescribed with a suitable salt of the metallic or vegetable base. The valerianates have been used for dogs and cats in epilepsy, chorea, and nervous excitability, in doses of grs. ij. to grs. v.

Sodium Valerianate, or Sodæ Valerianas ($\text{NaC}_5\text{H}_9\text{O}_2$), is obtained by the oxidation of fusel oil, by distilling it with potassium dichromate and sulphuric acid, and saturating the distilled liquid with solution of soda. It occurs in dry white masses devoid of alkaline reaction, is soluble in rectified spirit, and emits a strong odour of valerian when moistened with dilute sulphuric acid.

Ferric Valerianate is made by mixing, in the cold, solutions of sodium valerianate and iron sulphate. The precipitated ferric valerianate dries as a loose, light-red powder, with a faint odour of the acid, and a styptic taste.

Zinc Valerianate is prepared by dissolving and heating together sodium valerianate and zinc sulphate. On evaporation the zinc valerianate crystallises in white, pearly, tabular crystals, with a feeble odour of valerian and a metallic taste.

Quinine Valerianate, prepared by mutual decomposition of sodium valerianate and quinine sulphate, occurs in silky, needle-like crystals, which have a bitter taste of quinine and a slight odour of valerian, and are dissolved with difficulty in water, but readily in rectified spirit and ether.

VERATRINE.

VERATRIA. An alkaloid, or mixture of alkaloids, obtained from Cevadilla; not quite pure. (B.P.)

It is prepared from the concentrated tincture of the dried ripe seeds of Cevadilla or Sabadilla—the *Schœnocaulon* offi-

cinale or *Asagrea officinalis*—a Mexican liliaceous plant. It is pale grey, amorphous, odourless, bitter, and acrid, insoluble in water, but soluble in spirit, in ether, and in diluted acids. In nitric acid it dissolves, yielding a yellow solution, and, warmed with hydrochloric acid, produces a blood-red colour. Commercial specimens are said to consist of other two alkaloids resembling jervine (p. 624).

ACTIONS AND USES.—Veratrine is a topical irritant and subsequent paralytant, especially of the heart and other muscles, and is sometimes used to relieve rheumatic and neuralgic pains, and as a parasiticide and vermin-killer.

GENERAL ACTIONS.—Rubbed into the skin or placed upon a mucous surface, it causes irritation and then numbness, similar to that produced by aconite, and depending upon irritation, followed by paralysis of sensory nerve endings. When inhaled it induces violent sneezing; when swallowed in considerable doses it causes gastro-enteritis, followed by collapse. It produces prolonged muscular contraction. Muscles which have been exhausted by over-exertion have their powers restored by veratrine. The effect on the heart muscle is the same as on voluntary muscles. Motor like sensory nerves have their sensibility increased, but subsequently their peripheral ends are paralysed. It has no marked action on the brain or spinal cord. Its actions closely resemble those of *Veratrum viride* and *V. album*.

TOXIC EFFECTS.—Magendie found that one grain of veratrine acetate killed a dog in a few seconds when injected into the jugular vein, and in nine minutes when injected into the peritoneum. One to two grains swallowed by dogs caused great uneasiness, nausea, vomiting, violent purging, slowness of respiration, slowness and irregularity of circulation, extreme prostration of strength, spasmodic twitching, and subsequently paralysis of the voluntary muscles, especially those of the extremities, and death from respiratory arrest, usually amid convulsions. Horses swallowing five or six grains, or one-fifth of these doses hypodermically, are salivated, sweat profusely, have trembling of external muscles, and violent contractions of the gastro-intestinal muscles, with efforts to vomit. Similar doses in cattle produce emesis (Kaufmann). The appropriate anti-

dotes are stimulants, warm coffee, potassium carbonate solution, and perfect quiet.

MEDICINAL USES.—From its febrifuge and analgesic actions it has been prescribed in such febrile diseases as acute pneumonia, pleurisy, peritonitis, rheumatism, and laminitis; but it must be used with extreme caution. In persistent cases of shoulder rheumatism in horses Friedberger recommends half a grain to one and a half grains, dissolved in proof spirit, to be hypodermically injected into the affected muscles daily, beginning with the smaller amount, and gradually increasing it, intermitting the treatment every fourth or fifth day, and walking the patient after each injection until the general excitement produced abates. Kaufmann prescribes it in muscular atony and in chronic intestinal catarrh.

Externally, a solution or ointment is used to relieve rheumatic and neuralgic pains, and as an insecticide.

DOSES, &c.—Horses and cattle *per orem* take gr. i. to grs. ij., but hypodermically not more than gr. ss. to gr. j., at least for a first dose. Dogs take *per orem* gr. $\frac{1}{2}$; hypodermically, not more than gr. $\frac{1}{40}$, given in weak spirit.

VERATRUM VIRIDE AND ALBUM.

VERATRI VIRIDIS RHIZOMA. Green Hellebore Rhizome. The dried rhizome and rootlets of *Veratrum viride*. (B.P.)

VERATRI ALBI RHIZOMA. White Hellebore Rhizome. Dried rhizome and rootlets of *Veratrum album*. Not official.
Nat. Ord.—Colchicaceæ or Melanthaceæ.

The *Veratrum viride* is a native of North America, the *V. album* is indigenous in many parts of Continental Europe. Both are perennial liliaceous plants, producing tuberous fleshy root-stalks, which, with the attached rootlets, have a bitter acrid taste, excoriate the mouth and fauces when chewed, and produce sneezing when the powder is inhaled. They contain about one-half of one per cent. of the several alkaloids—jervine ($C_{26}H_{37}NO_3$), pseudo-jervine, cevadine, with traces of veratrine.

ACTIONS AND USES.—Both the *viride* and *album* are **motor**

depressants, closely allied in physiological action to veratrine, and resembling aconite and tobacco. They slow and weaken the action of the heart, and cause muscular weakness, nausea, and in men and dogs vomiting. Fuller doses induce extreme rapidity, weakness, and imperceptibility of the pulse, partial unconsciousness, and collapse. The album is more powerful than the viride.

Professor H. C. Wood states that **jervine** depresses the functions of the spinal cord and cardiac ganglia, producing muscular and cardiac weakness, while concurrently it irritates the motor centres of the brain, inducing convulsions. Death ensues from paralysis of respiration (*U.S.A. Dispensatory*).

Toxic Effects.—Waldinger states that two ounces veratrum album caused in **horses** increased salivation, efforts to vomit, and relaxed bowels. Rytz declares that one ounce induces purgation and gastric derangement. Mr Miller, Bradnoch, in the *Edinburgh Veterinary Review* for 1863, records that a three-year-old filly accidentally ate about two ounces of the powdered root, and in half an hour was in much pain, frothing at mouth, attempting to vomit, heaving at the flanks, with a full pulse, numbering forty; painful spasms, involving especially the muscles of the neck, injection of the mucous membranes of the nostrils and eyes, stiffness in walking, and, after a few hours, partial paralysis of the hind limbs. The filly was bled, and had drachm doses of tannin given in starch gruel. In three hours the symptoms abated, gradual recovery took place, and in four days she was again at work.

Dogs are liable to suffer from absorption of strong dressings. Mr Howard records that liberal application of veratrum ointment causes nausea, sometimes vomiting, accelerated and weakened action of the heart, short, catching, and moaning respiration, prostration, with death sometimes in four hours. Congestion of the mucous membrane of the stomach, lungs, and heart was notable post-mortem (*Veterinarian*, February 1873). The **antidotes** consist in demulcents, diffusible stimulants to counteract cardiac depression, and morphine to relieve nausea and gastric irritation. Infusions of tannin form insoluble compounds with unabsorbed alkaloids.

MEDICINAL USES.—As a sedative in acute inflammatory

diseases veratrum was highly spoken of by Percivall and Morton, who prescribed it for horses in doses of twenty to thirty grains, repeated every four or five hours. But its actions are irregular and uncertain. For neuralgic and rheumatic cases it has been superseded by tincture of aconite. For the destruction of lice, for smearing setons, and as an addition to blisters—objects for which it is still occasionally used—there are more fitting remedies. Active preparations have the disadvantage of sometimes being absorbed and producing untoward constitutional effects.

Doses, &c.—Of the powdered rhizome horses and cattle take ℥ss. to ℥j.; sheep and pigs, grs. xx. to grs. xxx.; dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{3}$, given in bolus, or dissolved in dilute alcohol, and repeated at intervals of three or four hours. It is used **externally** in the several forms of powder, watery decoction improved by a little spirit, and ointment made with one part of veratrum to eight of vaselin or lard. It is occasionally applied with tar or sulphur dressings.

W A T E R.

AQUA. Hydrogen Oxide or Monoxide. H_2O .

Two volumes of hydrogen and one of oxygen, in the presence of a light or an electric spark, unite with explosive force, yielding two volumes of gaseous water or steam. It exists in the solid, liquid, and gaseous forms. The familiar liquid is transparent, neutral, colourless, odourless, and tasteless. A minim weighs .91 grain; a fluid ounce, 437.5 grains. It is the standard of comparison for specific gravities of liquids, its specific gravity being represented as 1 or 1000. It solidifies, freezes, or crystallises at 32° Fahr., expanding and giving out latent heat; it reaches its greatest density at 39°·2 Fahr.; it slowly volatilises at all temperatures; at 212° Fahr. it boils, rising in steam, and increasing in bulk 1700 times. A cubic inch of water becomes a cubic foot of steam. When the solid ice melts, heat is absorbed or becomes latent; when the liquid water boils, or gives off gas, still more heat is absorbed. A cubic foot of water expanding into steam renders latent 900°

of heat. The melting ice or evaporating water, thus abstracting heat from bodies in contact with them, are valuable refrigerants.

Water is a very **universal solvent**; it readily dissolves many mineral matters, gases, and organic substances. From soils and rocks through which it passes it takes up **salts**, especially of calcium, magnesium, and sodium, and occasionally of lead. It absorbs atmospheric air, carbonic acid, and other **gases**, some adding to its sparkling, refreshing, and palatable qualities, others rendering it disagreeable and unwholesome. Gases are more soluble in cold than in hot water; solids, conversely, are generally more quickly and freely dissolved by hot than by cold water. **Organic matters** are present, especially in river and marsh waters, causing them to spoil rapidly when kept, and sometimes to produce diarrhoea and dysentery in animals drinking them. Surface drainage and sewage are apt to introduce vegetable and animal **parasites** and their ova, which give rise to dangerous diseases in animals as well as in man.

Even in potable waters the nature and proportion of the **solid constituents** differ materially. Glasgow derives from Loch Katrine the purest water supply of any large city in the world, containing only three-fourths of a grain of organic matter and one and a half grains of inorganic matters to the gallon. The water of the Thames, supplied to part of London, contains about three grains of organic and sixteen grains of inorganic matters to the gallon. When the mineral constituents, consisting of salts of calcium and magnesium, exceed $\frac{1}{3000}$ th part, the water is said to be hard, and is unsuitable for many pharmaceutic and domestic purposes; it curdles or precipitates soap, instead of forming with it a froth or lather; it forms a brown encrustation on the kettles or furnaces in which it is boiled; it is not so well liked by animals, and is apt to cause diarrhoea and other digestive derangements, especially in subjects unaccustomed to it. When the salts do not amount to $\frac{1}{3000}$ th part the water is considered soft.

The presence of the more dangerous **organic and organised impurities are discovered** by several simple tests—(1) Half a pint of the water is well shaken in a clean, wide-mouthed

bottle; when sewage is present an offensive smell will be perceived on removal of the stopper or cork. (2) In a tumbler of water two or three drops of sulphuric acid are placed, and sufficient Condyl's red fluid to render the water pink. When allowed to stand for fifteen minutes, the water, if containing organic impurity, will have become colourless. (3) Sewage contaminated water usually contains common salt, which may be discovered by silver nitrate producing milkiness (AgCl), which is not removed by a few drops of nitric acid.

For purifying water various methods are adopted. **Subsidence** and decantation get rid of grosser mechanical particles. **Filtration** through sand, charcoal, gravel, or spongy iron removes coarse and organic impurities. **Alum**, even in minute amount, clears turbid water. **Oxidation** gradually destroys disagreeable or dangerous defilements; hence a running stream, contaminated even by sewage several hundred yards lower down, may again become clear and wholesome. **Alkaline permanganates**, by similar oxidation, promptly destroy organic contamination. **Boiling** destroys most noxious vegetable and animal matters, drives off carbonic acid gas, and thus throws down calcium carbonate, the cause of **temporary hardness**. **Sodium carbonate**, or **lime**, as in Clarke's process, diffused through hard water, which is then allowed to settle, abstracts carbonic acid gas, and causes subsidence of calcium and magnesium carbonates, and also reduces the more **permanent hardness** produced by calcium sulphate. For delicate chemical and pharmaceutical purposes, **aqua distillata** is requisite, and distillation leaves behind all impurities except a trace of organic matters, and one to two per cent. per volume of air. Such distilled or other pure water is understood to be used when "water" is ordered for pharmaceutic purposes.

Mineral waters are unfit for general use on account of their undue proportion of mineral matters or gases, or from their being at a higher temperature than that of the locality in which they are found. The most common mineral waters are those containing iron and salines. **Sea water** has a specific gravity of 1027; an imperial pint contains about 312 grains of solid matters, of which about 240 grains are common salt.

ACTIONS AND USES.—Water is nutrient, diluent, antipyretic,

evacuant, and detergent. Introduced into the body in excess of its requirements, it is removed usually within six hours, chiefly by the kidneys, but in less amount by the skin and bowels. When given cold, the kidneys perform the main excretory office; but when used hot, water is an adjuvant diaphoretic, cathartic, and, in dogs and other carnivora, an emetic. Water applied topically, as in the form of hot fomentation, or as the familiar water dressing, is emollient and anodyne, abates congestion of circumscribed inflammation and wounds, and its beneficial effects are also reflexly propagated to adjacent parts. At high temperatures water is an irritant. But steam mixed with air is emollient and soothing. Cold water is refrigerant and tonic. Ice is a prompt and effective refrigerant; it controls congestion and inflammation, especially of the throat, and arrests hæmorrhage from the stomach, lungs, and other parts. Baths are used not only for comfort and cleanliness, but for the cure of disease, and have already been discussed (p. 149).

Water constitutes from fifty-five to sixty per cent. of the weight of the higher animals, and is essential for digestion, absorption, secretion, excretion, and indeed for every vital process. It is largely present **in every kind of food**, facilitating its digestion and assimilation, and replacing the loss of fluid constantly taking place by the skin, lungs, and kidneys. Insufficient and excessive supplies are alike injurious; but animals in health, and with constant free access to water, rarely take more than is good for them. Excepting for a few hours previous to any great exertion, and when hungry, overheated, and prostrated, the horse in health should not be restricted in his water supply. Indeed, in many well-managed modern stables a limited amount of water is constantly at the horse's head, and the daily quantity thus drunk is actually less than when the animal is allowed to slake his thirst three or four times daily. Although a moderate amount of water is essential for digestion, an excessive quantity injuriously dilutes the alimentary ferments, and favours acid fermentation. In animals very thirsty and long deprived of water, drinking too freely may cause destruction of blood corpuscles by osmosis (Ringer).

Horses, especially if tired and hungry, before having a little hay—which, being eaten slowly, is in such circumstances preferable to grain—should receive a few swallows of water, or, better still, a gallon of gruel. In some cab and carrying establishments, each hard-worked horse, on his return to the stable, is provided with a supply of oatmeal gruel, which is found not only to help condition, but to diminish attacks of colic and other gastro-intestinal derangements. A copious draught of water, taken immediately after a rapidly-eaten meal, hurries the imperfectly digested food too rapidly into the large intestines, where it is apt to set up colic and inflammation. **Very cold water** freely drunk, especially by hungry, exhausted horses, is a fruitful cause of gastro-intestinal derangement; and in many establishments throughout winter steam or hot water is introduced into the horse-troughs, or the buckets are filled and brought into the stable several hours before they are required for use.

Water, judiciously used, is a valuable **diluent**, **febrifuge**, and **evacuant**, serviceable in febrile and inflammatory diseases. When given moderately cold, it is more palatable and satisfying than in the tepid state in which it is sometimes presented to sick horses. Rendered feebly bitter with a little cascarilla or quassia infusion, secretion is encouraged and thirst is more effectually quenched. Small portions of ice placed in the mouth are sucked by most animals, and promote secretion, abate thirst, and also relieve congestion and irritation. Horses greedy of water, and especially those with damaged wind or liability to acidity or diarrhoea, should be supplied with small quantities and often, while, further to relieve thirst, the food should be damped. After a cathartic dose, and until the physic has ceased to operate, even moderate draughts of cold water in many horses cause griping. Calves and lambs, feverish and purging, soon kill themselves if they have free access to water.

As a **diluent**, water mechanically relieves choking and coughing; dilutes corrosive and irritant poisons; assists the action of diaphoretics, diuretics, and purgatives. Tepid water is a convenient **auxiliary emetic** for dogs and pigs. Injected into the rectum, warm water allays irritability of the bowels

and urino-genital organs, and promotes the action of the bowels. Water, whether cold or hot, checks bleeding; but is most effectual at a temperature of about 120° Fahr. Injected into the vagina, it stays discharge of blood or of leucorrhœa. A good scrubbing with tepid water and soap is a very essential preliminary to the successful treatment of mange or scab. It removes scales and dirt, abounding especially in inveterate cases, and hence facilitates access of the special dressings to the burrows of the female sarcoptidæ.

Water is the important constituent of **emollients** (p. 52). **Hot fomentations** (p. 159) moisten, soften, and relax dry and irritable textures, and relieve tension, tenderness, and pain. Applied early, and continued for several hours, they control or prevent congestion or inflammation of strains and contused wounds. Their external application, by reflex action, often soothes irritated or inflamed internal parts. In this way fomentations allay the pain of colic and inflammation of the bowels. Steaming the head and throat in like manner often relieves catarrh, sore-throat, and strangles. Professor Williams insists on the value both of steaming and hot fomentations in laryngitis, croup, and bronchitis, and prefers fomentations to counter-irritants in pneumonia and pleurisy (*Principles and Practice of Veterinary Medicine*).

Soothing watery vapour, medicated, if need be, with laudanum, belladonna, ether, vinegar, sulphurous acid, or alkaline hypochlorites, is readily evolved from a steam-kettle, from a well-made bran mash, placed in a roomy nose-bag, or from a bucket of water, from which steam is driven off by plunging a hot iron into it at short intervals.

Water-dressings, consisting of several folds of lint or tow, saturated with hot water, and covered with oiled skin, mackintosh, or guttapercha cloth, to retard evaporation, or a sheet of well-soaked spongio-piline, are frequently substituted for fomentations and poultices, and are usually preferable, especially to poultices, on account of their lightness, cleanliness, and less tendency to sodden and injure adjacent parts.

Water, nearly boiling, is a prompt and powerful **counter-irritant**, especially useful in cattle practice. It is laved over the part either with a sponge or piece of flannel. When

applied to the chest or abdomen of horses or cattle, several folds of thick woollen horse-rug are sometimes placed round the patient, and hot water from time to time poured amongst the folds. The counter-irritation thus rapidly developed, in careful hands, does not blemish, and frequently proves of service in the first stages of pneumonia and pleurisy, in colic, enteritis, peritonitis, and obstinate constipation, alike of horses and cattle.

Cold water is a useful **refrigerant**. When the acute congestion, heat, and tenderness of bruises, strains, and wounds have been so far abated by hot applications, cold exerts wholesome refrigerant, tonic, and constringing effects. Calico bandages, constantly wetted, relieve chronic strains, jars, and windgalls in the legs of horses. Cold water is also serviceable in broken knees, open joints, and circumscribed burns and scalds; these wounds should not, however, be directly wetted, but kept covered by folds of antiseptic lint, constantly wetted. Such continuous irrigation is readily effected through a small vulcanised indiarubber pipe, brought from a supply tank on a higher level. Cold water similarly supplied keeps at low temperature the swabs around the coronets and feet of horses suffering from laminitis.

Cold water dashed over the head and neck is a **powerful stimulant**, serviceable in migrains, sunstroke, phrenitis, convulsions, syncope, and the comatose stages of milk fever in cattle, as well as in poisoning with alcohol, chloroform, opium, and prussic acid. The shock is increased when very cold water is used, and when it falls on the patient from a height of several feet. Such cold affusion must not, however, be long persisted with, as it quickly abstracts animal heat. Equally effectual results are more safely attained by alternately douching with cold and warm water.

Ice in small fragments, placed in the mouth, is readily sucked by most animals, and often **relieves inflammation** of the tongue and throat, and irritability of the stomach, especially in dogs. Applied usually in a bag or bladder, it is serviceable in inflamed and prolapsed uterus and rectum, in piles, hernias, in those violent bleedings which occur at the time or shortly after parturition, as well as in phrenitis and puerperal apoplexy in cows. Two parts of ice mixed with one of salt form a

powerful freezing mixture of the temperature of 4° Fahr. Snow or ice is applied to retard the sudden rise of temperature and consequent gangrene in frost-bite, to arrest circumscribed congestion and inflammation, to check bleeding and stop convulsions. Ice remaining in contact with the skin for six or eight minutes removes sensation, so that opening of abscesses, neurotomy, and such operations, may be performed without pain; but for inducing local anæsthesia, cocaine or ether spray is preferable. The curative effects of the ice-bag applied to the spine have already been referred to (p. 161).

W A X.

Prepared from the honeycomb of the hive bee (*Apis mellifica*).

Bees' wax is furnished from the glands on the ventral scales of the bee. After removal of the honey, the comb, pressed, fused in boiling water, strained, and poured into moulds, constitutes **yellow wax**, which has a dull yellow colour, a granular fracture, a slightly sweet and pleasant taste and odour; it should be free from greasiness; it is insoluble in cold rectified spirit, but entirely soluble in oil of turpentine. **White wax** is made by melting yellow wax with steam, straining, and decolorising it by exposure in thin ribbons for one or two weeks to air and sunshine, or by boiling with nitrate of soda and sulphuric acid.

Wax has the specific gravity .960 to .965, is tough and solid, insoluble in water, soluble in fixed and volatile oils, and in about twenty parts of boiling alcohol, melts at about 145° Fahr., and readily unites with fats and resins. It consists of nearly two-thirds of **cerin**, an imperfectly saponifiable waxy substance; about one-third of **myricin** or melissyl palmitate, a body analogous to spermaceti, and about five per cent. of **cerolein**, a soft acid fat. Chinese wax is the product of an insect of the cochineal tribe. Wax is also produced by several plants.

ACTIONS AND USES.—Wax, although allied to the fats, is much more difficult of digestion, less nutritive, and less demulcent and emollient. Melted with egg or mucilage, it is occasionally prescribed to correct diarrhœa. Its chief use, however,

is to increase the consistence and prevent the rancidity of **ointments, cerates, and plasters**. Yellow wax, mixed with hogs' lard, or any of the bland fixed oils, is much used for investing abraded or irritable surfaces, protecting the sound skin from acrid discharges, and preventing corrosives or blisters extending their effects beyond the parts to which their action is to be limited. The **unguentum simplex** is usually made with one part of yellow wax to four of prepared lard, or one part of wax to one and a half each of almond oil and benzoated lard.

ZINC AND ITS MEDICINAL COMPOUNDS.

Metallic zinc is obtained by roasting zinc blende, which is a native sulphide, or calamine, which is a native carbonate. Zinc, alloyed with nickel and copper, yields German silver; when alloyed with copper, it yields brass. A coating of zinc on iron prevents rusting, and constitutes galvanised iron. Zinc is a bluish-white metal, brittle at low and high temperatures, but between 212° and 300° Fahr. it is ductile and malleable. It is diatomic; its salts are colourless.

The tests for zinc salts are—no precipitate with hydrochloric acid, or with hydrogen sulphide in presence of hydrochloric or other mineral acids. Ammonium sulphide precipitates the white zinc sulphide (ZnS), soluble in dilute mineral but not in acetic acid. Caustic potash and also ammonia precipitate the white hydrate $Zn(OH)_2$, soluble in excess of the precipitant. Potassium ferrocyanide gives a white precipitate of zinc ferrocyanide $Zn_2Fe(CN)_6$. Zinc salts fused with sodium carbonate leave a mass which burns with a white flame fringed with green.

ACTIONS AND USES.—Zinc salts coagulate albumin, and hence are **astringents**. As solids and concentrated solutions, several, moreover, unite with water, and hence are **caustics**. Although not affecting the unbroken skin, when applied to mucous membranes small doses are astringents, large doses are irritants. The chloride, nitrate, and iodide are readily soluble and diffusible, and hence are active and corrosive. The sulphate and acetate, although less energetic, have more activity than the less soluble

oxide or carbonate. The sulphate and acetate are prompt **emetics** for dogs and other animals that vomit; unlike tartarised antimony, cause little depression of the circulation, and produce emesis, partly by local action on the stomach and partly by stimulating the vomiting centre in the medulla. They are **absorbed** probably as albuminates, and act as **nerve tonics, astringents**, and anhidrotics, while continued full doses produce symptoms allied to those of poisoning by copper or lead. They are eliminated more rapidly than mercury, lead, or copper, in small quantity by the kidneys, but chiefly by the liver and intestinal glands (Bartholow).

ZINC OXIDE. Zinci Oxidum. Oxide of Zinc. ZnO.

When metallic zinc or the carbonate is exposed to a red heat in earthen chambers through which a current of air is maintained, the oxide is produced—a soft, nearly colourless, tasteless, inodorous powder, insoluble in water, but soluble without effervescence in acids and in alkalies. When heated it becomes yellow, but if free from iron nearly loses its colour on cooling. Under the names of zinc or china white it is sometimes substituted for lead oxide for painting; has the advantage of being non-poisonous and not dissolved by hydrogen sulphide, but the disadvantage of not mixing so readily with oils, thus rendering the paint more liable to peel off.

ACTIONS AND USES.—It is a desiccant and protective, but, being insoluble in water, it acts mechanically unless dissolved by an acid, when it is mildly astringent. It is occasionally prescribed in catarrh and bronchitis for the arrest of profuse secretion, is a nerve tonic, and is given to dogs in epilepsy.

It relieves cutaneous tenderness and itching. In exudative erythema, in which it is often desirable to avoid moist dressings, it is dusted over the tender surface mixed with four to six parts of kaolin, "Sanitas" powder, or starch flour. In many cases of erythema it is usefully conjoined with glycerine, vaselin, or soft soap. Acute vesicular eczema is often successfully treated by a thorough soaking with mercurous oxide wash and the subsequent in-rubbing of zinc oxide ointment or oleate. Where there is much tenderness or itching such

dressings are mixed with or followed by application of morphine oleate. After cleansing the meatus the ointment is useful in canker of the ear of dogs, and in diseases that simulate it.

Doses, &c.—Horses and cattle take ℥ij. to ℥iv.; dogs, grs. ij to grs. vj., given in bolus or solution. For external use **aqueous solutions** are made with equal parts of zinc oxide and of borax or other alkaline salt or glycerine added to ensure solution, with ten to thirty parts of water. It is also used with subnitrate or oxide of bismuth. **Liniments and ointments** are prepared with one part of oxide to five or six of olive oil, vaselin, or other fatty matters. Some cutaneous complaints, in which ointments freely used are apt to impair secretion and excretion, and others which should not be wetted, are satisfactorily treated by **pastes or powders**. Zinc oxide suits well for such purposes, and may be applied mixed with kaolin, silicious earth, magnesium carbonate, or starch.

ZINC CARBONATE. Zinci Carbonas. Carbonate of Zinc.

Calamine, the native carbonate, is an important ore of zinc. The B.P. carbonate—white, tasteless, and insoluble in water—is usually prepared by boiling together nearly equal weights of zinc sulphate and sodium carbonate, and is a mixture of carbonate and oxide with water of crystallisation ($\text{ZnCO}_3(\text{Zn}_2\text{HO})_2 \cdot 3\text{Aq.}$) Its uses are identical with those of the oxide.

ZINC SULPHATE. Zinci Sulphas. Sulphate of Zinc. White Vitriol. $\text{ZnSO}_4 \cdot \text{H}_2\text{O} \cdot 6\text{Aq.}$

Zinc blende, the native sulphide (ZnS), when roasted, yields a crude sulphate. The B.P. salt is got by dissolving granulated zinc in diluted sulphuric acid, getting rid of any iron or tin by chlorine solution, and adding zinc carbonate. It occurs in colourless, transparent, long prisms, isomorphous with those of Epsom salt, with a styptic metallic taste, and efflorescent in dry air. It is insoluble in alcohol, soluble in less than its own weight of boiling water, and in about twice its weight at 60° Fahr. Heated, it melts in its water of crystallisation,

six of the seven water molecules are expelled; at higher temperatures it is decomposed, and oxide is left. Any metallic impurities are deposited on a strip of metallic zinc placed in the solution.

ACTIONS AND USES.—It is irritant, emetic, astringent, antiseptic, and nerve tonic. It is used externally as a stimulant, astringent, and antiseptic.

TOXIC ACTIONS.—**Powerful astringent** effects are produced on **horses** by sixty to seventy-five grains; three to five drachms dry the buccal and gastro-intestinal secretions, and cause nausea, colic, and efforts to vomit (Tabourin). Two horses had each half an ounce daily for a fortnight without marked effect, but larger doses impaired appetite, and caused nausea and diuresis (*Veterinarian*, January 1844). Somewhat larger doses produce similar effects on cattle. **Dogs** receiving seven to thirty grains promptly vomit; but the act is seldom accompanied by the nausea and depression produced by tartar emetic. Orfila found that seven and a half drachms were vomited by **dogs** in a few seconds, but produced no lasting bad effects. When vomiting, however, was prevented by ligature of the œsophagus, much smaller quantities sufficed to destroy dogs, in about three days, from gastro-enteritis. Thirty grains in solution, injected into the veins, depressed the action of the heart and destroyed life in a few seconds (*Christison On Poisons*). Repeated doses are detected in the spleen, liver, fæces, and urine. Unlike lead or mercury, it exhibits no cumulative action.

MEDICINAL USES.—As a **tonic** it resembles, but is inferior to, iron and copper sulphates. As an **astringent**, compared with lead or silver salts, it contracts capillary vessels more powerfully. It is sometimes prescribed with opium in diarrhœa and dysentery, but is less serviceable than copper sulphate or lead acetate. For arresting spasmodic diseases in the lower animals, it is not so effectual as copper sulphate, arsenic, or quinine. It checks acute chorea in dogs in good condition; but iron is better in chronic cases associated with debility. For drying **excessive discharges**, especially from the alimentary canal, and for checking undue perspiration and hæmorrhage, frequent small doses are given with sulphuric acid and opium. As a safe and prompt **emetic** it is prescribed for dogs and pigs to

empty the stomach of undigested food, foreign bodies, and poisons.

Externally, it is much used as a **stimulant** and **astringent** in weakly, over-secreting wounds, in foul ulcers, simple ophthalmia, relaxed sore-throat, irritable conditions of the mucous membrane of the uterus or vagina, vesicular and pustular skin eruptions, and interdigital inflammation in sheep. Where powerful astringent and caustic effects are sought, the zinc sulphate is conjoined with that of copper or iron, or with both. Mr Malcolm, of Birmingham, in his successful treatment of canker in the foot of the horse, uses a dressing of equal parts of zinc, copper, and iron sulphates, with carbolic acid, and vaselin sufficient to form a paste.

DOSES, &c.—As an emetic for dogs and pigs, grs. viij. to grs. xv. are given in two or three ounces of water. As an astringent and tonic for horses and cattle, ℥ss. to ℥ij.; for sheep, grs. x. to grs. xx.; for dogs, grs. j. to gra iij. are given, either in the solid or fluid state. **Externally**, it is used in powder or solution, usually made with thirty to sixty parts of water. Three-quarters of an ounce of zinc sulphate and an ounce of lead acetate, dissolved in a quart of water, constitutes the **white lotion** so familiar in veterinary practice, but for most purposes this strong solution requires further dilution.

Zinc sulpho-carbolate is sometimes used as an antiseptic and astringent, two to five grains being dissolved in an ounce of water (p. 345).

ZINC CHLORIDE. Zinci Chloridum. Butter of Zinc. $ZnCl_2$.

When metallic zinc or the oxide is boiled in hydrochloric acid, the solution evaporated to dryness, and the residue melted, there remains the greyish-white, opaque, waxy-looking deliquescent chloride, usually moulded into sticks, possessing an astringent metallic taste, and soluble in water, alcohol, and ether.

ACTIONS AND USES.—It is an irritant and corrosive poison. Medicinal doses are antiseptic, astringent, and tonic; but it is scarcely ever given internally. Externally, it is applied as a

stimulant, astringent, caustic, and parasiticide. It is also used as an antiseptic, disinfectant, and deodoriser.

SURGICAL USES.—From its strong attraction for water, and its coagulating albumin, it is an **energetic caustic**. It resembles mercuric and antimony chlorides. It is used to control luxuriant granulations, unhealthy ulcerations, and foot-rot in sheep, and for such purposes is sold in pencils similar to those of silver nitrate. To remove malignant growths and slough away the cartilaginous secreting surfaces of fistulas, it is introduced, usually mixed with two parts of flour made into a paste with water. Unlike arsenic or mercury salts, it is not liable to undergo absorption and produce constitutional mischief. Strong solutions, containing eight or ten per cent, secure the aseptic state of foul or envenomed wounds, and are serviceable where repeated dressings are inadmissible, and the volatile carbolic acid cannot be conveniently replaced. Solutions of two to three per cent. are used for ordinary astringent purposes and for the destruction of skin vermin.

Like mercuric chloride, it is serviceable for keeping animal tissues for dissection. Its antiseptic effects are exerted even in the presence of considerable quantities of water, which interfere with the efficacy of the tar acids. Besides preventing and arresting putrefaction, it also decomposes hydrogen sulphide, ammonia, and other offensive products of decay. **Sir William Burnett's disinfecting and antiseptic fluid** contains twenty-five grains zinc chloride in every fluid drachm, and is ordered to be used in the proportion of one pint to five gallons of water.

ZINC ACETATE. Zinci Acetas. Acetate of Zinc. $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{Aq.}$
or $\text{Zn}(\text{CH}_3\text{CO}_2)_2 \cdot 2\text{Aq.}$

Zinc acetate is prepared by dissolving metallic zinc, its oxide or carbonate, in dilute acetic acid. It crystallises in colourless, odourless, pearly, rhomboidal plates, which have a sharp, disagreeable, metallic taste, are readily soluble in water, and, when heated with sulphuric acid, evolve the characteristic acetous odour. It is the active constituent of the **white lotion** so much used by the late Professor Dick.

ACTIONS AND USES.—The acetate closely resembles the sulphate. It is emetic and nerve tonic, but is seldom used internally. Externally, as a stimulant and astringent it dries excessive serous and pustular discharges, relieves erythema, eczema, and impetigo, as well as conjunctivitis and other superficial inflammations. Professor Tuson (*Veterinary Pharmacopœia*) recommended a solution for saturating at short intervals the wash-leather bandages applied to the jarred, swollen legs of hunters. According to the purposes for which it is used, two to twenty grains are dissolved in the ounce of water.

INDEXES.

INDEX OF DISEASES AND REMEDIES.

ABORTION.

Slipping; Premature birth—(1) Accidental cases caused by rough treatment, falls, railroad journeys, acute indigestion, ergotised food; occur in all domestic animals. (2) Epizootic cases depending upon a microbe present in the uterine discharges and amniotic fluids of animals which abort; chiefly occur in cows and ewes.

Isolate aborting from pregnant animals.

Burn, thoroughly disinfect, or deeply bury fetus and placenta.

Cleanse and thoroughly disinfect premises in which animal has aborted.

Irrigate with effectual germicides uterus, vagina, external organs, and tail root of every animal aborting.

One part corrosive sublimate, 40 common salt, 4000 clean rain-water, or one part each mercuric iodide and pot. iodide in 1000 water, safe and effectual.

With this solution irrigate repeatedly vagina, external genitals, and tail root of animals that exhibit premonitory symptoms.

Wash similarly external genitals and tail of gravid animals that have herded with those aborted.

Animals which have aborted should be fed, for the microbes are dislodged with difficulty, and fresh generations are liable in subsequent conceptions to repeat their attack (Nocard).

Prevent use of bulls with balanitis or suspicious discharge.

ABSCESS.

A circumscribed swelling containing pus.

Fomentations, poultices, water dressings relieve tension and pain.

When maturing tardily, apply counter-irritants—mercury oleate or iodine around or adjacent.

Evacuate when ready with knife, especially when deep-seated.

When deep-seated, superficial parts, before opening, may be anaesthised with cocaine or ether spray.

Dress antiseptically.

Healing of chronic abscess when opened hastened by antiseptic injection.

Belladonna inunction relieves pain.

Salines, sulphides, belladonna internally tend at outset to abort abscess.

Alkaline sulphides internally in more advanced stages hasten suppuration.

ACAR. MITES. See MANGE and SCAB.

Their secretions produce skin irritation, itching, occasionally eruption.

Soft soap, alkalies, and hot water cleanse skin, remove scales, and lay bare burrows.

Soaking with oil and alkali facilitates removal of crusts.

As parasiticides rub in sulphur, or sulphur iodide ointments, mercury oleate, carbolic or tar oils, stavesacre, or corrosive sublimate solutions.

For dogs—anisseed or other volatile oils, wood tar oils.

For sheep—solutions of tar oils, arsenic, corrosive sublimate, tobacco.

Separate affected from healthy. Narrowly watch suspected. Disinfect premises, racks, rubbing posts, &c.

ACTINOMYCOSIS.

Clyers: A vegetable parasite found on barley and other plants, thence introduced into the bodies of animals, probably through abrasions in the mucous or other membranes, producing granulomata, nodules, or tumours; found chiefly on the tongue and jawbones of cattle, spermatic cord of horse, udder of sows, &c.

In early stage excise diseased structures.

Scrape and dress with iodine tincture, iodoform, a mixture of iodine, carbolic acid, and glycerine.

Administer full doses pot. iodide for month.

Precautions to prevent transfer of parasite to man or other animals.

Generous diet; tonics.

ACIDITY OF STOMACH.

Pyrosis. Occurs in all animals, notably when under artificial conditions. Change of food, which should be digestible, unstimulating, and rather restricted in amount.

Half dose of physic will remove any irritant.

Mineral acids, given before or with food.

Alkaline bicarbonates as palliatives.

Lime water and chalk when diarrhoea present.

Magnesia or magnesium carbonate when constipation present.

Place a piece of whiting and of rock salt in horse's manger.

Conjoin antiseptics with antacids when associated with flatulence.

Bismuth and opium when accompanied by irritation.

Gentian, nux vomica, and other bitters when resulting from atony.

Silver oxide, tannin, lead acetate, when associated with gastric catarrh.

ACNE.

Inflammation of sebaceous follicles and glands, leading to eruption of pimples, usually produced in horses by bad fitting and dirty harness. Hot fomentations; water dressing; alkaline solutions, such as saturated solution sodium bicarbonate, borax, glycerine and water, or sulphur iodide.

See to fitting and proper lining of harness.

Sulphur, both locally and internally. Belladonna extract, hydrocyanic acid, or Goulard's extract relieve local irritation.

Salines and arsenic internally in chronic cases.

ACNE CONTAGIOUS OF HORSES.

Has been called *Variola equina*: A vesiculo-pustular contagious eruption, stated by Professor Axe to have been imported into England in 1887 with Canadian horses.

The sick isolated, and premises, harness, and stable appliances disinfected.

"Sanitas" carbolic or corrosive sublimate solution applied.

AFTER PAINS.

Post-partum pains; Heaving.

Remove placenta and clots from uterus; raise hind-quarters.

Syphon into uterus antiseptics and anodynes—carbolic acid, Condy's red fluid, mercuric iodide or chloride, with belladonna and opium.

Ergotin hypodermically, if uterus flaccid and dilated.

Administer chloroform or chloral, with cannabis indica or belladonna.

Morphine and atropine hypodermically in persistent cases.

Laxatives and enemata to empty bowels; draw away milk.

ALOPECIA.

Baldness depending on faulty nutrition of skin and atrophy of hair bulbs.

Oleaginous diet, tonics, sulphur iodide.

Stimulate skin with ammonia liniment; cantharides tincture, 1 part; soap or camphor liniment, 8 parts; or castor oil.

Shave and rub in "Sanitas" fluid or vaselin daily, dressing occasionally with above stimulants.

AMAUROSIS.

- Gutta serena ; Glass eye ; Paralysis of optic nerve and retina.
 Unless when depending upon brain derangement or debility, it is incurable.
 Blisters, setons around orbit.
 Strychnine in traumatic cases and those of nerve atrophy, but unsuitable where there are brain symptoms.

ANÆMIA.

- Bloodlessness. Diminution of red corpuscles and other essential constituents of the blood.
 Pernicious anæmia, probably dependent on a microbe (Friedberger), frequently infectious, and accompanied by fluidity and redness of bone marrow.
 Generous diet, containing suitable proteids and fats.
 Comfortable quarters, pure air, exercise ; clip horses with heavy coats.
 Iron salts and occasional laxatives.
 Gentian, quinine, and other bitters where appetite faulty ; strychnine.
 Mineral acids where gastric mucous membrane soft and relaxed.
 Arsenic, after iron has been persisted with for ten days, or where iron disagrees.
 Calcium phosphate in growing young animals ; Parrish's syrup, alternated with Donovan's solution.

ANEURISM.

- A localised dilatation of an artery.
 Equable pressure, truss, bandages, acupuncture, cat-gut ligature.
 Aconite relieves pain and lowers circulation.
 Ergotin locally injected contracts vessels.
 Pot. iodide encourages absorption. Rest, quiet ; rather low diet.
 Electrolysis, injection of ferric chloride, lead acetate, or ergotin may cause coagulation within sac.
 Radical cure and obliteration of vessel by continuous digital acupuncture.

ANGLE BERRIES. See also WAETS.

- Remove with knife, torsion, caustic, or ligature ; dress antiseptically.

ANTHRAX. CHARBON.

Depends upon the *Bacillus anthracis*, which occurs both as a saprophyte and a parasite, and is communicable by inoculation from one animal and from one species to another. Mice, guinea-pigs, sheep, and cattle are specially susceptible. Horses, rats, dogs, birds, and frogs are slightly susceptible. Both bacilli and spores are taken up by animals in their food and water. The characteristic carbuncular swellings are accompanied by acute pyrexia, prove fatal in one to three days, and are usually localised—

- (1) In the subcutaneous structures, corresponding to the malignant pustule of man.
- (2) In the tongue, chiefly of herbivora, constituting glossanthrax or blain.
- (3) In the pharynx and larynx of pigs, and occasionally of horses and other animals.
- (4) In the rectum of susceptible subjects.
- (5) In the spleen, chiefly of adult cattle and sheep, recognised as splenic apoplexy ; very sudden in its onset, and killing sometimes within an hour.

Black-leg, or symptomatic anthrax, occurring amongst young cattle, is caused by the *Bacterium Chauvæi*. See BLACK-LEG.

The Loodiana prevalent amongst the equine species in India, the African horse sickness, and Texas cattle fever, although sometimes classified as anthracoid diseases, and probably organismal in their nature, do not result from the *Bacillus anthracis*.

ANTHRAX. CHARBON—continued.

Curative treatment, where attempted, consists in free administration of non-poisonous antiseptics—sodium sulphite, hydro-naphthol, pot. chlorate, or of carefully regulated doses of creolin, carbolic acid, ferric chloride, or mercuric iodide or chloride.

Carbolic and other antiseptics injected hypodermically.

Promote action of bowels and other excreting channels.

Scarification of malignant pustule or other limited accessible swelling, and dressing antiseptically.

Preventive treatment consists in protection from access of bacillus and spores.

Burn or deeply bury infected discharges and diseased carcasses, which should neither be skinned nor opened.

The flesh of animals dying from anthrax has produced the disease in pigs and occasionally in dogs eating it.

Thoroughly disinfect infected premises.

Keep susceptible animals off pastures where disease has occurred, and from low-lying swampy districts and other situations affording favourable habitat for the micro-organism.

Inoculation with cultivated virus does not always ensure protection.

ANURIA.

Dysuria; Retention of urine. Results from calculi, or urethral obstruction, paresis or spasm of the neck, or other part of the bladder; more common and distressing in horses and dogs than in cattle or sheep.

The bladder in the horse may be gently pressed by the hand introduced into the rectum.

Friction and warm applications to the perineum may overcome paralysis or spasm.

Anti-paralysants or antispasmodics administered.

Catheter used. Surgical treatment for calculus.

APHTHA.

Vesicles in the mouth; Thrush. Associated with the epiphyte, *oidium albicans*. Most common in young animals.

Alum, borax, sulphurous acid, chlorine or pot. chlorate solutions applied locally.

Oxymel, glycerine and water, or glyceride of starch.

When connected with gastric derangement, give laxatives, salines, hydrargyrum cum creta.

When patient reduced prescribe tonics.

Soft digestible food.

APHTHOUS OR VESICULAR EPIZOOTIC.

Foot-and-mouth disease; Eczema contagiosa: A contagious eruptive fever affecting cattle, sheep, pigs, and occasionally poultry. The contagious agent, a micrococcus contained in the discharges from the vesicles and ulcerations, retains its activity for several months, and is transmissible directly and indirectly.

Segregate affected; disinfection; soft digestible food.

Keep inflamed, abraded surfaces clean, and moisten occasionally with alum, borax, or zinc sulphate, made up with treacle, honey, or glycerine and water.

Lead or zinc acetate solution or ointment, Goulard's extract or Condy's fluid diluted, applied to udder and feet.

Milk affected cows frequently, preventing lodgment in udder of stale milk.

The milk unsafe to use unless boiled for fifteen minutes.

Pot. nitrate and chlorate, mixed with mash or drinking water, when fever high.

One attack does not certainly protect the subject exposed to infection in subsequent year.

APOPLEXY, CEREBRAL.

- Rupture of blood-vessel, usually from atheroma, causing pressure, and sometimes softening of brain substance. Not common in domestic animals.
- Blood-letting, aconite, blister behind the ears, lower arterial pressure where attack threatened, or in earlier comatose stage.
- Active purgative, laxative enemata, cold water and ice to head relieve congestion.
- Nitro-glycerine and bromides also diminish cerebral congestion.
- Alcohol and other stimulants may be needful to combat subsequent anæmia.
- Massage, electricity, strychnine relieve paralysis.
- Digestible laxative food; avoid over-exertion or exposure to heat of sun.
- Iodine and pot. iodide promote absorption.
- Recurring attacks in robust subjects prevented by careful diet and seton in poll.

APOPLEXY, PARTURIENT.

- Milk fever: A disease of cows and ewes, occurring at parturition, or within three days thereafter; characterised by obscuration or loss of consciousness, and paralysis of motion and sensation; sometimes ushered in by cerebral excitement, spasms, and convulsions; attacking animals in the prime of life, in good condition, and free milkers. Mortality ranges from 25 to 50 per cent. No marked pathological appearances. Those recovering do so quickly, and usually perfectly. Genesis of disease still unexplained.
- Bleed in earliest stage. Cathartics, active—salts, with calomel, gamboge, or croton, treacle, and aromatics.
- If swallowing difficult, give cathartic and other medicine with Reid's pump.
- Prop on sternum; keep up head; turn patient from one side to other every three hours.
- Remove milk every few hours and rub bag.
- If urine retained, empty urinary bladder by catheter twice daily.
- Ice or refrigerants to head; clothe and rub body and legs.
- Linseed gruel occasionally by stomach pump and clyster.
- Whisky or other alcohol, with ammonia solution and carbonate, where collapse threatened.
- Rubefacients to spine.
- Until recovery fairly established, withhold dry food, but allow mashes and diluents.
- Purgatives, counter-irritants to the spine, pot. iodide and nux vomica relieve resulting paresis.
- Prevent by sparingly feeding susceptible subjects for a month before calving.
- Cathartic a fortnight before parturition, and another if required immediately after.
- Milk cow a fortnight before calving, earlier if milk can be drawn, and empty bag twice daily.

APOPLEXY, PULMONARY.

- Hyperæmia and œdema of lungs. Occurs especially in horses out of condition, usually from violent over-exertion.
- Cool air to breathe; smart hand-rubbing of body and limbs, which must subsequently be warmly clothed.
- Small repeated doses of alcohol, ether, or ammonia stimulate cardiac and respiratory centres.
- Abstraction of blood from jugular relieves congestion of right heart.

APOPLEXY, SPLENIC. See ANTHRAX.

APPETITE, IMPAIRED.

Varied and tempting diet.
 Food removed if not eaten, and fresh supply presented at next meal.
 Acids, bitters, cannabis indica.
 Examine teeth, mouth, and throat, and look for gastric or other cause.

ARTERITIS.

Inflammation of arteries. Not common in the lower animals.
 Rest, alteratives, salines, pot. iodide; blister if vessel superficial.

ARTHRITIS.

Inflammation of joints. Occurs in all animals; in young, from cold, pyæmic infection, or rheumatism; in horses, from strains, injuries, or sepsis from open joint. Synovial membrane primarily affected, but other structures become involved, and in chronic cases perosteum, ends of bones, and ligaments are attacked.
 Rest, anatomical and physiological fomentations, hot compress.
 Antipyretics, with analgesics subcutaneously, to reduce pyrexia and pain; counter-irritants.
 Slings needful for horses in acute attacks.
 Antiseptics in treatment of open joints.
 Sodium salicylate in rheumatic cases.
 See **SYNOVITIS** and **OPEN JOINTS**.

ASCARIDES. See WORMS.**ASCITES.**

Abdominal dropsy: Non-inflammatory exudation of fluid in cavity of abdomen, depending on disease of some important internal organ obstructing return of venous blood to the heart. More common in dogs, sheep, and cattle than in horses.
 Remove if possible conditions on which it depends.
 Diuretics, salines, oil of turpentine, pot. iodide, pilocarpine.
 Digitalis, especially in cardiac complications.
 Generous diet and tonics in anæmic or tuberculous disease of peritoneum.
 Concentrated dietary, iron salts, and turpentine in sanguineous form appearing in impoverished sheep and lambs.
 Tapping, even when it does not cure, relieves distressing symptoms.

ASTHMA IN HORSES. See BROKEN WIND.**ASTHMA IN DOGS.**

Dyspnoea depending on intermittent spasm of the muscular fibres of the bronchioles. Rare in horses or cattle, more frequent in dogs.
 Paroxysm checked by cautious inhalation of anæsthetics, amyl nitrite, or nitro-glycerine, or by chloral given by mouth.
 Broniides; strong coffee internally.
 Emetics relieve many cases associated with bronchial symptoms.
 Inhalation of terebene with or without steam; of stramonium with pot. nitrate and chlorate, or amm. chloride.
 Belladonna, stramonium, sometimes with eucalyptus, internally or inhaled.
 Alkalies, amm. chloride, pot. iodide; inhalation of sulphur fumes when associated with dry bronchial catarrh.
 Oil of turpentine, asafoetida, benzoin, eucalyptus oil when discharges profuse.
 Strychnine internally or hypodermically when respiratory centre weak.
 Acids and arsenic when complicated with gastric derangement.
 Occasional dressing of throat with stimulant embrocation, especially in old dogs with bronchial symptoms.
 Regular digestible, rather concentrated, diet.

ATHEROMA.

Degeneration of arteries, with thickening of their inner coat. Not so common in lower animals as in man.

Avoid over-exertion; digestible oleaginous dietary.

Ammonium iodide promotes absorption.

Iron salts, phosphates, Easton's syrup in debilitated patients.

Phosphorus in small doses where brain vessels implicated.

ATROPHY.

Wasting; Emaciation. Results chiefly from imperfect nutrition, nervous lesions, pressure, or disease.

Suitable diet; fitting use of wasted part; tonics, arsenic, and strychnine internally.

Friction, massage, electricity.

Inunction of oil, cantharides, or mercuric iodide in muscular atrophy.

AZOTURIA. See HÆMOGLOBINURIA.**BALANITIS.**

Inflammation of the glans of penis. Common in dogs; occasionally contagious.

Penis withdrawn, examined, cleansed, and dressed with astringent.

Injection of mild astringent daily for a week.

Any fungoid or vascular formations scraped or cut off.

In persistent cases horse or bull must be cast and secured, thorough examination made; inflamed, ulcerated, or fungoid surfaces dressed with silver nitrate solution.

Zinc sulphate or lead acetate injections repeated daily.

Perfect rest, dose of physic, laxative diet.

BARRENNESS.

Congenital, sometimes from hermaphroditism. Also caused by disease of organs of generation and faulty general health.

Change of diet and surroundings; exercise.

Alteratives; pot. iodide; phosphorus and cantharides, small doses.

Gradual lowering of fat plethoric subjects.

Improved condition of debilitated by diet and tonics.

Dilatation of os uteri if it be impervious; change male.

BELLONES.

Horses with polypus or tumour in nasal passages.

Excise polypus; dress antiseptically.

Pads over nostril sometimes diminish noise.

BITES OF INSECTS.

Ammonia or pot. bicarbonate solutions.

Creolin, carbolic acid, prussic acid, chloroform, cold water dressings.

BLACK-LEG OR BLACK QUARTER.

Quarter evil; Symptomatic anthrax. Consists in phlegmonous, emphysematous swellings, usually about the hind-quarters, occasionally on the shoulders, neck, or fore-quarters, caused by the Bacterium Chauvæi. Cattle, sheep, goats, and rabbits are readily inoculated; the horse, ass, and white rat exhibit only local swelling at the point of inoculation; the pig, dog, cat, black rat, and man are immune. The disease is endemic; the bacterium is taken up from the infected pasturage or in water. Cattle from four to twenty months are most liable to attack.

Curative treatment very unsatisfactory. Free scarification of limited external swellings and moistening with antiseptics arrest a few slight cases.

Prevention is effected by keeping young cattle and sheep out of pastures known to be infected.

Animals dying from the disease should be burned unskinned and unopened, or deeply buried with lime.

BLACK-LEG OR BLACK QUARTER—continued.

Disinfection of premises is adopted as for anthrax.

Setons have generally been credited with some preventive power.

Administration once or twice weekly of pot. chlorate or other saline antiseptic advised.

Prepared virus used intravenously, intratracheally, and hypodermically as a preventive in France, Germany, and other parts of Europe, stated to be effectual, but cattle and sheep injected with this vaccin in several English experiments were not protected, and died when subsequently inoculated with unattenuated virus.

BLADDER, URINARY, INFLAMMATION OF. See CYSTITIS.**BLADDER, IRRITABLE.**

Diluents, linseed tea, suitable diet. Interdict heated grain or fodder, or other acrid food.

Laxative relieves any gastro-intestinal irritation.

Belladonna as anodyne used internally and locally.

Benzoic acid or ammonium benzoate when urine alkaline.

Alkaline bicarbonate when urine acid.

Copaiba and cubebs as antiseptics in chronic cases.

Sulphuric and salicylic acids with iron sulphate where irritation in horses is connected with influenza or purpura.

Anodyne enemata benefit reflexly.

Cleanse with soap and water prepuce and external meatus of male.

BLADDER, PARALYSIS.

Prevent accumulation of urine by use of catheter, or in horse by gentle pressure on viscus from within rectum.

Prescribe cantharides, ergot, or cannabis indica; nux vomica when atonic.

BLEEDING. See HÆMORRHAGE.**BOG SPAVIN.**

Distension in acute cases; inflammation of hock joint of horse.

Rest; high-heeled shoe.

In acute cases rest best secured by slinging.

Foment when joint hot and tender.

Cold water and refrigerants when acute inflammation abated.

Spring truss in young animals sometimes used to give equable pressure.

Counter-irritation encourages absorption; firing-iron or seton in chronic cases.

BOILS.

A localised acute suppurative inflammation, with a limited necrosis of the cutis. A carbuncle is a boil on a larger scale.

Mercuric nitrate or belladonna ointment, or painting with silver nitrate, sometimes aborts in early stages.

Fomentations and poultices hasten maturation and relieve pain.

Counter-irritants around inflamed spot hasten suppuration.

Anodynes locally relieve irritation and pain.

Laxative diet, alkaline sulphites and chlorates, and calcium sulphide internally.

When opened, treat antiseptically.

Arsenic internally sometimes prevents recurrence.

BONE SPAVIN. See SPAVIN.**BOTS IN HORSES.**

Larvæ of *cestus equi* developed in stomach.

Turpentine and oils, bitters, hydrochloric acid, copper and iron sulphates, arsenic, followed by purgatives.

Green fodder; destroy larvæ as they are expelled in spring, and the fly.

BOWELS, INFLAMMATION OF. *See* ENTERITIS.

BRAIN, INFLAMMATION OF. *See* PHRENITIS.

BRAXY IN SHEEP.

A form of septicæmia depending upon a microbe, characterised by patches of congestion and ecchymosis, chiefly affecting the mucous and serous membranes and skin.

Most cases prove fatal.

Prevent by carefully regulated dietary.

Removal from exposed, undrained, infected grazings.

BROKEN KNEES IN HORSES.

Where skin not broken, tie up head and apply diluted zinc or lead acetate solutions for two or three days.

When skin cut, cleanse thoroughly, dress antiseptically, bring edges together with plaster, styptic colloid, or shellac paste; retain them in position with light calico bandage; dress with mild astringent solutions.

When skin considerably lacerated, the tendon and its bursa bruised and exposed, or the knee-joint opened, the limb should be put in splints and animal slung; several folds of antiseptic lint, retained in place by a calico bandage, over which, to moderate inflammation, cold water is made to trickle.

When tendon much bruised, knee-joint laid open, bones seriously injured or fractured, ankylosis must ensue, and the animal had better be destroyed.

BROKEN WIND IN HORSES.

A chronic asthma, mainly consisting in spasm of the muscles of the bronchioles, characterised by expiratory dyspnoea and nervous cough.

Incurable, but relieved by careful dietary; good concentrated food given damped; water frequently, in limited quantity at a time, but withheld before hard, fast work.

Reasonable restriction of water specially needful when heart affected.

Laxatives and salines given occasionally.

Rock salt, chalk, or whiting in manger. Two or three ounces linseed oil with food.

Arsenic (Fowler's solution) given daily or every second day, may be continued for months.

Professor Dick's cough balls occasionally.

BRONCHIAL CROUP.

Membranous exudation on tracheal and bronchial mucous membrane.

Frequent in cattle and sheep, and in other animals which have breathed smoke and hot air.

Rapid progress renders treatment very hopeless.

Inhalation of watery vapour medicated with phenols, eucalyptus oil, or amm. chloride.

Apomorphine chloride in carnivora.

Tracheotomy essential to prevent asphyxia.

BRONCHIAL FILARIA. *See* WORMS.

BRONCHITIS, ACUTE.

Inflammation of mucous membrane lining bronchi. Usually involves upper air-passages, sometimes extends into the bronchioles, alveoli, and lung parenchyma. Horses and dogs attacked more frequently than cattle or sheep. Usually classified as (1) Acute; (2) Croupous; (3) Chronic; (4) Verminous.

Place horse in comfortable box, 60° to 65° Fahr.; cool, pure air to breathe; body and limbs clothed.

Inhalation of watery vapour from steam-kettle, large meshes, or buckets of boiling water promote exudation in dry stage.

BRONCHITIS, ACUTE—continued.

Inhalation, medicated as required by expectorants, anodynes, or antiseptics. Fomentations and mustard to throat and sides.

Mustard in earlier stages applied for fifteen to twenty minutes, washed off, and reapplied if needful.

Spirituous essence of mustard injected hypodermically.

Salines in drinking water, or antifebrin or antipyryn, relieve fever.

Aconite, a few doses early in robust subjects, where symptoms acute.

Ammonium acetate solution, ipecacuanha, and squills while membrane dry and congested.

Apomorphine hydrochlorate, pilocarpine.

Benzoic acid, eucalyptus oil, terebene, mineral acids diminish excessive secretion.

Soap liniment and laudanum rubbed into throat and down neck twice daily relieve difficult breathing, especially when secretion excessive.

Belladonna stimulates respiratory centre and eases cough, conjoined with camphor, ether, or chloral hydrate, and in debilitated patients with small repeated doses of alcohol.

Electuaries or gargles of opium, chloral hydrate, with glycerine, also relieve cough.

Pot. chlorate and amm. chloride promote fluid secretion.

Lobelia and opium where there is much discharge and paroxysms of cough.

Ammonium carbonate when mucus abundant and viscid and patient low.

Mash diet; regulate bowels if possible by enemata; cathartics dangerous in horses.

For dogs, emetic in early stage; apomorphine hydrochlorate, ipecacuanha, and antimonial wines where membrane dry and congested and fever high; in weakly subjects and advanced stages, bronchi cleared by emesis produced by ipecacuanha, squill, and ammonium carbonate.

BRONCHITIS, CHRONIC.

Frequently follows acute attacks. Sometimes of verminous origin. See **WORMS.**

Equable temperature; pure fresh air; comfortable clothing, which must be removed and patient wiped over night and morning.

Salines, with or without mercurials, relieve congestion and fever.

Terebene and eucalyptus oil as stimulants of bronchial secretion.

Belladonna, balsams, and mineral acids diminish excessive secretion.

Ammonium carbonate and chloride useful where secretion viscid and irritating.

Belladonna and ether stimulate respiratory and cardiac centres.

Chloroform, chloral, and opium abate cough.

Mustard and other counter-irritants, carefully used, lessen congestion, irritation, and cough.

Mustard embrocation, although most effectual in early stages, also useful in chronic cases.

Soap liniment, with or without laudanum, frequently relieves cough.

Alcohol, ether, volatile oils, digitalis, maintain heart-action in weakly subjects.

Sulphurous acid, creosote, eucalyptus, and other antiseptics inhaled or *per orem* when secretions fetid.

Arsenic occasionally relieves emphysema.

Careful dietary, nutritive oleaginous food, bland oils.

Iron and other tonics promote convalescence.

BRONCHOCELE. GOITRE.

Hypertrophy of thyroid gland. Rare in horses and cattle, more common in dogs.

BRONCHOCELE. GOITRE—continued.

Local stimulation, iodine, pot. iodide.
Puncture and inject with iodine (Professor Cagny).
Liberal dietary; full proportion of fatty matters.

BRUISES: CONTUSIONS.

Foment, poultice, water-dressing, refrigerants, carbohc and other anti-septics. Massage, subsequent inunction with oil, promote absorption.
Lead, zinc, and other astringent solutions probably prevent leucocytes exuding and accumulating outside vessels.
Belladonna, opium, aconite paralyse sensory nerves and relieve pain.

BRUSHING OR INTERFERING.

Occurs in horses with faulty action, especially when leg weary or out of condition.
Careful shoeing. A three-quarter shoe, or a shoe thin on inside web, without heel on outside.
Well-fitting boot on the fetlock liable to be struck.
Improved condition often the most effectual remedy.

BULLE.

Pemphigus: Herpes: Eruption of large vesicles in irregular patches about junction of skin and mucous membranes, usually connected with gastric derangement, especially in young patients. Rare in animals. Classified by Friedberger as (1) Traumatic, (2) Thermic (caused by burns), or (3) Chemical (as induced by cantharides).

Vaseline, "Sanitas" solution, carron oil.

Laxatives and salines when connected with gastric derangement.

Adult horses subject to an inflammatory form passing to pustulation treated by laxative, alkaline wash, and zinc ointment (Robertson's *Equine Medicine*).

BURNS AND SCALDS.

Protect immediately from air and irritants by layers of cotton wool or application of carron oil.

Liniment of oil and litharge, with five per cent. boric, salicylic, or carbohc acid, or peppermint oil.

Whiting and water, or fuller's earth, applied, about consistence of cream, repeatedly, until tolerable coating formed.

Zinc oxide, with about ten parts vaselin, or of glycerine and water.

Alkaline solutions, soap lather, saturated solution sodium bicarbonate relieve irritation in slighter cases.

Where discharges are foul, add antiseptics to above dressings.

Where there is irritation or pain, add chloroform or laudanum, or both.

Combat constitutional symptoms with antiseptics and anodynes internally.

BURSATTEE.

Kunkur: A parasitic fungoid disease affecting horses and other animals in India and other tropical countries.

Improved sanitary conditions; change of food and surroundings.

Kunkur growths excised; wounds and ulcers treated antiseptically.

CALCULI, BILIARY.

Purgatives, salines.

Chloroform, chlorodyne, belladonna internally.

Morphine and atropine hypodermically.

Nitric acid, nitro-hydrochloric acid.

Hot fomentations, counter-irritation.

CALCULI, INTESTINAL.

Dust balls; Concretions from hard water.

Rectal exploration; use Professor Fred. Smith's long enema tube.

Avoid active cathartics, but give enemas. Restrict to soft concentrated food.

CALCULI, INTESTINAL—continued.

Morphine and atropine hypodermically most prompt and effectual means of relieving spasm and pain.

CALCULI, URINARY.

Lithiasis ; Gravel.

Dilute mineral acids in horse.

Alkalies or alkaline bicarbonates diminish tendency to urinary deposits common especially in highly-fed rams and wethers.

Ammonia benzoate helps resolution of phosphatic deposits of sheep.

Diluents, cooling laxative food ; raise feeding sheep thrice daily, and drive hem a few hundred yards, ensuring their urinating.

Sheep affected must be placed on buttocks, and by manipulation the sabulous matter in urethra is gradually moved.

Where canal hopelessly blocked it must be opened either at the ischial arch or by amputation of penis.

Lithotomy in horse and ox, or lithotripsy in mare or cow, only means of removing cystic calculi of any considerable size in these animals.

CANCER.

Carcinoma : A malignant growth of epithelial-like cells contained in an alveolar stroma. Affects all classes of animals.

Excision of localised accessible deposits in early stage by knife.

Removal by chromic acid or other caustic seldom successful or safe.

Carbolic acid, bromine, or iodoform may retard growth and lessen risk of secondary infection.

Generous diet retards exhaustion caused by absorption of disintegrated tissues.

Analgesic, antiseptic, and deodorant dressings.

CANKER OF HORSE'S FOOT.

A fungoid disease affecting the secretory surfaces of the frog and sole, and producing disorganisation of the horn material and fetid, infective discharges.

Mr Malcolm, Birmingham, has shown canker to be purely local, occurring in all breeds and descriptions of horses, possibly depending on an epiphyte, and while confined to the frog and sole curable (*Journal of Comparative Pathology and Therapeutics*, March 1891).

In slight cases, mainly affecting the frog, Mr Malcolm has the degenerate unattached horn, fungus growths, and every portion of canker tissue either excised with the knife or cauterised with the hot iron.

Dressed with equal parts of sulphate of copper, iron, and zinc, with crude carbolic acid, and vaselin added to form a paste. This is covered with tow and a leather or iron sole, and the shoe replaced.

In more serious cases, and where the sole is involved, the horse is cast ; every particle of non-adherent frog removed ; the sole, if affected, thinned ; every spot of canker excised or cautiously cauterised, and the dressing applied as above.

Daily, or every second day, the horse, either standing or cast, examination is made for any canker specks, which are removed and dressed as before.

Mineral acids and silver nitrate sometimes serviceable.

Calomel used dry encourages growth of horn.

Examination and dressing repeated at longer intervals.

After first few days even bad cases are best at work.

Cure generally effected in six or eight weeks.

CANKER OF EAR. See OTORRHOEA.**CAPPED HOCK, KNEE, AND ELBOW IN HORSE.**

(a) A serous cyst in areolar tissue, immediately underneath the skin.

(b) Swelling of bursa of gastronemius tendon.

CAPPED HOCK, KNEE, AND ELBOW IN HORSE—continued.

Capped Knee—Distension of bursa of extensor metacarpi magnus.

Capped Elbow—Subcutaneous infiltration from bruising.

Hot fomentations; subsequently stimulate with cantharides liniment or mercuric iodide ointment; soft soap rubbed in daily.

Equable pressure applied by truss where practicable.

Evacuate serous cyst; inject cavity with iodine or astringent solution.

In bursal form of capped hock use shoe raised at heel.

CARDIAC. See HEART DISEASES.**CARDITIS. MYOCARDITIS.**

Rare in lower animals. Inflammation of muscular fibres of heart with (1) infiltration or induration, or (2) suppuration, as in puerperal metritis in cattle, or omphalo-phlebitis of foals (Friedberger).

Concentrated good food.

Digitalis, caffeine, alcoholic stimulants as heart tonics.

Stimulant embrocations to chest.

Combat pyæmic infection with antiseptics and quinine.

CARIES OF BONE.

Molecular disintegration and absorption of bone. By some authorities regarded as tuberculous (Dr Coats).

Excise diseased tissue; provide exit for discharges.

Sulphuric or phosphoric acid diluted; dress antiseptically.

Administer calcium phosphates.

CATARACT.

Opacity of the lens or its capsule.

Extraction by operation.

Mydriatics—belladonna or atropine—for diagnosis, operation, and alternated with physostygmine for obtaining free movement of iris.

Phosphoretted oil, instilled into human eye, if borne, leads to absorption.

CATARRH.

Inflammation of any mucous membrane, with serous or muco-purulent discharge. But the term is specially applied to inflammation of the membrane lining the nasal chambers and upper respiratory passages, constituting Cold in head or Coryza. More frequent in horses than other animals.

House comfortably; clothe body and head; bandage legs.

Equable temperature of 60° to 65° Fahr.

Steam head with vapour of water alone, or medicated with antiseptics or anodynes.

Warm or vapour bath; patient quickly dried and re-clothed.

Mash diet or green food; laxative enemata; laxatives if required.

Amm. acetate solution; pot. nitrate or chlorate; other saline electuaries.

Hot fomentations; stimulating embrocations to throat.

CATARRH, CHRONIC, OF HORSES.

Usually accompanied by nasal discharge. Cure uncertain.

Isolate patient until assured there is no glanders.

Nasal douche or spray.

Wash out nasal, and, if necessary, trephine and wash other sinuses.

See to faulty teeth. Cleanse guttural pouches.

Fresh air, rest, or gentle work; if coat rough clip or seinge.

Green fodder; feed on floor, or graze by day.

Inhalation of sulphurous, carbolic, or iodine vapours.

Administer iron, arsenic, terebene, or copaiba.

CATARRHAL FEVER, MALIGNANT, OF CATTLE.

An acute contagious fever, with catarrhal inflammation of the mucous membrane of the eyes and respiratory organs, occasionally involving the gastro-intestinal and urinary membranes, usually of two to

CATARRHAL FEVER, MALIGNANT, OF CATTLE—continued.

four weeks' duration; the mortality 70 to 90 per cent. More frequent in Europe and America than in Great Britain, chiefly affecting young animals in spring (Friedberger and Law).

Antipyretics, saline expectorants, maintain strength.

Combat formidable symptoms.

CEREBRAL ANÆMIA.

Occurs in all animals.

Stimulants to combat syncope.

Mustard and other cutaneous irritants.

Phosphorus, phosphates, quinine, strychnine.

CEREBRAL HÆMORRHAGE. See APOPLEXY.**CEREBRAL HYPERÆMIA.**

Occurs in all classes of animals, especially in early life, and appears in an active and passive form.

Blood-letting in earliest stage, but not when coma supervenes.

Ice-cap or refrigerants; darkened, cool quarters.

Cathartics, salines, warm clothing to stimulate skin.

CEREBRO-SPINAL MENINGITIS IN HORSES.

Hyperæmia and inflammation of the cerebro-spinal meninges. Horses and sheep more frequently affected than cattle, hogs, or dogs; horses in America attacked more frequently than in Great Britain; enzootic and epizootic; but special infecting agent has not been discovered.

Slings essential where horse cannot stand.

Half dose of physic, oil, and a few grains calomel.

Salines, laxative enemata, mash diet.

Where urine not freely passed use catheter.

Strychnine thrice daily.

Cold or ice-bag to head and neck; counter-irritation to spine.

Ergotin and atropine hypodermically approved by Mr Lyman, Boston, U.S.A., and Professor Williams.

Pilocarpine hydrochlorate, ten grains hypodermically (Friedberger).

CHOKING.

Usually from obstruction of œsophagus. Common in cattle feeding on roots.

Repeated small quantities slowly given of linseed gruel, oil, or other lubricants.

Secure wooden gag in mouth, which evokes swallowing movements and secretion of saliva.

Remove foreign body, upwards if possible, by introducing hand into mouth, and by external manipulation of gullet.

Failing, carefully pass the probang, cup and first.

Other means unsuccessful, cut into gullet and extract obstruction.

Where hoven becomes serious liberate gas with trochar or knife.

COLIC.

Gripes; Spasm of intestines; Irregular inordinate contractions of muscular walls of intestines. Occurs in all animals; presents two forms—(a) spasmodic; (b) flatulent.

Place horse in spacious, well littered box.

Purgative to remove irritant: in horse, aloes; in cattle and sheep, oils and salines; in dog, castor oil.

Catharsis hastened and pain relieved by copious laxative enemata, hot fomentations and friction to abdomen, and gentle exercise.

Physostygmine and pilocarpine if bowels continue torpid.

Ether, oil of turpentine, other volatile oils, ammonia, and ammonium carbonate combat flatulence.

Ether, alcohol, and chloral hydrate, conjoined with opium, belladonna, or cannabis indica, control spasms and pain.

COLIC—continued.

Morphine and atropine hypodermically or inhalation of chloroform quiets violent spasm.

Repeated recurring attacks in influenza in horses, often connected with hepatic derangement, treated with half dose of aloes and a little calomel, spirit of chloroform, and mustard embrocation to abdomen.

Tobacco smoke clysters sometimes useful.

In intractable cases of flatulent colic in horse the distended colon may be punctured by suitable trocar and canula.

Similar treatment in other classes of patients.

CHOLERA OF FOWLS AND HOGS. See FOWL CHOLERA and SWINE FEVER.**CHOREA.**

Irregular involuntary convulsive movements of voluntary muscles, or groups of muscles. Stated to be sometimes dependent on localised sclerosis of spinal cord (Reports of Brown Institute).

Occurs in all animals, usually in the young, feeble, or anæmic.

In horse most common in the form of stringhalt, which see.

In dog as sequel of distemper, or from intestinal worms.

Remove gastro-intestinal derangement, worms, or other cause of reflex irritability.

In weakly dogs or convalescents from distemper, generous diet, fair proportion of good milk or other fatty matters.

Iron, arsenic, other tonics, ether, and spirits of camphor; Fellows's syrup.

Sponging or affusion with water, at first tepid, subsequently cold.

Violent spasms relieved by full doses chloral hydrate internally, or chloroform inhalation.

Counter-irritants over spine in long-standing cases.

COMA.

Stupor, symptomatic of impaired brain function.

Affusion alternately with warm and cold water; ice-bag to head.

Ammonia given by inhalation and subcutaneously.

Mustard to extremities; stimulating enemata.

Cautious bleeding; endeavour to promote action of bowels and skin.

CONJUNCTIVITIS.

Inflammation of mucous membrane of eye. *See also* OPHTHALMIA.

Remove any irritant; foment; drop of castor oil between lids relieves irritation. Poppy-head poultices.

Silver nitrate, zinc acetate, or other astringent solution suitably diluted.

Shield from light; try cold applications.

Belladonna or atropine as anodynes locally and internally.

Mercuric nitrate ointment when lids inflamed.

Ergot fluid extract undiluted relieves vascular engorgement.

Dose of physic; blister orbit.

CONSTIPATION.

Torpidity of bowels. Insufficient intestinal secretions and movements.

Laxative diet, diluents, salines, regular exercise.

Purgatives in moderation, especially when liver deranged; repeated laxative clysters; massage of abdomen.

Aloes, oils, calomel, small doses Epsom salt for horses.

Salts, croton, gamboge, calomel for cattle.

Calomel and jalap, castor and linseed oils, emetics for dogs and cats.

Gentian, quinine, and other tonics when associated with debility.

Oil of turpentine by mouth and rectum where there is flatulence.

Physostygmine and pilocarpine in obstinate cases.

Soap suppository in young animals.

Nux vomica, belladonna; electricity or ergot to give tone,

CONSTIPATION—continued.

Where action of bowels obstructed by concretions or displaced viscera, cathartics are injurious, and diluents, laxative enemata, and anodynes are indicated.

In dogs use oil and grey powder, or jalap and calomel.

In poultry clear out the rectum and cloacum and give castor oil.

CONSUMPTION, PULMONARY. See TUBERCULOSIS.**CONVALESCENCE.**

Easily digested nutritive food, milk and eggs, fresh air, exercise.

Alcoholic stimulants, bitters, mineral acids, arsenic.

Pepsin for dyspeptic dogs and young herbivora feeding on milk.

Iron salts, phosphates, baths, cold sponging.

CONVULSIONS.

Fits produced usually by irritation of motor centres of brain or spinal cord; they may be (1) cerebral or (2) spinal, and these again (a) central or (b) reflex.

Chloral hydrate; chloroform inhaled and swallowed.

Morphine subcutaneously; spinal ice-bag.

When of cerebral origin, bromides or ammonia internally; cold affusion; ice to head.

When reflex remove source of irritation.

CORNEAL OPACITIES.

Nebula: Albugo: Leucoma.

Touched with silver nitrate, solid, or 1 part to 100 water, or corrosive sublimate 1 part. common salt $7\frac{1}{2}$ parts to 3000 water.

Sodium chloride injected under conjunctiva.

Iodine and pot. iodide internally and locally promote absorption.

CORNS IN FOOT OF HORSE.

Bruise of secreting sole.

Remove shoe, pare to relieve pressure and ensure exit of any pus.

Poultices soften sole and abate tenderness.

Use light shoe with wide web.

Shoe strong feet with tips.

COUGH.

An expiratory explosion forcing open the glottis and following a deep inspiration. More common and serious in horses than other animals.

Comfortable housing and clothing, pure air, careful feeding.

Catarrhal.—Steam head; ammonium acetate solution, salines, ether, mustard to throat.

Bronchial.—Ammonium acetate, ipecacuanha, squills, nitrous ether, counter-irritants.

Dry, with scant secretion.—Amm. acetate or chloride, pot. bicarbonate and chlorate, borax.

With profuse discharges.—Balsams, eucalyptus oil, tar, terebene, creosote, astringent sprays or inhalations.

Irritable.—Demulcents, camphor and belladonna, conium, opium, hydrocyanic acid, cocaine.

Rheuz.—Bromides, chloral hydrate; remove cause of irritation.

Verminous.—Frequent in calves and lambs. See WORMS.

COUGH, CHRONIC, OF HORSES.

Careful dieting, food damped, linseed mash or oil.

If coat long clip or seinge.

Epsom salt or other salines occasionally.

Professor Dick's recipe.

Belladonna, camphor, alcohol, tar, creosote, arsenic.

Counter-irritants: mustard, mercuric iodide ointment, setons.

CRIB-BITING.

Iron stable fittings.

Manger when unused turned into recess in wall.

Use muzzle or spiked neck strap; concentrated digestible food.

Chalk, antacids, and occasional laxative relieve the indigestion from which crib-biter usually suffers.

Crib-biter should be placed by himself, as other horses imitate and acquire the habit.

CROUP. CYNANCHE TRACHEALIS. See CROUPOUS LARYNGITIS.**CURE.**

Sprain or injury of straight ligament of hock.

Foment; lead acetate solution; refrigerants.

Counter-irritants; mercuric iodide ointment; charges; firing-iron.

High-heeled shoe, no toe-pieces.

Rest, especially in young horses, must extend for several months.

COW-POX. See VARIOLA VACCINA.**CYSTITIS.**

Inflammation of urinary bladder of several forms—chiefly catarrhal, purulent, crupal, hæmorrhagic, chronic.

Oleaginous laxatives; aconite, calomel and opium abate acute fever.

Emollient anodyne enemata and suppositories of hyoscyamus, opium, or belladonna.

Rugs wrung out of boiling water, or fresh sheep-skins to horse's loins.

Mashes, linseed, boiled barley, diluents.

Benzoic, boric, or salicylic acids, borax, pot. chlorate or creolin when urine alkaline, fermenting, or bad-smelling.

Pot. bicarbonate or other alkalies internally when urine acid and acrid.

Syringe female bladder with alkaline solutions when urine acrid; when smelling, with boro-glycerine or dilute copper sulphate.

Creolin, astringents, buchu, bearberry, eucalyptus oil in chronic vesical catarrh.

Irrigation with solution ferric chloride, creolin, alum, or tannin in hæmorrhagic cases.

DEBILITY.

Weakness. Endeavour to remove cause.

Easily assimilated nutritive food; suitable hygiene.

Acids, bitters, quinine when gastric digestion weak.

Alcoholic stimulants when heart action feeble.

Laxatives when elimination of waste defective.

Calcium phosphate and fatty matters useful in young animals.

Nux vomica and Easton's syrup of phosphates in nervous debility.

Iron salts when associated with anæmia.

Arsenic when assimilation is at fault.

Cold sponging and baths for dogs.

DELIRIUM.

Perversion and inco-ordination of brain functions.

For vigorous patients cold affusion applied cautiously.

Ice and refrigerants to head.

Perfect quiet, cathartics, salines, digestible cooling diet.

Chloroform, cannabis indica, bromides, internally.

Alcohol, ammonia, belladonna, camphor, when associated with exhaustion.

Blood-letting in delirium, resulting from injuries, in earlier acute stages of phrenitis, and in robust subjects.

DENTITION FEVER.

Not infrequent in horses.

Soft laxative food, rest, salines, febrifuges.

Lance gums if absolutely needful.

Remove temporary teeth interfering with access of permanent.

When dentition of dogs delayed or defective give calcium phosphate.

DIABETES INSIPIDUS.

Hydruria ; Polyuria ; Excessive secretion of urine. Peculiar to horses.
 Caused apparently by some toxic material derived from faulty food, frequently heated, musty grain or fodder, or produced in connection with such diseases as influenza and glanders. Seldom fatal.
 Half dose physic, especially when digestion out of order.
 Iodine with pot. iodide, either in bolus or solution.
 With iodine alternate or conjoin iron salts.
 Chalk or whiting in manger, or sodium bicarbonate in water, counteracts acidity frequently present.
 Phosphoric acid and bitters lessen thirst.
 Careful feeding ; change food. Avoid stale, damp, badly-saved fodder or musty, unsound grain. Allow moderate supply of water.

DIABETES, SACCHARINE.

Diabetes mellitus. Pathology not explained. Occasionally occurs in dogs, very rarely in horses or cattle. Incurable.
 Relief afforded by withholding carbo-hydrates, substituting soup, cooked animal food.
 Codeine and iodine ; antipyrine ; sodium salicylate.

DIAPHRAGMATIC SPASMS.

Usually resulting from over-exertion or acute gastric derangement ; specially observed in horses and dogs ; intermittent, seldom lasting many hours.
 Chloral hydrate and alcohol *per orem*.
 Dogs an emetic, especially if of gastric origin.
 Stimulant embrocation applied to chest.

DIARRHŒA.

Scouring ; Frequent discharge of fluid fæces. Occurs in all animals.
 Laxatives in first stage to remove irritant.
 Perfect rest ; keep patient comfortable and warm.
 Restrict water ; diet carefully ; wheaten flour gruel.
 Alkalies ; chalk where dejections acid.
 Mineral acids or gallic acid with opium in profuse serous discharges.
 Enemata of starch gruel at 100° Fahr., with lead acetate and opium.
 Aromatics and camphor abate nervous irritability.
 Oil of cinnamon valuable in cases resulting from cold.
 Volatile oils, ether, chloroform, chlorodyne in moderate, frequently repeated doses relieve flatulence and spasm.
 Ammonium carbonate where watery secretions continued and heart action weak.
 Arsenic and opium in chronic cases.
 Copper sulphate ; corrosive sublimate with creosote and opium when chronic discharges contain mucus and blood.
 Ergotin and opium administered with keratin where discharges profuse and continued.
 Antiseptics, sulphites, sulpho-carbolates where discharges foul.
 Nitric acid and nux vomica when complicated with hepatic derangement.
 In young animals castor oil with a few drops laudanum.
 Grey powder in young patients where discharges pale and fœtid.
 While patient fed on milk, if it disagrees when given with lime water in cautiously regulated, restricted amount, substitute cooked starch food, or beef tea and white of egg, with a little wine or spirit if animal reduced.

DIPHTHERIA.

A specific inflammation of the mucous membrane, frequently of the upper air-passages, characterised by fibrinous exudation and necrosis of affected tissues, with liability to secondary infections. Its essential cause is a microbe, communicable from the sick to animals of the

DIPHTHERIA—continued.

same and other species. It is not so rapidly fatal in the lower animals as in man.

Isolate the infected and adopt strict disinfection of patient and discharges.

Ice sucked abates tenderness and swelling.

Ferric chloride tincture, locally and internally.

Spray with chlorine, iodine, iodoform solutions.

Electuaries of boro-glycerine or glycerine of carbolic acid.

Sodium sulphites and hyposulphites, locally and internally.

Belladonna electuaries relieve congestive stage.

Salicylic acid and pilocarpine aid in dissolving false membrane.

Soft nutritive food, eggs, beef tea, alcohol sustain strength.

Animals inoculated with attenuated virus can be rendered immune.

DIPHTHERIA IN POULTRY.

Croupous diphtheritic exudations, chiefly within the mouth, throat, nasal cavities, and about head; of two varieties—(1) depending on bacteria, chiefly cocci; (2) on gregarines or coccides; this latter condition more chronic and less serious, and affects rabbits, rats, and fish, as well as poultry (Friedberger).

Isolate affected birds; enjoin thorough cleanliness and disinfection.

Moisten external eruptions with 1 to 2 parts corrosive sublimate, 10 parts salt, and 1000 water.

Where mouth or throat affected give every two hours electuary, 1 part creolin, 5 each borax, pot. chlorate, glycerine, and 100 simple syrup.

Feed liberally to sustain strength.

DISLOCATIONS.

Luxations. Not common in the lower animals.

Bring bones into natural position.

Retain in position if needful by splints, bandages, plasters; sling if necessary.

Abate inflammation by either hot or cold applications, as may be suitable.

DISTEMPER IN DOGS.

A contagious eruptive fever affecting the mucous membranes and skin, and frequently the cerebro-spinal axis. It attacks dogs, cats, foxes, wolves, hyenas, jackals, and monkeys. Evidently of organismal origin; cultivations to the seventh generation produce the disease when inoculated in dogs and cats; but the distinctive microbe has not yet been described.

Prevent spread by early isolation and disinfectants.

Good nursing and cleanliness as important as doctoring.

An emetic and mild laxative if required in early stage.

Ammonium acetate solution and ipecacuanha, steaming and sponging nose and eyes relieve catarrh.

Boric acid, two per cent. solution in conjunctivitis, which see.

Hot compresses, embrocations, stimulant expectorants in laryngeal and bronchial cases.

Chlorodyne or spirit of chloroform and morphine allay gastro-intestinal irritation.

Boric acid or "Sanitas" powder with ten parts kaolin or starch abate skin irritation.

Sodium sulphite as antiseptic and antipyretic (Professor Williams).

For nervous complications see CHOREA, EPILEPSY, CONVULSIONS.

If food not spontaneously taken give beef tea and milk, beef tea with white of egg, and, if required, wine or spirit.

Cow pox vaccine has no protective power.

Attenuated virus produces mild attack, which affords protection for several years (Friedberger).

DROPSIES.

- Serous effusions.
- Endeavour to restore functions of heart, kidneys, or liver, the impaired actions of which usually cause the effusion; Turkish baths.
- Digitalis infusion and strychnine useful in most dropsies, especially in cardiac, in which given with salines.
- Copaiba in cardiac and hepatic cases.
- Laxatives and pot. iodide in renal dropsies.
- Encourage vicarious functions of bowels and skin if kidneys affected.
- Iron and salines in cases associated with anæmia.
- Restrict quantity of fluid; friction; shampooing; external stimulants.
- Trocar and canula, aspirator, acupuncture.

DYSENTERY.

- Contagious specific inflammation of mucous and glandular structures of intestine, occurring in foals, calves, and lambs within four days after birth. In muco-purulent, often blood-stained exudate are numerous bacteria. Mortality 10 to 80 per cent. Observed to concur with epizootic abortion (Friedberger).
- Isolation of infected; thorough disinfection.
- Antiseptic treatment of females aborting and parturient. *See* ABORTION.
- Castor oil and grey powder.
- Well-boiled starch gruel or other mucilage, with a few drops laudanum.
- Salicylic and tannic acids with camomile infusion (Fröhner).
- Rhubarb, magnesium carbonate, and opium (Hertwig).
- Chlorodyne, creolin, or resorcin, with laudanum.

DYSPEPSIA. INDIGESTION.

- Treatment varies with cause and nature of attack. Suitable dietary.
- Avoid indigestible food and long fasts. Rectify irregularity of bowels.
- Enjoin exercise.
- Resulting from over-eating, an emetic for dogs; cathartic for animals that do not vomit.
- For flatulence, essential oils, ginger, creolin, hydrochloric acid, ether.
- For gastric catarrh, ammonium chloride, sodium hyposulphite, fragments of ice.
- Alkalies, chalk, magnesia, given before feeding or with food.
- For atonic forms, mineral acids, usually more permanently useful, are given with bitters.
- Pepsin for dogs and young animals while living on milk.
- Where food irritates, provoking diarrhœa, bismuth or arsenic with morphine.
- Depending upon worms—appropriate vermicides.
- In chronic dyspepsia, obviate errors of diet or management, examine teeth, change food.
- Provide horses with whiting and rock salt to lick. Try daily 1 lb. linseed cake.
- With cattle restrict to mash diet for two days, and add salt and treacle to drinking water.
- Both in hoven and overloading with dry food rub left flank and belly; soap and water enemata.

DYSPŒA.

- Difficult breathing.
- Discover and, if possible, remove cause.
- Fresh air; chloroform, inhaled or swallowed.
- Chloral hydrate in spray or draught.
- Belladonna extract and ether.
- Amyl-nitrite; nitro-glycerine in angina pectoris.
- Counter-irritants if due to congestion or inflammation of air-passages.
- Tracheotomy where obstruction occurs in upper air-passages.

ECLAMPSIA.

Epileptiform spasms, unconnected with pathological conditions. Most common in infantile subjects, dogs during teething, and from worms, occasionally in bitches nursing.

Remove any exciting cause ; attend to general health.

Pot. bromide, chloral, morphine hydrochlorate hypodermically, or chloroform inhalation where excitement considerable.

ECTHYMA.

American skin disease ; Eruption of papules and rather large pustules. Affects horses, sheep, and dogs.

Laxative salines remove gastro-intestinal or other irritants.

Exercise further hastens removal of waste products.

Digestible, rather laxative, dietary.

Mineral acids, iron salts, bitters, arsenic act as antiseptics and alteratives.

Pustules treated by water dressing, boric acid, zinc oxide ointment.

Sometimes contagious ; hence patients isolated and disinfection adopted.

ECZEMA.

Cutaneous catarrh. A dermatitis presenting localised eruption of papules, vesicles, or pustules, appearing consecutively or together, causing itching, thickening, and discharge, and subsequently scales or scabs. The earlier or acute stages may continue one to three weeks, the later for months. Not parasitic or contagious. Affects particular regions, chiefly the dorsal column, tail, and extremities. Young, old, and delicate subjects most susceptible. A frequent disease of dogs, in which the several varieties usually well marked. It occurs about the heels of horses, constituting a variety of grease. Cattle in foul premises or eating acrid food suffer about the tail.

Friedberger records the following stages or varieties, under which the suitable treatment is given :—

- (1) *Erythematous*.—The skin hot, tender, red, and swollen.

Cleanse skin with soap and water. Apply vaselin or creolin tincture.

Endeavour to prevent rubbing and biting.

Laxative salines, cooling diet correct gastric derangement.

- (2) *Papular*.—The lichen stage of some authors. Patches of small, soft swellings, varying in size from a millet to a pea.

With treatment as above, moisten with boro-glycerine or borax solution.

Itching abated by strong solution of pot. bicarbonate.

- (3) *Vesicular*.—Eczema simplex. Tetter. Patches of minute, crowded vesicles.

Whether in dogs or horses, trim or shave all hair from irritable spots.

Wash with soap and water.

Moisten several times daily with saturated solution pot. bicarbonate.

Subsequently anoint with vaselin.

Zinc oleate or zinc ointment soothes and softens.

Dry dressings, such as zinc oxide and bismuth nitrate, one part each, six or eight parts kaolin or starch, preferable when skin tender or puffy.

- (4) *Humid*.—Eczema rubrum. Red mange of dogs. Inflammation extended and exudation greater.

Remove irritating discharges.

Soak limited areas with mercurous oxide wash.

Subsequently dress with zinc oleate or ointment.

Paint limited inflammatory spots with five per cent. silver nitrate solution, or moisten lightly with ten per cent. nitric acid.

Tannin with ten parts paraffin oil. Dust with boric acid or iodoform.

After abating any pyrexia, administer mineral acids, bitters, tonics, arsenic; linseed in herbivora. In dogs avoid oatmeal and heating animal food, and give cod-liver oil.

ECZEMA—continued.

- Mercuric nitrate ointment in eczema of eyelids.
 Boro-glycerine or hydronaphthol for eczema labialis or facialis.
- (5) *Pustulous*.—Impetigenous. Inflammation more deeply involving the several skin textures, with free pus formation, as in grease in horses; liable to assume chronic form.
- Cleanse and soften scabs with soap and warm water.
 Soak suppurating surfaces with zinc or lead acetate in aqueous or oily solution.
- Alternate these dressings with mercurous oxide wash, copper sulphate ointment, carbolic acid, naphthol, or chrysarobin.
 Paint inflamed spots with silver nitrate or nitric acid as above.
 Attend to state of bowels and kidneys.
 Digestible nutritive food, tonics, arsenic, mineral acids.
- (6) *Squamous*.—Desquamating. Sometimes termed Pityriasis or Psoriasis.
- Soak crusts or scabs with oil for some hours and remove them.
 Salicylic acid in strong borax solution also removes scabs.
 Dress with four parts each pot. carbonate and sublimed sulphur, one oleum picis, thirty each lard and olive oil, leaving it on for three or four days, then washing off with soap, alkali, and water.
 Carbolic acid and paraffin ointment, sulphur iodide ointment.
 Naphthol, ichthyl, resorcin, chrysarobin.
 Mercuric nitrate, or iodine ointments where skin thickened.
 A blister in inveterate cases sometimes re-establishes healthy action.

ELEPHANTIASIS OF HORSES.

- Chronic grease; Dermal and subdermal hypertrophy.
 When the papillæ are seriously enlarged and skin folds formed cure is hopeless.
- Slighter cases cured and others ameliorated by antiseptic treatment. See GREASE.
- Green food, laxatives, diuretics, salines, iodine, and pot. iodide.

EMBOLISM.

- Blood clot or foreign body plugging vessel.
 Perfect rest; concentrated, rather spare, diet.
 Ammonia salts increase fluidity of blood.

EMPYEMA.

- Pus in the chest.
 Remove by operation with antiseptic precautions, and provide drainage tube.
 Wash out cavity with boric, salicylic, sulphurous, or other antiseptics.

EMPHYSEMA.

- Pneumatosis; Air swelling.
 Puncture, pressure, counter-irritation.
 Diuretics, tonics, arsenic.
 Prevent entry of air if emphysema due to wound.

EMPHYSEMATOUS LUNGS.

- Occurring in old hard-worked horses.
 Careful dietary, concentrated damped food, occasional linseed mash.
 Treatment only palliative.
 No water given within an hour of work.
 Arsenic and belladonna relieve dyspnœa.
 Bleeding or draught of chloral in sudden acute cases relieves engorgement of right side of heart.
 Strychnine stimulates the respiratory centre.

ENCEPHALITIS.

- Congestion and inflammation of the membranes covering the brain and spinal cord, sometimes extending to the subjacent nervous structures.
 Occurs in all herbivora.

ENCEPHALITIS—continued.

Bleeding in early stages relieves either coma, delirium, or tonic spasms.
 Full dose of cathartic; sloppy food until bowels opened.
 Enjoin perfect quiet; place in dark box.
 Cold applications or ice-bag to head, or blister to poll.
 When acute symptoms abate, pot. iodide encourages absorption.
 Stimulants may be required if cardiac action feeble.
 Nux vomica and counter-irritants where paralysis supervenes.

ENDOCARDITIS.

Inflammation of membrane lining heart cavities and covering valves.
 More frequent than myocarditis; occurs especially in horses, cattle, and pigs; usually as sequel of contagious fevers depending on septic or pyæmic infection. Acute cases frequently affect left heart, chronic and pyæmic the right (Trasbot).
 Perfect rest and quiet.
 Digitalis to steady heart; quinine and other antipyretics.
 Frequently repeated stimulants maintain heart action in exhausted patients.
 In rheumatic complications salicylic acid or pot. bicarbonate.

ENTERITIS.

Inflammation affecting the mucous membrane of the bowels of all animals; is produced by irritants, exposure to cold, &c. In dogs, cattle, and sheep the small intestines are chiefly affected. Horses, especially hard-worked, irregularly-fed animals of the heavier breeds, are subject to rapid, usually fatal, hæmorrhagic effusion into the submucous tissues of the colon and cæcum, and the subserous structures of the attached mesentery.
 In these equine cases morphine and atropine hypodermically every two hours. Ergotin sometimes conjoined with the view of contracting blood-vessels.
 Half drachm each opium, belladonna extract, and camphor in pint of gruel, repeated every two hours.
 Where cardiac action violent, one or two small doses of aconite tincture may be added to the anodyne draught.
 Bleeding sometimes useful in earliest stage in vigorous subjects.
 Occasional laxative enema. Purgatives aggravate morbid conditions.
 From the outset rugs wrung out of hot water placed for two hours around the trunk, and soap liniment with opium subsequently rubbed over abdomen.
 Enteritis in other animals not so sudden in onset or so rapidly fatal.
 Blood-letting in robust subjects, oil and calomel, few doses of aconite.
 Hot fomentations, mustard and soap liniment.

ENTROPIUM.

Inversion of eyelid and eyelashes. Dogs more frequently affected than horses.
 Excision of elliptical portion of relaxed lid; edges secured by metallic suture; antiseptic dressing.

EPILEPSY. FITS.

Unconsciousness associated with spasmodic movements. Excitation of motor centres of cranial cortical substance. Result from (a) Tumours, morbid conditions, or parasites in the brain or meninges; (b) Reflexly from irritation of bowels or lesions of peripheral nerves; (c) Fright, anger, excitement. Most common in young dogs.
 Hold head of small animals firmly. Protect eyes from light. Maintain normal position.
 Take care that animal is not injured during convulsion.
 Regulate bowels. Remove worms or irritation connected with teething.
 Avoid causes of excitement.

EPILEPSY—continued.

Digestible nutritive diet; healthy surroundings.

Pot. bromide twice daily persisted with.

Iron salts in anæmia; zinc salts where gastric derangement.

Copper ammonia sulphate. Silver nitrate and iodine sometimes useful.

EPISTAXIS.

Bleeding from nostrils.

When from injury rupturing small blood-vessel, plug nostrils, raise head. A polypus present will be removed.

When from inflammation or ulceration of nasal membrane apply ice to frontal surfaces and head; spray with ferric chloride tincture.

When from purpura give by mouth ergot, ferric chloride, or pyrogallic acid; or ergotin subcutaneously.

Relieve any determining cerebral, cardiac, or respiratory congestion.

Warm-water bag to spine.

EPIZOOTICS.

Diseases attacking large numbers of animals in a short space of time and spreading widely; generally contagious.

Endeavour to destroy disease germs by carbolic acid, chlorine, sulphurous acid gas, or other disinfectants.

Isolate infected subjects. Enjoin cleanliness.

Sponge sick and healthy with sulphurous or carbolic solutions.

Administer sodium sulphite, glycerine carbolate, or other antiseptics.

ERYSIPELAS.

A specific febrile disorder, characterised by diffuse inflammation of the skin and subjacent tissues, believed to depend upon a microbe. Occurs occasionally in horses; on heads of sheep, spreading as a contagious epizootic (Professor Cagny); and in swine, known in France as *mal rouge*, and caused by a minute bacillus. See SWINE FEVER.

Isolate and disinfect; generous diet.

Aperients, salines, pot. chlorate conjoined with spirit of camphor.

In horses hot fomentations persevered with for several hours, and affected surfaces moistened with borax solution and laudanum.

Subcutaneous injection of antiseptics sometimes limits swellings.

Abscesses should be opened, but scarification of phlegmonous swellings rarely justifiable.

Milk and eggs, beef tea, alcoholic stimulants sustain strength.

Ferric chloride solution, both locally and internally, especially in weakly patients, for whom also prescribe quinine.

ERYTHEMA.

Patches of superficial dermal inflammation, with effusion into the epidermis. Occurs in all patients from rubbing, alkaline mud and cold.

Intertrigo and mud fever common varieties in horses.

Cleanse thoroughly. Dust with starch, fuller's earth; or zinc oxide, one to six or eight of starch; apply zinc or lead salts in solution or ointment.

Zinc oxide with kaolin or starch, in exudative forms, in which moisture to be avoided.

Horses liable to mud fever should not have the hair removed from their legs, and washing should be forbidden.

Salines in drinking water; pot. bicarbonate.

Laxatives, especially when connected with gastro-intestinal irritation.

Chronic forms, such as occur in cracked heels in horses, painted over with silver nitrate, one part to twelve water; or where this fails, blisters, diuretics, with liquor arsenicalis internally.

Arsenic and quinine in persistent cases.

EXOSTOSIS.

Deposit of bone.

Fomentations or refrigerants allay inflammation and pain of early stages.

Counter-irritants when heat and tenderness have been removed.

EXOSTOSIS—continued.

Mercuric iodide ointment ; fring-iron ; setons ; periosteotomy.
 Plugs moistened with irritant placed under skin over exostosis.
 Laxatives, with iodine and pot. iodide internally, promote absorption.

FAINTING.

Syncope. Results from enfeebled action of heart.
 Fresh air ; remove any pressure from neck.
 If horse down do not attempt to raise him.
 Raise blood-pressure by draught of cold water.
 Ammonia inhaled, swallowed, or injected hypodermically.
 Alcohol and ether, swallowed or in enema, especially when heart action weak or fluttering.

FALSE QUARTER.

Fissures in wall of horse's foot, from injury of secreting coronary band.
 Endeavour to restore secretory function of coronary band.
 Dress and promote healing of any wounds in band ; dead horn trimmed away ; equable pressure applied.
 Apply bar shoe to relieve concussion ; prevent dirt getting into cracks by filling them up with guttapercha.
 Blisters to coronet sometimes useful.

FARCY.

A chronic variety of glanders, exhibiting cutaneous or subcutaneous nodules, which ulcerate and develop secondary infection of the lymphatic glands. Caused by the glanders bacillus. Occurs in equine species ; produced in man and other animals by inoculation.
 Farcy subjects and in-contacts likely to have been infected slaughtered under Order of Board of Agriculture of 16th October 1892.
 Premises, harness, and utensils disinfected.
 Treatment only palliative, and the subjects liable to infect healthy animals with either farcy or glanders.

FAVUS.

Honeycomb ringworm, produced by the epiphyte *Achorion Schönleinii*.
 Occurs in man, horses, cattle, dogs, cats, and poultry, but not so common as the *tenea* variety.
 Soft soap and warm water, or alkalis with bland oils, soften and remove scabs.
 As parasiticides—iodine solution or ointment, sulphur iodide, iodoform, mercurial and corrosive sublimate ointments, ferric chloride solution, thymol, creosote.
 In weakly subjects give internally mineral acids, bitters, tonics.

FEVER, ACUTE OR INFLAMMATORY.

Concurring with acute local inflammation.
 Aconite ; occasionally blood-letting in earlier stages in robust subjects.
 Aperients, salines, laxative enemata.
 Remove any causes of irritation ; attend to wounds.
 Warm clothing, but cool air to breathe.
 Warm bath or sponging with tepid water.
 Antifebrin and other antipyretics ; sodium sulphite and antiseptics.
 Alcohol and digitalis sustain cardiac tone.
 Salicylic acid and sodium salicylate in rheumatic fever.
 Acids and bitters allay thirst and aid digestion.
 Light, easily digested food ; diluents ; salines in drinking water.

FEVER, LOW OR "TYPHOID."

Occurs in most epizootics, in connection with septicæmia and pyæmia, in inflammation of mucous membranes, and in debilitated subjects.
 Mild laxatives and enemata when required.
 Antipyretics, antiseptics, salines, acids, bitters.
 Quinine, especially in intermittent types ; arsenic in malarial cases.

FEVER, LOW or "TYPHOID"—continued.

Alcohol, ethers, or volatile oils promote excretion and cardiac action.
Turpentine and iron salts indicated in hæmorrhagic cases.
Suitable clothing, diet, hygiene, sponging, baths.

FEVER, SIMPLE.

Continued fever. Febricula. Occurs independently of local inflammation or septicæmia; common among horses brought into dealers' stables.

Comfortable box; plenty fresh air and light; perfect quiet.

Clothe body, bandage legs, mild laxative, mash diet, gruel, diluents.

Salines, ammonium acetate solution, pot. chlorate or nitrate, antifebrin, spirit nitrous ether.

Alcohol, ether, bitters, acids, tonics so soon as acute symptoms abate.

Catarrhal, gastro-intestinal, or other special symptoms receive appropriate treatment.

FISTULA.

A sinus with more than one opening; A narrow suppurating canal.

Remove diseased texture or other irritant. Render wound aseptic.

Open sinuses with knife; pass seton, or otherwise provide dependent opening.

Encourage healing of wound from below.

Where knife unsuitable, inject solution of corrosive sublimate, or of sulphate of copper or of zinc.

Milder treatment failing, slough out ulcerating surfaces and secreting walls with corrosive sublimate or arsenic plug.

Dress with carbolic or other antiseptic.

FLATULENCE. See DYSPEPSIA and HOVEN.**FLEAS.**

Pulex irritans.

Soap and water; cleanliness of skin and surroundings.

Turpentine, aniseed, or other volatile oils.

Persian insect powder; stavesacre decoction; tobacco water.

Pine sawdust for dog's bed.

FLUKEWORM IN SHEEP. See HYDATID IN LIVER—under WORMS.**FLYBLOW.**

Affecting wounds; specially troublesome in sheep.

Corrosive sublimate solution, turpentine, tar oil.

FOOT-ROT IN SHEEP.

Includes two diseases—

(1) Abrasions of horn from injuries, rough ground, long journeys; the exposed secreting surfaces especially of the sole becoming inflamed by dirt and grit insinuating under the damaged crust; the consequent fungoid growths and disintegration of horn proceed from below upwards. Non-contagious.

(2) A specific contagious inflammation originating in the interdigital skin, producing the vesicular eruption, subsequent perverted epithelial and horn growth, and from the outset an infective discharge, which inflames the secreting papillæ detaching the horny crust. This proceeds from above downwards. The discharge in contact with sound feet, or introduced by inoculation into the bodies of healthy sheep, produces the disease in fourteen to twenty-one days.

The non-contagious form cured by placing diseased sheep on dry soils, removing loose horn, dressing fungous growths with mild caustica.

The contagious form necessitates separation of affected sheep, dressing them daily or thrice a week.

One part carbolic acid, ten glycerine, applied between the dew-claws (Professor T. G. Brown).

Loose and diseased horn removed by knife.

FOOT-ROT IN SHEEP—continued.

Fungous growths cauterised with mixture of copper sulphate and crude carbolic acid made into paste with vaselin.

Mercuric nitrate, zinc or iron chloride solutions also useful.

Protect surfaces with tar dressing or guttapercha varnish.

Drive sheep twice a week over floors strewn three inches thick with freshly-slaked lime.

Walk sheep through wooden trough containing one pound each arsenic and sodium carbonate to twenty gallons water, or one part copper sulphate to fifty parts water (Professor Williams).

Prevent introduction of disease by three weeks' quarantine of fresh purchases.

FOUL IN FEET OF HERBIVORA.

A popular, somewhat indefinite term applied to chronic disease of the feet and fetlock of cattle or sheep, usually resulting from neglected injuries of the feet of cattle, or of foot-rot in sheep, or of tuberculous or rheumatoid inflammation.

Poultice; foment; remove loose and diseased horn.

Dress with copper sulphate and carbolic acid, regulating strength by state of parts.

Where disease is deep seated or intractable disarticulate or amputate.

FOUNDER. See LAMINITIS.**FOWL CHOLERA.**

Affects all species of birds, and by inoculation is produced in rabbits and white mice. Its essential features are croupous and hæmorrhagic inflammation of the mucous membrane and follicles of the intestine, similar conditions usually attacking lungs and heart. It runs its course in one to three days; 90 per cent. die. It is caused by a minute bacterium.

The premises should be swept; all litter, manure, and dead birds burned. Walls, woodwork, cribs repeatedly washed with boiling water, with carbolic acid, or corrosive sublimate.

Fumigation with sulphurous acid.

Preventive vaccination advised by Pasteur; but some birds die, and two or three operations necessary to secure immunity.

For curative treatment ferrous sulphate with a few drops hydrochloric acid every three hours.

Carbolic acid five per cent. solution subcutaneously used by Nocard.

FRACTURES.

Broken bones.

Bones brought into apposition.

Splints of leather, lath, block-tin, paroplastic, or guttapercha.

Encase in plaster of Paris, starch bandages.

Ends of bones may be kept together by metallic sutures.

Smart blister causes outpouring of fibrinous, plastic, reparative material, also favours parts being kept at rest.

Larger animals may require to be slung.

Wounds in compound fractures treated antiseptically.

Calcium phosphate internally in weakly subjects hastens union.

FRONTAL AND MAXILLARY SINUSES; INFLAMMATION OF LINING MEMBRANE.

Usually from catarrh, carious teeth, injuries, malformations, or glanders.

Unilateral. More common in horse than other patients.

Trephine. Wash out cavities with antiseptic: corrosive sublimate, carbolic acid, or iodine solution.

Injection should if possible be done while animal standing.

Frontal and maxillary sinuses of sheep the seat of the larvæ of *œstrus ovis*.

FRONTAL AND MAXILLARY SINUSES—continued.

These larvæ also sometimes occupy the chambers at base of horns.

Produce chronic catarrh and cerebral excitement.

Washing with an antiseptic solution the nostrils of sheep shortly after the ova have been deposited may prevent the mischief.

Subsequent treatment very hopeless, even when the sinus is trephined, as it is difficult to wash out all the larvæ.

FROST-BITE. GELATIO.

Raise temperature of frozen parts gradually.

Stimulants to affected parts, turpentine and oil, soap liniment.

Treat sloughs antiseptically.

FUNGUS HÆMATODES.

Vascular sarcomatous growth, usually protruding from orbit. More common in cattle and sheep than horse.

Extirpation of eyeball.

Speedy feeding and slaughter of patient.

GANGRENE.

Mortification. Death and decomposition of a part, usually accompanied by presence of micro-organisms.

Remove textures already dead by knife or silver nitrate, chromic or carbolic acid, iodoform or bromine.

With silver nitrate or other caustic endeavour to limit extension of gangrene.

Maintain wounds aseptic. Stimulate circulation in surrounding parts.

Sustain general strength by generous diet; tonics and stimulants.

Administer sulphites and other antiseptics.

GAPES IN FOWLS.

Caused by *Strongylus syngamus*. See WORMS.

GARGET. See MAMMITIS.**GASTRITIS.**

Inflammation of stomach. Rare in adult horse except from action of irritants; occurs in badly-fed foals, calves, and dogs; occasionally in older cattle as abomasitis.

Oily laxative to remove any irritant and irritant discharges.

In dogs foreign bodies or irritants removed by apomorphine solution hypodermically.

Ice, with hydrocyanic acid or morphine, or morphine hypodermically, relieve irritation and pain.

Antacids and bismuth, with or without small doses opium, in young animals and dogs.

Hot fomentations to abdomen.

The brain symptoms and paralysis occurring in adult cattle usually relieved by full doses of oil, followed by demulcents, treacle, salines, and laxative enemata.

Patients nourished with milk, eggs, well-boiled gruel, and nutritive enemata.

GASTRO-ENTERITIS.

Occurs in all the domestic animals. Nature and causes very varied.

Subdivided by Friedberger as Simple, Croupous, Infectious, and Toxic. See ENTERITIS.

Gentle laxatives; emetic, apomorphine hydrochlorate for dog or pig; demulcents.

Allay prominent symptoms with analgesics, antispasmodics, styptics, or special antidotes.

Hot applications externally; soothing enemata; fluid or semi-fluid digestible food.

GLANDERS IN HORSES.

A specific contagious, malignant disease of the horse, ass, and mule, depending upon a bacillus, entering the body with the inspired air or food, specially affecting the air-passages and lymphatic system, and transmissible to man and many other animals. Occurs in a more localised chronic form as farcy, which see.

Incurable. Under Contagious Diseases (Animals) Act, glandered subjects must be immediately reported and slaughtered.

GLANDULAR SWELLINGS.

Counter-irritants around or near; iodine, mercury oleate, or iodide.

Salines, iodine, and iodides internally.

Calcium chloride and sulphide internally help maturing of indolent swellings.

Iron salts in anæmic patients.

Inject with diluted carbolic acid, naphthol or other antiseptic.

GLASS EYE. See AMAUROSIS.**GLAUCOMA.**

Disease of vitreous humour of eye.

Not amenable to treatment; iridectomy affords relief.

Physostygmine diminishes intraocular pressure.

GLOSSANTHRAX. See ANTHRAX.**GLOSSITIS.**

Inflammation of tongue. Occurs in all animals.

Irrigate with mild astringent solutions.

Electuary of bismuth and oxymer, or treacle and vinegar.

Furnish soft nutritive food.

Scarify if œdema extensive.

GRAPES IN HORSES.

Inflammation, œdema, and hypertrophy of the papillary structures of the skin of horses' heels.

Remove by knife, scissors, hot iron, or caustics.

Dress with mixture of zinc sulphate, carbolic acid, and vaselin.

Dry the discharges with one part corrosive sublimate, five to ten parts hydrochloric acid, 1000 water.

Laxative diet; exercise or suitable work.

Iron salts, arsenic, iodine, salines internally.

GREASE.

Chronic inflammation of the several layers of the skin of the horse's fetlock. By many authorities regarded as pustulous or impetiginous eczema. But Professor Müller, of Berlin, has shown that the verrucose characters distinguish it from eczema, and terms it *Dermatitis chronica verrucosa*. The rete mucosum produces an excessive cell growth, which rapidly degenerates, irritating the surface skin and causing sero-purulent, greasy, fetid, irritant discharges. The proliferative process extends to the papillary layer, developing fungoid warty growths. The hair follicles and cutaneous glands are involved. Pathologically it is allied to canker in the foot (*Journal of Comparative Pathology*, March 1890).

Clip or shave hair, and thoroughly cleanse with soap and warm water.

Wash daily with one part corrosive sublimate, ten parts hydrochloric acid, 1000 water.

Envelop in wood-wool wadding, which absorbs discharge and protects denuded surfaces, and is kept in place with circular bandage.

When after a few days, discharge thus reduced, apply a pad of jute saturated with one part creosote to six parts spirit to disinfect and repress proliferating growth, and continue to keep dry with wood-wool wadding.

GREASE—continued.

Dust any ulcerating spots with zinc oxide or iodoform.

With knife, scissors, or hot iron remove grapes or warty growths.

When the discharge is abated, mercuric oxide ointment or tar dressing.

GROGGINESS. See NAVICULAR DISEASE.**GROUSE DISEASE.**

Depends upon micrococci found by Dr Klein in viscera of infected birds.

In order to limit production and distribution of microbe, diseased birds should be destroyed and burned with all found dead.

HÆMATEMESIS.

Hæmorrhage from stomach. Occasional in all animals.

Iced food, fluid and concentrated.

Astringents: lead acetate and opium; ergot hypodermically.

When bleeding from bowels give styptic in pills coated with kreatin.

HÆMATURIA.

Bloody urine from injury or disease of urinary organs. Occurs in all animals.

Oleaginous laxatives, sulphuric acid, iron salts, lead acetate internally.

Ergotin and belladonna hypodermically.

Fresh sheep-skins to loins of horse, spinal hot-water bag.

HÆMOGLOBINURIA or HÆMOGLOBINÆMIA OF HORSES.

Azoturia. This disease invariably occurs in horses which have been rested for a day or two. The pathology is still unexplained. The urine, although its specific gravity is unaffected, is albuminous and high-coloured from suspended granular pigment, probably derived from the voluntary muscles, which are suddenly affected by spasm, and subsequently become pale, flaccid, and wasted; while both the muscles and various internal organs contain after death a crystalline pigment (Professor J. M'Fadyean, *Journal of Comparative Pathology*, March 1888).

Dose of physic; action seconded by laxative enemata.

Physostygmine hypodermically where prompt catharsis required.

Chloral hydrate and opium, or nitrous ether and turpentine used as anti-spasmodics.

Ammonia and turpentine liniments applied over loins.

Frequently repeated moderate doses of alcohol, ether, or spirit of ammonia, with sulphuric acid and quinine, combat tendency to cardiac failure.

Where urine is not regularly passed use catheter thrice daily.

Attacks prevented by regular work or exercise, and sloppy, unstimulating food when resting.

HÆMOGLOBINURIA OF RUMINANTS.

Red and black water. Consists apparently in the breaking down of the red corpuscles of the blood, probably from the action of a bacterium, and the removal of the disintegrated products by the urine. Occurs enzootically in impoverished young cattle and occasionally sheep, and in cows shortly after parturition.

Change of diet; careful feeding; restrict supply of roots.

Salines and oils remedy the earlier constipation.

Astringents and demulcents the later diarrhoea.

Iron salts, bitters, mineral acids relieve anæmia.

Prevention consists in proper feeding and shelter of stock.

HÆMOPTYSIS.

Bleeding from the lungs. More common in horses than in other patients.

Abundance of fresh air, and where lungs congested friction to skin, embrocation to legs, which subsequently envelop in flannel bandages.

Ice to swallow; cold compresses over chest; ferric chloride or ergot.

HÆMOPTYSIS—continued.

Alcoholic stimulants, repeated every hour or oftener, to restore balance of circulation.

Ergotin hypodermically.

Digitalis where heart action weak or irregular.

In dogs and small animals moisten chest externally with chloroform.

HÆMORRHAGE. BLEEDING.

Bleeding from superficial wounds, when only small veins are lacerated, usually arrested by pressure, application of cold water, ice, refrigerants, or styptics.

A bleeding artery, as in castration, sealed by touch of hot iron, by torsion, or ligature; sometimes by severing a partially cut vessel.

Bleeding which cannot be got at arrested by cold or heat applied so as to act reflexly; by administration of such styptics as lead acetate and opium, sulphuric or tannic acids, ferric chloride, or by ergotin hypodermically.

HÆMORRHAGE, POST-PARTUM.

Occasionally occurs in all veterinary patients.

Promote uterine contraction by removal of placenta and introduction of ice into uterus or rectum, or both.

Contraction also produced by injection of water at about 110° Fahr.

Also by packing uterus with antiseptic tow or cotton wool.

Injection into uterus of ferric chloride or ergot solution, or ergotin hypodermically.

Raise hind-quarters; hot-water bag to dorsal region.

Alcoholic stimulants with laudanum ward off collapse.

HEART, DILATED.

Usually affects left ventricle, and accompanied by compensatory hypertrophy.

Avoid over-exertion. Digestible, rather concentrated, nutritive diet.

Digitalis, iron salts, or morphine, as indicated by special conditions.

As with most cardiac diseases, treatment only palliative.

HEART, FATTY.

Common in pampered dogs, and in horses that have suffered from serious or repeated attacks of reducing disease.

No over-exertion; suitable dietary.

Iron salts, arsenic, strychnine.

HEART, HYPERTROPHIED.

Occurs in hard-worked aged horses.

Discover and mitigate producing conditions.

Aconite and digitalis in small doses if heart action violent.

Moderate, slow work, caffeine, nutritive diet.

HEART, PALPITATION.

Rest, perfect quiet, generous diet; iron tonics where there are anæmic murmurs.

Aconite, small doses, where cardiac action violent.

Digitalis where action weak and irregular.

Bromides sometimes useful where action irregular and fluttering.

Laxatives when connected with digestive derangement.

Belladonna where condition associated with strain or over-exertion.

Strychnine acts as heart tonic.

HEART, VALVULAR DISEASE.

Endocarditis, acute or chronic, is the common cause in horses and dogs; it follows rheumatism in cattle. In horses lesions are most frequent on aortic valves.

Treatment only palliative.

Over-exertion and excitement avoided; nourishing diet.

HEART, VALVULAR DISEASE—continued.

Steady circulation by digitalis and alcoholic stimulants.

Purgatives, nitrites, arsenic lower vascular tension.

Relieve dropsy by caffeine, pilocarpine, other diuretics.

Combat dyspnoea and palpitations by morphine hypodermically, and pot. bromide by mouth.

HEPATITIS.

Inflammation of the hepatic cells.

Cathartic, salines, amm. chloride; aconite if febrile symptoms prominent. Ipecacuanha valuable, especially in dogs.

Fomentation and stimulation over region of liver.

Digestible, laxative diet; suitable exercise when acute symptoms relieved.

Nitro-hydrochloric acid in chronic cases.

Salines and careful dietary safer than more active remedies when hepatic inflammation or congestion associated with epizootic or other debilitating disease.

Chronic cases usually terminating in cirrhosis or amygdaloid degeneration treatment only palliative.

HERNIA.

Protrusion of organ from natural cavity.

Umbilical.—Exomphalos, chiefly occurs in young animals.

Patient, after fasting for several hours, must be cast, placed on back, and protruding portion of intestine returned.

Retained in position by sutures, clamps of wood or iron, skewers, or elastic ligature.

Cantharides blister, or other irritant, applied to adjacent skin, causes swelling, and in slighter cases occludes opening.

Ventral.—Protrusion of abdominal viscera through rupture in abdominal wall, usually through staking or thrust of a horn.

Unless large, or liable to strangulation, seldom causes inconvenience.

Where small and recent, opening usually closed by a blister.

Radical cure effected by returning viscus, and cutting down and suturing opening in abdominal walls.

Inguinal and Scrotal.—Although occurring in entire horse, extremely rare in gelding.

Cast, and return the bowel by taxis, and if need be by application of ice or refrigerants.

If this fails, enlarge constricting ring.

Covered castration operation in entire animal.

HERPES. See BULLÆ.

HOESE IN CALVES—caused by *Strongylus micrurus*. See **WORMS**.

HOVEN IN CATTLE OR SHEEP.

When rumen distended, chiefly with gas—

Full dose diluted ammonia, ether, turpentine, or alcohol.

Exercise and friction to abdomen hasten expulsion of gas.

Introduction of hollow probang allows escape of gas when food in stomach limited in amount.

In serious cases puncture abdominal walls with trocar and canula, or with butcher's, carving, or other large knife.

Administer cathartic to remove any irritant, and feed for several days on sloppy, digestible food.

When rumen distended with food—

A smart purge conjoined with an active stimulant; but repeated purgatives are injurious.

Solid food interdicted; slops, treacle-water, and ginger, freely given.

Water containing salines offered at short intervals.

Nux vomica useful when viscus in atonic state.

When distension and distress increase, there should be no delay in emptying the engorged stomach by rumenotomy.

HYDATID IN BRAIN OF SHEEP OR CATTLE.

Cœnurus cerebralis; Larvæ of tapeworm.

Trephine; remove sac and contained hydatid by trocar and canula.

Effectually treat all dogs with tapeworm, and prevent their getting hydatid affected brains.

HYDROCKLE.

Dropsy of scrotum. Rare in veterinary patients.

Evacuate by trocar and canula.

Injection of dilute iodine or other astringent solution.

HYDROCEPHALUS.

Chronic ventricular dropsy, not infrequent in horses, rare in cattle, dogs, or swine. Arrests brain development, producing gradual immobilitéé, usually appearing after third year. Common in certain valleys of the Alps and Rhone (Friedberger).

Treatment unsatisfactory. Quiet; light but nutritive diet.

Pilocarpine hydrochlorate, calcium phosphates, iron salts.

Trephine to relieve pressure in extreme cases.

HYDROPHOBIA. See RABIES.**HYDROTHORAX.**

Fluid in the chest. Affects all patients, but specially dogs. Concurs with pericarditis and ascites.

Digitalis; pot. nitrate twice daily for a week.

Follow up with pot. iodide and iron salts.

Pilocarpine hypodermically (Friedberger and Fröhner).

Iodine ointment and rubefacients externally; or insert under skin of chest plng of tow anointed with irritant.

When such measures ineffectual, where water fills one pleura, or half of each, where for three weeks no diminution of fluid noted, or where dyspnœa increases, tap with trocar and canula, or pneumatic aspirator.

IMMOBILITÉ.

Crick-back. See SHIVERER.

IMPETIGO. PUSTULAR DERMATITIS. See PUSTULAR ECZEMA.**INDIGESTION. See DYSPEPSIA.****INDIGESTION, ACUTE, OF HORSES.**

Stomach or grass staggers.

Aloes or calomel and oil to unload stomach and bowels.

Ether or spirit of ammonia every two hours overcomes flatulence and spasm.

Repeated copious laxative enemata, vigorous hand-rubbing of abdomen, and walking exercise encourage action of bowels and relieve spasm.

Hot fomentations or cloths wrung out of hot water, or in-rubbing of merely warming dose of mustard, abate spasm and pain.

Where pain persists, morphine and atropine hypodermically.

One or two small doses of aconite tincture sometimes useful.

Blood-letting sometimes advisable where brain symptoms or dyspnœa occur.

A long, fine trocar and canula may be used in extreme cases where tympanitis becomes dangerous.

Paralysis resulting, use strychnine and counter-irritants to spine.

In young animals, where stomach overloaded with clots of curd, prescribe oil, followed by ether or spirit of ammonia.

INFLAMMATION, ACUTE.

Aconite, small doses in early stages, repeated three or four times until pulse and temperature reduced.

Blood-letting in first stage in robust patients, especially where serous membranes sharply attacked.

INFLAMMATION, ACUTE—continued.

Calomel and other mercurials, although useful in human patients when serous and fibrous membranes are affected, are seldom so serviceable in veterinary subjects.

Place patient in suitable quarters; ensure cool, pure air.

Clothe body, bandage legs.

Hot fomentations or poultices most useful where inflammation is comparatively superficial.

Mustard or other stimulant embrocations applied to warm skin without blistering.

Ice or refrigerants applicable where inflammation limited or superficial, and in pharyngitis and laryngitis.

Cathartics to open bowels and lower arterial tension and temperature.

When more acute symptoms relieved, salines in small repeated doses—pot. nitrate and chlorate, magnesium sulphate, ammonium salts, sodium sulphite.

Simple digestible diet; diluents.

Cannabis indica, opium, belladonna; other analgesics internally and topically.

Provide for removal of morbid products by maintaining activity of excretory channels.

Salicylic acid, salicylates, alkalies, and salines in rheumatic, and with belladonna in cystic inflammations.

INFLAMMATION, CHRONIC.

Secure removal of morbid products by keeping excreting channels, unless themselves inflamed, in good working order by clothing, suitable diet, diluents, occasional laxatives, &c.

Salines and antiseptics. *See* INFLAMMATION, ACUTE.

Where patient reduced give digestible nutritive food.

Bitters, acids, and alcohol promote appetite.

Alcohol and volatile oils most useful in worn-out town horses, or where blood-poisoning has occurred.

Iodine and pot. iodide liquefy and remove exudate.

Counter-irritants frequently valuable—mercury oleate, embrocations, mustard occasionally applied and washed off.

Hypodermic injection of Savary's liquid mustard.

When joints or bones affected, mercuric iodide ointment, seton, or firing.

Opium, belladonna, other analgesics topically.

Ice and cold applications occasionally answer better than hot.

INFLUENZA.

Contagious febrile epizootic of horses, affects primarily the respiratory tract, but also involves the nerve centres, circulatory system, digestive mucous membrane, eyes, and subcutaneous structures. Communicable chiefly directly, but also indirectly; producible by inoculation of exudate; occurs in ass and mule; is not transferable to or from man; animals attacked usually immune for one to two years. Results from microbes whose natures are not yet definitely determined.

Two varieties described by Friedberger and other foreign authorities—

- (1) Catarrhal influenza or epizootic. Horse distemper. *Pferdestaupe*. Severe cases constitute Pink-eye.
- (2) Infectious, lobular, croupous, or gangrenous pneumonia, with secondary pleurisy and parenchymatous degeneration of principal organs. Chest plague. Depends upon a small ovoid transversely segmented bacterium (Schütz), which has been cultivated, and reproduces the disease, not only in horses, but in mice, rabbits, and pigeons. Besides this bacterium, pyogenic microbes are subsequently produced, which are probably chief factors in the production of gastro-intestinal or other complications. This pneumonic form is more serious than the catarrhal.

INFLUENZA—continued.

- Isolate patients, for their own comfort and safety of healthy subjects.
 Disinfect premises daily. Provide special attendant for sick.
 Comfortable box, temperature 60° to 65° Fahr., pure air.
 Rugs, hood, bandages to legs.
 Enemata, linseed mashes, and, if need be, occasional laxative; maintain bowels in regular state.
 Liquor amm. acetatis, Epsom salt, and nitre alloy slight pyrexia.
 More acute fever treated by antifebrin, antipyrin, thallin, digitalis, camphor, alcohol, and ether.
 Sodium salicylate, pot. iodide, and digitalis conjoined by Trasbot.
 Restrict to mash diet, with a little green food, but when pyrexia abates give digestible concentrated nutritive food.
Catarrhal forms treated by steaming head, medicated inhalations, or sprays. *See* CATARRH.
 Flannels wrung out of hot water, mustard, or other embrocations to throat relieve congestion of upper air-passages.
 Edema requires, with salines and antiseptics, early use of alcohol, ether, oil of turpentine, or ferric chloride solution.
 Purpura combated by pot. chlorate and quinine, alternated with ferric chloride and oil of turpentine.
Pneumonic cases are more difficult to treat. Liquor amm. acetatis, other stimulating expectorants, with pot. nitrate or chlorate and camphor, relieve dyspnoea.
 Hot fomentations to chest; mustard applied, but washed off in fifteen to twenty minutes; reapplied if needful; or injection of Savary's mustard extract.
 Cardiac asthenia combated by alcohol or ether given early, in moderate doses, every three hours, and conjoined with camphor and digitalis, or with caffeine and atropine.
 Diuretics, alkalies, and pilocarpine prescribed by Friedberger.
 When lung secretions are fœtid, phenols, *per orem*, or inhaled.
 Gastro-intestinal complications treated in earlier stages by a few doses of grey powder or calomel, conjoined with laxatives.
 In later stages, and with hepatic symptoms, by nitro-hydrochloric acid, sodium salicylate, or hyposulphite.
 Abdominal pain relieved by chloral and cannabis indica internally, or by morphine hypodermically.
 Rheumatic symptoms treated with salicylic acid, oil of turpentine, diuretic doses of digitalis and salines, with stimulation of affected muscles and joints.
 When febrile symptoms abate, coax patient to eat mash, green food, malt, steamed oats.
 When strength reduced, give milk, eggs, beef tea, and frequent alcoholic stimulants.

INTERTRIGO. See ERYTHEMA.**INTUSSUSCEPTION.**

- Invagination of a portion of intestine into immediately posterior portion of tube.
 No treatment of much avail. Restrict to limited amount of soft food.
 Avoid cathartics.
 Opium and cannabis indica allay spasm and pain.
 In the horse Professor Fred. Smith's long enema tube may be tried.
 Failing other means, cut down and endeavour to rectify the displacement.

IRITIS.

- Inflammation of the iris. Occurs in periodic ophthalmia in horse, which see.
 Dark box, cathartics, salines; continuous cold irrigation or ice-bag.
 Belladonna or atropine, alternated with physostygmine, prevent adhesions.
 Cannabis indica, opium, and other anodynes internally and locally.
 Seton or counter-irritant on side of face.

JAUNDICE.

The Yellows. Icterus. Skin discoloration from bile pigments. 1. Catarrhal, affecting the bile ducts. 2. Retention or reabsorption of bile. 3. Hepatic, from congestion, inflammation, or degeneration of liver.

Laxatives clear away excess of bile lodged in the bile tubes or duodenum. Simple digestible food beneficially diminishes formation of bile.

Massage of liver, mustard embrocations, or faradisation relieve biliary torpidity and retention.

Amm. chloride and salines in catarrhal cases.

Nitro-hydrochloric acid; where patient weak conjoin quinine.

Little can be done when depending on cirrhosis or fatty degeneration.

KENNEL LAMENESS. See RHEUMATISM.

LAMINITIS.

Acute founder. Inflammation of sensitive laminae of horses' feet.

Shoes removed, horn thinned, box bedded with several inches chaff or cut straw or tan.

Continued hot fomentations or poultices soften horn and relieve tenaion and pain.

Large cold bran poultices sometimes afford more relief than hot.

Bleed from jugular or toe in acute cases.

Bleeding more suitable when attacks result from concussion than from gastric derangement.

Repeated small doses of aconite, nitre, and other salines relieve fever.

Bowels, if need be, regulated by half dose physic and laxative enemata.

Vapour bath frequently serviceable.

When inflammation subdued, removal of exudate hastened by cold applications, and later by blisters to coronet, occasionally by frog setons.

Keep heels low and toe short; use stout wide-webbed and long bar shoes.

Neurotomy sometimes subsequently useful where lameness persistent.

LAMPAS.

Congestion of gums and palate of horses from teething and gastric derangement.

Soft food, astringent wash.

Scarify when swelling excessive and painful.

LARYNGITIS.

Inflammation of mucous lining of larynx, pharynx, and trachea. The following fourfold classification adopted by Friedberger:—

- (1) *Catarrhal*.—Occasionally epizootic and contagious. Occurs especially in horses and dogs.

Comfortable box, suitable clothing, moist atmosphere of 60° to 70° Fahr. Steam head and throat persistently with medicated vapour; heat and moisture externally.

Aconite and laxatives abate fever; emetics in dogs and pigs.

Ammonia acetate solution, camphor and belladonna electuary.

Counter-irritants of soap and opium liniment, mustard, cantharides.

Intratracheal injection of solution of morphine and hydrocyanic acid used successfully in 200 acute cases by Jelkmann (*Journal of Comparative Pathology*, December 1889).

Tracheotomy where dyspnoea becomes dangerous.

- (2) *Chronic*.—Usually a sequel of the catarrhal form. Alum or ferric chloride as electuary or spray; glycerine of carbolie or tannic acid.

Belladonna and camphor, with glycerine and water as anodyne gargle.

Counter-irritants; essence of mustard hypodermically.

Intratracheal injections of alum, lead acetate, glyceride of tannin (Friedberger).

- (3) *Croupal or membranous*.—Occurs in cattle and cats; rare in horses and dogs. Usually rapidly fatal.

LARYNGITIS—continued.

Steam throat with watery vapour medicated with benzoic acid or tar oils.
Emetics in carnivora.

Hot compresses; mustard or other counter-irritants; tracheotomy.

- (4) *Edema glottidis*.—(Edema of submucous tissue of glottis. From (a) acute attacks of laryngitis, from smoke or hot air, corrosive irritant liquids; (b) infective pyæmia, as in charbon, glanders, &c.

Watery medicated vapour.

In-rubbing or hypodermic injection of mustard essence.

Tracheotomy.

LEUCORRHEA.

Fluor albus. The Whites. Inconstant muco-purulent discharge from the uterus. Occurs in all domestic animals.

Syphon or syringe the uterus and vagina with tepid alkaline solutions, and subsequently with dilute carbolic acid or zinc sulphate.

Belladonna or iodoform in suppository, or injection where there is excessive secretion or pain.

Copper or iron salts, turpentine internally, especially in delicate subjects, or in obstinate recurring cases associated with tuberculosis.

Common cause of vaginitis, perhaps of abortion, also of balanitis in male having connection with affected female.

LICE.

Pediculi; Phtheiriasis. Each of the domestic animals infested by its own species, and also by the allied apterous insects, the Trichodectes.

Cleanse skin with soft soap and warm water, and rub in decoction of stavesacre—one to forty water. For limited areas, one part stavesacre, twenty vinegar.

Oil of tar, one part; oil of rape or other bland oil, four parts.

Oil of tar, five parts; liquor amm. fort., one part; water, fifty parts.

Equal parts carbolic acid and soft soap, ten of oil.

Sulphur iodide or mercuric nitrate ointment used cautiously for isolated, thickly-infested spots.

Patients long and seriously infested should have long coarse hair clipped and dressing well rubbed in.

The usual dipping mixtures for sheep.

Diluted solution of chloroform and essential oil for pet dogs.

Strong tobacco decoctions and mercurial ointments apt to produce constitutional effects.

Isolate infested subjects and their belongings, and thoroughly cleanse premises occupied by them.

LICHEN.

Chronic papulo-vesicular eczema. See ECZEMA.

Laxatives, salines, oleaginous diet.

Apply locally, night and morning, an alkaline wash, to which—if there is itching—add a little thymol, chloroform, or pot. cyanide.

Tonics and arsenic, with iodide of sulphur ointment, and tar oils alternated in chronic cases.

LITHIASIS: GRAVEL. See CALCULI and URINARY DEPOSITS.**LOCKJAW. See TETANUS.****LOUPEING ILL IN SHEEP. See MENINGITIS.****LUXATIONS. See DISLOCATIONS.****LYMPHANGITIS IN HORSES.**

Weed. Monday morning disease. Inflammatory œdema. Inflammation of lymphatic glands, absorbents, and blood-vessels of horse's limbs; usually affects the inguinal glands.

Bleed from jugular in robust subjects and where fever acute.

LYMPHANGITIS IN HORSES—continued.

Cathartic, laxative enemata, salines in drinking water remove irritant waste products. Bran mashes and wet food.

Aconite where fever acute. Antipyrin or antifebrin *per orem* or subcutaneously in inflamed region (Professor Cagny).

Hot fomentations persisted with for several hours, and limb then lightly swathed in woollen or hay bandages.

Where limb tender and painful after fomenting, moisten with soap liniment and laudanum.

When weather cold, clothing needful to promote skin functions.

Stimulants useful where preliminary rigor severe or continued.

Exercise injurious while acute symptoms continue, but serviceable later.

In hard-worked, debilitated subjects, bleeding and aconite unsuitable.

Give half dose physic and salines, foment limb, and administer turpentine and alcoholic stimulants.

Aid removal of swelling by exercise, and subsequently moderate work; smart friction of limb daily with oil; diuretics and tonics; iodine or pot. iodide internally; laxative diet and green food.

Careful regulation of food, work, and rest prevent recurrence.

LYMPHATICS, INFLAMED.

Occurs especially in horses; from pricks, other injuries, infective material, as of glanders.

Remove if possible the original cause.

Cooling diet, salines, pot. iodide.

Foment while heat and tenderness continue.

When tenderness abates, apply friction, bandages, iodine ointment; continue salines in drinking water.

MAD STAGGERS. See PHRENTIS.**MALADIE DU COÛT OF HORSES.**

A specific chronic equine disease of the male and female genitals, characterised by catarrhal discharges, œdematous and phlegmenous swellings and ulcerations. There supervenes a vaso-nervous urticaria and spinal paralysis. The disease is communicable from coition by affected horse or mare, and is doubtless caused by a microbe; the period of incubation varies from eight to sixty days; the mortality in the horse is greater than in the mare, reaching 70 per cent.

Thorough daily irrigation of affected parts with corrosive sublimate 1 part, common salt 10, water 1000.

Ulceration treated with strong solutions silver nitrate or copper sulphate.

The horse cast and penis thoroughly examined, and treatment adapted to special lesions.

Concentrated nourishing food.

Iron and copper salts, iodine and iodides, arsenic, quinine.

Months of patient treatment often elapse before cure effected.

In Prussia no affected stallion can be used in the stud until three years after recovery has been reported.

A contagious exanthematous vesicular eruption of a comparatively benign type affects the genital mucous membrane of dogs and cattle, occasionally of horses, and less frequently of goats, sheep, and hogs. The male suffers more than the female. The incubation stage three to six days.

Astringent lotions; ulceration treated as above.

MAGGOTS FROM FLYBLOW.

Turpentine and oil; phenol solutions; corrosive sublimate solution.

MALLENDERS AND SALLENDERS.

Chronic squamous eczema of the skin in the flexures of the horse's knee and hock. The chronic scaly condition preceded by an erythematous and vesicular stage.

MALLENDERS AND SALLENDERS—continued.

Soft soap and water, or carbonated alkali and vaselin, remove scales.
 Boro-glycerine or zinc oxide ointment relieves irritation.
 Mercuric nitrate or iodine ointments abate thickening and infiltration.
 Tar oils or decoction of oak bark in chronic cases.
 Half dose physic, salines, laxative diet.
 In debilitated subjects iron tonics and arsenic.

MALNUTRITION.

Liberal oleaginous dietary; change of food.
 Acids and bitters, iron salts, calcium phosphate in young animals.
 Alcohol, arsenic, nux vomica.

MAMMITIS.

Garget. Inflammation of the udder: (1) Catarrhal, affecting primarily the mucous membrane; and (2) Lobular or glandular. Occasionally in all milking animals, but most frequent in good dairy cows.
 Cathartic; antipyretics in drinking water.
 Bleed from jugular, and give a few doses of aconite where fever acute and patient in high condition.
 In cold weather clothe to promote skin functions.
 Milk three or four times daily, or oftener; and with careful pressure remove drippings, which ferment and increase irritation.
 The teat syphon sometimes facilitates removal of milk, but must be used very carefully. Support udder.
 Apply heat and moisture by persistent fomentations, or poultices of spent hops, supported by wide web of sacking round the body.
 Belladonna extract and vaselin applied several times daily lessens congestion, milk secretion, and tenderness.
 When gland acutely inflamed inject atropine.
 When inflammation abates encourage removal of exudate by in-rubbing iodine ointment, and by iodine and salines internally.
 When abscess forms and matures open it and treat antiseptically.
 When gangrene occurs excise dead tissues and dress with antiseptics.
 After earlier pyrexia removed sustain strength by concentrated good food, tonics, and stimulants.
 Until udder again in normal state restrict to dry food, so that production of milk be minimised.

MANGE.

Scabies. See ACARI. Skin irritation and itching produced by several varieties of acari.
 (a) The Psoroptes or Dermatodectes live on surface of skin, obtaining nourishment from its blood and lymph, and distributed tolerably generally over the body.
 (b) The Sarcoptes burrow subcutaneously, prefer the head and portions of body sparsely covered with hair.
 (c) The Chorioptes or Symbiotes are more limited in their distribution, affect chiefly the limbs of horses and sheep, the base of the tail of cattle, and the external ear of dogs.
 The first and third genera are most frequent in horses and cattle; all three occur in sheep, the first most common. The *Sarcoptes canis* is the cause of the ordinary mange in the dog.
 Isolate infected subjects.
 Thoroughly cleanse, wash, and disinfect with carbolic or corrosive sublimate solution clothing, harness, stable fittings, rubbing-posts, &c.
 Clip, collect, and burn hair.
 Crusts softened and removed by soap and water, pot. carbonate, with oil, vaselin, or glycerine and water.
Psoroptes or *Symbiotes* are destroyed without much skin irritation or risk of poisoning by stavesacre ointment or solution, sulphur iodide ointment, or creolin tincture, applied daily for a week.

MANGE—continued.

Tar oil one part, palm oil six parts, laid on tolerably thickly, and should remain undisturbed for four or five days.

Wood tar and sublimed sulphur each one part, soft soap and alcohol each two parts.

Whichever dressing be used must be thoroughly rubbed in, and when washed off should within a week be reapplied.

Not more than one-fifth part of the body should at a time be dressed with ointments or tar liniment. Grooming or combing the patient scatters the parasites, and is meanwhile interdicted.

To kill the burrowing *Sarcoptes* the parts affected are lathered with soap and water, soaked for some hours with solution of pot. carbonate and oil, and the parasiticide rubbed in with a brush. To destroy subsequent hatchings a second, and in bad cases a third, dressing may be needed, at intervals of a week.

Oil of cade and coal tar, each one part, mixed in a mortar, and three parts benzine added, commended by Traasbot.

Corrosive sublimate and common salt, each two parts, 100 water, conjoined with an equal quantity of a 15 per cent. solution of tobacco (Friedberger). But this strong solution must be used very cautiously.

Persistent spots over limited area dressed with mercurial ointment.

Change dressings repeatedly.

For ears of dogs naphthol 10 parts, ether 30, olive oil 100.

For poultry dust skin thoroughly with pyrethrum powder (Professor Cagny).

Treatment in sheep specially noticed under SCAB.

MANGE, FOLLICULAR.

Caused by the *Demodex folliculorum* of the order *Acarus*—an Arthropodis of the *Dermatophiles* family. Inhabits the sebaceous glands and their tubes, usually about the head and extremities; produces erythema of adjacent skin, strophy of hair roots, muco-purulent discharge, formation of small abscesses; often assumes a squamous type.

Occurs in dogs, cats, and occasionally in pigs.

Separate patient from other animals.

Treatment uncertain and tedious; may occupy months.

Shave the parts affected; lather with terebene soap, and rub in daily for several weeks balsam of Peru (Siedamgrotzky).

Creosote one part, caustic pot. solution two, olive oil fourteen (Hunting).

Creosote or oil of cade with caustic pot. are rendered more penetrating by addition of chloroform.

Solutions of benzine or naphthol, sulphur iodide ointment.

Creolin and ichthylol are said to be effective if the dog is placed in a bath containing 2 to 3 per cent. of either remedy for a quarter of an hour daily for two months (Friedberger).

Creolin 5 parts, 100 lanoline, vigorously rubbed in night and morning (Guinard).

Scrub thoroughly every affected spot with forty grains pot. sulphide to a pint of water, dress limited sections of the legs or body with cantharides ointment, and rub the head and remaining portions with balsam of Peru. Repeat daily for a week, applying the cantharides to fresh spots. After a few days' rest resume (Brussasco, Veterinary College, Turin).

MEGRIMS.

Vertigo: Giddiness; occurring in horses; consisting in cerebral congestion, usually resulting from pressure of the collar, sometimes from reflex irritation.

Remove any pressure interfering with cerebral circulation.

Dash cold water over head and neck.

Walking exercise; hand-rubbing of body and legs.

Moderate bleeding or dose of physic sometimes useful.

Horses subject to megrims should be driven with breast-strap.

MELANOSIS.

A pigmented species of Sarcoma, usually localised where pigment already occurs, as in the skin or eye. Most frequent in grey horses.
Remove by knife or caustic.
Dress with antiseptics.

MENINGITIS.

Inflammation of the membranes of the brain and spinal cord. The intensity of the attack and the parts specially affected determine excitement or paralysis of the central nervous system. Occurs in all veterinary patients; frequent and fatal in cattle and sheep, in which often associated with gastric derangement.

Where cerebral excitement prominent, dark box, active cathartic; blood-letting in robust subjects; ice to head. See PHRENTIS.

Cathartics, physostigmine, and pilocarpine (Friedberger).

When functional activity of cord exalted hot or cold compresses to spine; laxatives.

Remove retained contents of bladder or rectum.

Sling horses that have difficulty in standing.

When acute symptoms relieved pot. iodide and salines.

Chronic paresis treated by strychnine and embrocations to poll or spine.

Epizootic form in horses—cerebro-spinal meningitis, which see.

Sheep suffer from chronic spinal paralysis, characterised by hyperæsthesia and convulsive movements, general muscular feebleness, paresis of the hind-quarters, and progressive wasting; no definite pathological lesions; popularly known as Louping-ill, described by Friedberger as Lumbar prurigo, by Trasbot as Maladie des trotteurs, and believed by Professor Williams to result from a microbe with which the sheep are inoculated by ticks—the *Ixodes ricinus*.

Treatment unsatisfactory. Remove affected animals from breeding flock.

Feed young stock liberally.

Improve poor pastures on which disease occurs.

METRITIS. METRO-PERITONITIS.

Inflammation, usually septic, affecting the uterine and peritoneal membranes. Occurs in all animals, usually about three days after parturition. Liable to spread by contagion.

Syphon or syringe uterus and vagina with one per cent. creolin or one per 1000 corrosive sublimate solution.

Remove portions of placenta or blood clot; render aseptic any wounds.

Where walls of uterus dilated or flaccid inject solution of ergot and belladonna tincture.

Woollen cloth or lint wrung out of hot water applied over loins and round abdomen relieves spasms and pain.

As in other septic cases, creolin, ether, phenols, naphthol, or sulphites are given internally.

If bowels torpid half dose physic with laxative enemata.

Remove urine by catheter.

Sustain strength by generous diet, tonics, and stimulants.

Isolate patients from gravid or parturient animals, and use disinfectants.

MORTIFICATION. See GANGRENE.**MUD FEVER. See ERYTHEMA.****MURRAIN.**

Foot-and-mouth disease. See APHTHOUS EPIZOOTIC.

MYOSITIS.

Inflammation of muscle, usually from direct violence, strains, rheumatism, or pyæmia. Occurs in all animals.

Rest. Injured muscles if possible kept relaxed.

Fomentation succeeded by application of belladonna or opium liniments.

Cathartic and antipyretics, especially when dependent upon rheumatism or pyæmia.

MYOSITIS—continued.

Counter-irritation, galvanism, regular exercise if atrophy supervenes.
Free incision if pus forms.

NASAL GLEET.

Ozæna. Usually occurs in horse.

Sulphurous acid, iodine, iodoform inhalations.

Nasal douches of salt and water containing a few drops of iodine tincture.

Bleaching powder scattered in box.

Copper or iron sulphates, arsenic, turpentine, buchu, and copaiba.

Blister over sinuses; remove faulty teeth.

Other treatment failing, trephine sinuses; wash out with antiseptics.

Isolate all horses with suspicious nasal discharges.

NAVICULAR DISEASE.

Grogginess. Rarifying osteitis of the navicular bone of the horse, with necrosis of the articular cartilages and surrounding structures; the flexor pedis perforans tendon is subsequently inflamed, and becomes adherent to the navicular bone. Concussion and rheumatoid diathesis believed to be the chief causes.

Remove shoes and allow frog to come to the ground.

Stand horse in cold water baths, or apply cold wet swabs for several hours daily.

Apply at night poultice, but not too unwieldy, or preventing patient lying down.

Dose of physic and cooling diet.

After fortnight or three weeks lightly blister coronet.

If marked benefit does not result, seton frog, and keep seton in three or four weeks.

If disease still persists relegate horse to slow work with shoes without heels or toe piece.

Concussion diminished by shoeing with leather, and using shoes thick in quarters and thin at toe and heels.

Where foot and limbs otherwise sound neurotomy may secure several years' fair service.

NECROSIS.

Death of bone in whole or in part; corresponds to gangrene in soft parts.

Remove sequestrum; iodoform and other antiseptic dressings.

Encourage reparative process by local and general treatment.

NETTLE RASH.

Surfeit. See URTICARIA.

NEPHRITIS.

Inflammation of kidneys. Of several forms.

(1) *Acute*—chiefly affecting the glomerules.

(2) *Chronic*—usually involving various renal structures.

(3) *Purulent*—a sequence of the acute and of other diseases, with formation of renal abscess.

Absolute rest, light laxative food; diluents, milk diet for dogs.

Maintain activity of other excreting channels.

Foment, hot compresses; fresh sheep-skin to loins of horses; hot bath for dogs.

Pilocarpine hydrochlorate (Friedberger and Fröhner).

In suppression of urine Professor Williams orders digitalis decoction, repeatedly applied to the loins.

When heart weak or inquiet digitalis or caffeine.

Chronic cases require similar treatment.

Digestible nutritive food to sustain strength.

Digitalis, caffeine, and pilocarpine to combat effusion.

In purulent cases alkaline sulphites, copaiba, and eucalyptus oil.

Where abscess diagnosed pus may be withdrawn by aspirator.

Extirpation of kidney has been successfully practised.

NEURALGIA.

Pain along course of a sensory or mixed nerve.

Endeavour to discover and remove any cause of nerve irritation.

Any wound likely to cause or aggravate the condition should be fomented and dressed antiseptically.

Laxative beneficially promotes action of bowels and excretory channels.

Analgesics topically; morphine hypodermically along course of nerve.

Administer salines, iodine, with pot. iodide, arsenic, phosphorus; pot. bromide where patient irritable.

Counter-irritants, mustard, iodoform, veratrine, electricity in chronic cases.

Nerve stretching by flexion of parts or cutting down on nerve.

Iron salts, strychnine internally.

Generous diet, with fair proportion of oleaginous matters where patient debilitated.

NEURITIS or PERINEURITIS.

Inflammation of the sheath or connecting tissue binding the nerve fibres. Occasionally in all patients, from injury, cold, rheumatism, lead-poisoning.

Remove causes if possible.

Rest of parts supplied by nerve. Fomentations, analgesics.

In chronic cases blister along course of nerve.

ÆSTRUS EQUI. See BOTS.**ÆSOPHAGEAL OBSTRUCTIONS.**

Mechanical tumours; Peri-æsoophageal abscesses.

Pass probang or sound.

Remove obstruction if possible.

ÆSOPHAGEAL DILATATIONS.

Difficult to treat.

Feed frequently in small quantity on concentrated fluid or semi-fluid food.

Excision of pouch and insertion of sutures successful in horse (Friedberger).

ÆSOPHAGEAL PARALYSIS.

Pass sound; embrocations externally; administer strychnine.

ÆSOPHAGITIS.

Inflammation of mucous membrane or muscular structures of gullet—

- (1) Catarrhal; (2) Phlegmenous; (3) Parenchymatous; (4) Parasitic;
- (5) Tumours occurring in dog (Friedberger).

Give fluid soft food cold; ice.

Refrigerant compresses.

Antiseptic and mild astringent electuaries.

Stimulant embrocations to absorb hard circumscribed swellings.

OPEN JOINTS.

Healing by first intention promoted by cleansing wound and antiseptics.

Corrosive sublimate one part to 1000 water.

If wound of several days' standing inject with sublimate solution.

Sprinkle with iodoform; apply several layers lint filled with iodoform.

Severed surfaces may be brought together by suture, provided movement of joint and tearing can be prevented.

Splints and bandages secure support and protection.

Slings horse prevents movements which might reopen wound, and removes weight which in injuries of limbs aggravates inflammation.

Inflammation relieved by half dose of physic; cooling diet, and weak antiseptic solution allowed continuously to trickle over a calico bandage lightly laid over the joint.

OPEN JOINTS—*continued.*

When the wound is unlikely to close quickly, or simple treatment has failed, a blister is sometimes applied, with view of closing opening, limiting motion, and relieving pain.

Anchylous apt to result where injury has been serious or case neglected or badly treated.

OPHTHALMIA.

(a) *Simple inflammation* of the mucous membrane of the eye; Conjunctivitis; occurring in all animals.

(b) *Periodic or Specific*; Moon blindness; Specific inflammation of most structures of the eye of horses; hereditary; liable to recur, and eventually causing cataract and blindness.

Remove any foreign body. The membrana nictitans has sometimes to be first secured with a tenaculum or stitch.

Fomentation with tepid water and decoction of poppy-heads abates irritation, whether depending on foreign body or cold. Half dose physic.

Antiseptics, mild astringents; bland ointment to prevent lids sticking together.

Where inflammation severe blood may be drawn from the angular vein.

Belladonna and atropine, locally and generally, diminish irritation and prevent adhesion of iris.

Steam head when concurring with œdema of lids, as in influenza in horse.

Protect the eyes from light.

Periodic form incurable; relieved by cathartics, febrifuges, anodynes, belladonna or atropine, locally and internally.

ORCHITIS and EPIDIDYMITIS.

Inflammation of the testicles and epididymis.

Fomentations, anodynes, dose of physic; support testicle.

Iodine liniment; pot. iodide internally.

If pus forms must be evacuated by free incision.

Tubercular form intractable; castrate in early stage.

OSTEO-MALACIA or MOLLITIES OSSIUM.

Fragilitas ossium. Osteo-porosis. Softening of the bones of adults; corresponding to rickets of young animals. Appears to depend upon excess of lactic acid products in blood, and insufficient deposition of calcium phosphate in bones. Most frequent in cattle, especially milking cows, and poultry; not so common in horses and hogs; rare in sheep.

Concentrated nutritive food, fresh air, exercise; dry healthy surroundings.

Calcium phosphates. Remove any gastro-intestinal troubles.

OSTEITIS.

Chronic or subacute inflammation of bone; associated with periostitis; occurring in exostoses; sometimes tuberculous.

Heat and moisture; cold applications; allow escape of any exudate.

Cooling diet, salines, alteratives.

Blister; seton; fire.

OTORRHEA.

Catarrh of lining membrane of ear, extending from pharynx or larynx.

Occurs in dogs, also as sequel of distemper, or from being much in water.

Hot fomentations continued for several hours.

Warm solution of boric acid or glycerine of tannin dropped or syringed into ear.

Morphine hypodermically.

Cathartic; cooling diet. Strict attention to cleanliness.

If pain great and membrane much swollen carefully scarify.

OVER-REACH IN HORSE.

Bruise of coronet of fore-limb, caused by the shoe of the hind foot.
 Foment; antiseptic dressing.
 Protect coronet with pad.
 Use light shoes; shorten and round off offending shoe.

PARALYSIS.

Paresis. Palsy. Impairment or loss of motility or sensation. Impaired motility most common in lower animals. Classified as—(1) General; (2) Unilateral or Hemiplegia; (3) Transverse or Paraplegia; (4) Local. This last most frequent.

Pot. iodide and salines if dependent on pressure from fluid.
 Trephine and raise bone if results from depression of cranial bones.
 When caused by embolism or thrombosis treat as thereunder.
 Remove gastric, uterine, or other local irritation, or blood-poisoning.
 Rest, quiet, light digestible food.
 When bladder affected remove urine by catheter.
 Salines, tonics, and other remedies to improve general vigour.
 When chronic, strychnine to stimulate motor centres and nerves.
 Friction, kneading, and occasional application of counter-irritants and electricity impart nervous and muscular tone.
 In cattle, paresis when depending on gastric derangement treated by full dose of physic and subsequent nerve tonics.
 As a sequel of milk fever, pot. iodide followed by nux vomica, and counter-irritants to spine.
 Connected with anæmia, liberal dietary and tonics.
 In dogs, after dose of castor oil, prescribe pot. iodide, and, if stomach irritable, bismuth and hydrocyanic acid.

PAROTITIS.

Inflammation of parotid gland. Traumatic. Idiopathic. Metastatic. Actinomycotic (Friedberger).
 Hot moist compresses or poultices.
 Infriktion as required of mildly stimulating or anodyne ointments.
 When chronic or indolent, iodine or cantharides dressings.

PATELLA, DISLOCATION OF.

Occurs in colts, occasionally in calves.
 After replacement keep limb extended and drawn forward for several hours by cord attached to the fetlock and carried round the neck.
 Put on a shoe high at the toe and projecting forward.
 Blister stifle.

PERICARDITIS.

Inflammation of serous covering of heart. Rare in horses and dogs, in which usually rheumatic or septic; more frequent in cattle and goats, from their swallowing sharp-pointed bodies, which pass through the walls of stomach and diaphragm, and enter the pericardium, producing cardo-pericarditis.

Cautious blood-letting, followed by small doses aconite in acute idiopathic cases, but unsuitable in second stages, in epizootic or traumatic cases.
 Morphine hypodermically usually relieves acute pain.
 Woollen cloths wrung out of hot water applied to the chest for an hour or two at a time.
 Soap liniment containing one-twentieth part opium tincture rubbed in freely between each fomentation.
 Digitalis, strophanthus, caffeine moderate rapid, violent, irregular heart action.
 When fluid effused, supporting treatment; moderate doses of stimulants; pot. or ferrous iodide, with counter-irritants to chest.
 Digitalis and strychnine assist absorption of fluid by raising blood-pressure in renal arteries and promoting diuresis.

PERICARDITIS—continued.

Where hydrops pericardi persists, the fluid may be removed by special trocar and canula.

Needles and other foreign bodies have been cut down upon and removed.

PERIOSTITIS.

Inflammation beginning in or chiefly affecting the periosteum; may be acute or chronic; simple, as from kicks or injuries, or diffuse or infective. The vascular structures of the bone are involved. Occurs in all patients.

Rest, cold applications, analgesics.

Hot poultices if suppuration threatens.

Free incision if pus forms; antiseptics.

Liberal diet; stimulants and quinine if blood-poisoning imminent.

PERITONITIS.

Inflammation of serous membrane covering the bowels and lining the abdominal walls.

Blood-letting or two or three small doses aconite in early stages of acute non-epizootic cases in robust subjects.

Opium in full doses quiets movement of bowels and relieves pain.

Morphine and atropine hypodermically prompt and effectual.

Woollen rugs wrung out of hot water applied for two hours continuously, surface thoroughly dried and rubbed with soap liniment and opium tincture.

Light mustard dressing applied for fifteen to twenty minutes; but active counter-irritation injurious.

Milk, eggs, beef tea, and oatmeal gruel support strength.

When more acute symptoms past, salines in drinking water and enemata maintain natural condition of bowels.

Alcoholic or etherous stimulants and camphor useful in second stages and in young and weakly subjects, and earlier in most influenza cases.

A cantharides blister and pilocarpine where fluid remains unabsorbed.

Other treatment failing, laparotomy. *See ASCITES.*

PHARYNGITIS.

Inflammation of mucous lining of pharynx.

(a) Catarrhal or from local irritants; (b) Extension of neighbouring inflammation; (c) Specific infection. Occurs in all animals, notably horses, under the familiar title of Sore-throat.

Comfortable quarters, pure air, soft nutritive food.

Drinking water impregnated with borax, pot. chlorate, or vinegar.

Sponge lips and nostrils; gargle or syringe with mild antiseptics.

Combat acute inflammation by hot compress or poultices.

Belladonna and camphor relieve spasms of pharyngeal muscles.

When swelling hard and circumscribed apply stimulating embrocations.

Glycerine of tannin or ferric chloride solution when throat relaxed.

Liquor chlori or tinctura iodi in diphtheritic or infective cases.

Pharyngeal abscesses occur as sequels, are matured by steaming and fomentation, and may sometimes require to be opened by a guarded knife.

Tracheotomy when swelling produces dangerous dyspnoea.

PHLEBITIS.

Inflammation of vein. Simple or idiopathic; Diffuse or suppurative.

Apply cantharides blister along course of vein.

Open any abscesses; cathartic; laxative diet.

Horse with impervious jugular should not be turned to grass.

Diffuse phlebitis treated antiseptically, but rarely successfully.

PHRENTIS.

Cerebritis; Mad staggers of herbivora; Inflammation of the brain, usually also affecting the membranes. Not common in veterinary patients.

PHRENTIS—*continued*.

Bleeding where symptoms urgent. Cathartics and laxative enemata.
Cold applications; ice to head; perfect quiet.
Bromides when more acute symptoms abate but patient still remains
excitable and restless.

PHTHEIRIASIS. See LICE.**PHTHISIS PULMONALIS.**

Pulmonary consumption. See TUBERCULOSIS.

PILES.

Hæmorrhoids. Swellings inside or around the anus, consisting of dilata-
tion or varicosity of blood-vessels. Occurs in dogs.
Remove hardened fæces by enema; cooling digestible diet; oily aperients
if needful.
Gall and opium ointment or zinc benzoate ointment.
In persistent cases remove by ligature, clamp, canterly, or knife.

PLETHORA.

Defined as a superfluity or hypertrophy of blood. Although not a
disease, it occasionally gives rise to disease.
Remedied by regulating diet, reducing its quantity or nutritive quality.
In horses that, in stable language, are "gross," give half dose physic,
followed by salines in drinking water.
Reduce amount of corn, especially of beans.
Substitute a little green food for part of hay.
Secure sufficient exercise or work.

PLEURISY.

Inflammation of serous covering of lungs and lining of chest. Usually
unilateral. May be (1) Primitive or idiopathic, as occurs in horse or
dog exposed to cold winds, or sheep shorn in cold early spring; or
(2) Secondary, proceeding from pre-existing disease, such as crupral
pneumonia, tuberculosis, or injuries of chest.

Hygienic treatment as in pneumonia.

Blood-letting in acute attacks in vigorous horses and cattle.

Emetic and antimonials in animals that vomit.

Two or three doses aconite tincture, or calomel and opium, relieve pyrexia.

Salines and antipyretics as in bronchitis and pneumonia.

Pot. iodide and colchicum promote absorption of exudate; ferric chloride
tincture relieves debility and anæmia (Professor Williams).

Digitalis and nux vomica aid removal of fluid.

Rugs wrung out of hot water to sides, followed by hypodermic injection
of mustard essence, or in-rubbing of mustard, washed off in twenty
minutes.

Moderate counter-irritation maintained by ammonia and soap liniments.

Refrigerant compresses to chest advised in early stage by Friedberger.

Pain reduced by opium, or by morphine hypodermically.

Tapping requisite where outpoured fluid considerable and not undergoing
absorption. See HYDROTHORAX.

PLEURO-PNEUMONIA EPIZOOTIC.

Contagious lung complaint of cattle. An infective inflammation of the
lungs of horned cattle, probably caused by an anaerobic micro-organism.
It begins with irritation of the mucous membrane of the smaller
bronchi and epithelium of the air-vesicles, catarrhal proliferation
results, the peri-bronchial lymphatics are implicated and blocked,
fibrinous lymph fills the air-cells, inducing catarrhal bronchitis and
hæmorrhagic infarctions, and the pleura becomes similarly involved.
Does not attack all cattle; 25 per cent. appear insusceptible. Spreads
generally by direct cohabitation; incubation stage twenty to forty
days; animals recovering immune for several years.

PLEURO-PNEUMONIA EPIZOOTIC—*continued.*

Treatment generally unsatisfactory. Mortality 30 to 50 per cent.

Aconite tincture, antipyretics, and salines abate febrile symptoms.

Laxatives, mash diet, and linseed tea relieve indigestion.

Solid food interdicted or given very sparingly.

When rumination re-established, ordinary diet only gradually resumed.

Concentrated digestible food and stimulants prescribed when patient debilitated.

Prevention.—Under British Contagious Diseases (Animals) Act, cattle affected, and those in contact, immediately slaughtered. Slightly affected subjects in good condition are passed for beef; other carcasses, disinfected, used for manure.

Infected premises thoroughly cleansed and disinfected.

Uninfected cattle inoculated with serum taken from lungs in early stage of pleuro are generally protected, probably for several years.

PNEUMONIA. INFLAMMATION OF THE LUNGS.

The two chief distinctive forms are—

- (1) *Croupal or lobular*, affecting the bronchioli and alveoli, usually of the antro-inferior lobes; characterised by fibrinous exudation; reaches its height of red hepatisation about fifth or sixth day; the bacillus of Schütz appears an essential factor; the pleura frequently involved, especially in cattle. The most common form in horses.
- (2) *Catarrhal or broncho-pneumonic*. The form caused by irritants, including worms, and occurring epizootically; characterised by mucopurulent exudation and epithelial desquamation. Of less definite and usually slower progress. Not so frequent in horses, but the common type in dogs.

The contagious pneumonia of horses is generally classed as influenza, which see.

General principles of treatment the same in both types.

Suitable sanitary conditions, diet, and nursing.

Hot compresses changed every twelve or fifteen minutes.

Antipyretics, salines, bowels regulated by enemas.

If cathartic needful, oil better than aloes or salines.

In neither form is blood-letting required or desirable.

In both, especially in catarrhal, ammonium acetate solution, pot. chlorate or nitrate, given in draught or drinking water.

Two or three small doses aconite where pyrexia acute and horse or cow robust.

Emetic in outset of attack in strong dogs.

Mustard applied to sides for fifteen or twenty minutes, and reapplied as required. More useful in catarrhal than croupal cases.

Frequent doses alcohol, ether, or spiritus ætheris nitrosi where patient feeble.

Digitalis if heart weak.

Pot. iodide and moderate counter-irritation encourage absorption of exudate.

POLL EVIL. *See* FISTULA.POLYURIA. *See* DIABETES INSIPIDUS.

PRICKS IN HORSES' FEET.

Remove shoe, search for injury, picked-up nail, or other foreign body.

Remove diseased tissue and any pus.

Provide dependent opening; poultice; dress antiseptically.

PROLAPSUS OF THE RECTUM, UTERUS, OR VAGINA.

More common in cows that have had several calves than in other veterinary patients.

Remove any causes still in action.

Raise hind-quarters. Carefully return.

PROLAPUS OF THE RECTUM, UTERUS, OR VAGINA—continued.

If required, cleanse and wash organ with mild astringent solution.

If swollen, support on large linen towel or linen web.

Cross and twist in opposite directions ends of web, thus inducing pressure, and keep web soaked with ice-cold water.

Knead repeatedly with hands.

Scarification not desirable.

Straining combated by chloral hydrate by mouth, injection of morphine hypodermically.

Subsequent prolapse prevented by truss, bandaging, or sutures; the latter most effectual.

PROSTATIS.

Inflammation of prostate gland, usually from gonorrhœa, cystitis, or calculi. Occurs in dogs.

Hot fomentations. Catheter if needful to remove urine.

Alkalies and pot. iodide, belladonna and eucalyptus oil.

If abscess forms free incision in middle line of perineum.

PRURITUS.

Itching. Defined by Professor Robertson as a cutaneous neurosis, occurring independently of eruption or inflammation, and attacking both horses and dogs.

Resulting from exposure to sun-heat, the animal is brought into the shade, washed with pot. bicarbonate, any specially irritable spots moistened with lotion of two parts glycerine, one each of sugar of lead and laudanum, sixty water.

Pot. cyanide or chloroform solution alternated with alkaline washes allays hyper-sensibility.

Corrosive sublimate, thymol, or other volatile oils, locally when itching depends upon parasites.

Cathartics, salines, careful dietary, when associated with gastric derangement.

Iron salts, oleaginous food, alkalies, arsenic, internally when patients impoverished.

PSOÆ MUSCLES STRAIN. Occurs both in horses and dogs.

Rugs wrung out of hot water applied over loins and round abdomen.

Anodyne enemata.

Slings essential when both sides affected.

PSORIASIS.

In veterinary nomenclature the term is applied to the scaly forms of eczema, such as mallenders in horses, which see.

In human medicine it is defined as an inflammatory infiltration of the papillary skin layer, with a chronic eruption of dusky patches covered with thick white adherent scales. Nothing answering to this description is recognised in the lower animals.

PURPERAL FEVERS IN CATTLE. See APOPLEXY, PARTURIENT, and METRITIS.**PUMICED FOOT IN HORSES.**

Convexity and weakness of the sole, the result of laminitis.

Bar shoe with wide web.

Lessen concussion by tar dressing and leather soles.

Stimulate coronet.

PURPURA HÆMORRHAGICA IN THE HORSE.

Petechial fever. A contagious fever, characterised by circumscribed serous swellings and hæmorrhagic petechiæ on the skin and mucous membranes, and in their subareolar textures, becoming in bad cases ulcerous or gangrenous. Similar extravasations appear in the sub-

PURPURA HÆMORRHAGICA IN THE HORSE—continued.

- stance of muscles, in the lungs, and other organs. Frequently a sequel of exhausting disease, but etiology not fully explained.
- Remove to spacious airy quarters, clothe warmly.
- Pot. chlorate, three or four drachms two or three times daily, subsequently half doses; usually given in drinking water.
- Iron salts, sulphate, perchloride, quinine, oil of turpentine.
- Boric acid and cinchona bark in electuary (Friedberger).
- Concentrated nourishment; oatmeal gruel, milk, eggs, alcoholic stimulants.
- Bland oil or paraffin ointment diminishes skin tension and tendency to slough.
- Limited swellings about head bathed with cold water and refrigerants.
- About throat, body, and legs, hot fomentations preferable, especially in cold weather.
- Inject intratracheally 1 part iodine, 5 pot. iodide, 100 water (Professor Dieckerhoff).
- Scarification avoided unless swellings large and causing much inconvenience.
- Scrupulous cleanliness and antiseptic dressings essential while portions of skin ulcerating or sloughing.
- Tracheotomy desirable where dyspnoea distressing.

PYÆMIA.

- A variety of Septicæmia, characterised by pyrexia of an intermittent type and formation of secondary abscesses. It is an occasional sequel of strangles in horses, arthritis and other diseases accompanied by suppuration in cattle, and distemper in dogs.
- Any wounds whence infective pus may arise must be laid open, cleansed, and rendered aseptic.
- Injection of iodine tincture or dilute carbolic acid into inflamed glands sometimes checks destructive suppuration.
- Sanitary conditions must be attended to.
- The patient coaxed to take digestible nutritive concentrated food to sustain strength and ward off collapse.
- Moderate doses of alcoholic and etherous stimulants repeated every three or four hours; quinine, sulphites, creolin.

QUARTER EVIL. See ANTHRAX.**QUITTOR.**

- The pipes. *See also* FISTULA. A sinuous wound of the horse's coronet.
- Poultice, thoroughly cleanse, remove dead and detached tissue, provide dependent opening.
- Irrigate with aqueous solution of corrosive sublimate, 1 to 1000. Get perfect asepsis.
- Envelop foot in antiseptic tow or jute, kept wet with sublimate solution.
- In four days to a week remove dressings; with knife or silver nitrate get rid of dead tissue, and dress as before.
- Where foot strong no shoe needed; but if weak or broken, bar shoe relieves pressure.
- Stimulant embrocations to the coronet promote reparative action.

RABIES.

- A specific febrile disease, occurring especially in the canine and feline races, produced by a microbe found in the central nervous system and most organs and secretions, and usually communicated by the bite of a dog and the infected saliva entering the wound. The incubation period ranges from twenty to forty days. All warm-blooded animals are susceptible. The disease is most certainly and rapidly produced by inoculation of the virus, and when developed is incurable.

RABIES—continued.

Under the Contagious Diseases (Animals) Act, rabid dogs and animals bitten by them are destroyed.

The disease might be exterminated in this country if, with measures in force, the police were authorised to run in all dogs found at large without a muzzle.

When a person is bitten by a mad dog, circulation through the part should, if practicable, be checked by a ligature, the wound sucked, washed with corrosive sublimate solution, and it may further be cauterised.

M. Pasteur has demonstrated that dogs and other animals inoculated with attenuated virus do not take the disease when bitten by a rabid dog or inoculated with virus which would kill unprotected animals.

Like protection is generally secured if the man or animal, within a few days after being bitten, is inoculated with the protective vaccin.

The mortality of persons bitten by rabid dogs previous to 1886 was 16 per cent. Since then upwards of 10,000 bitten persons have been treated at the Pasteurian Institute, with the result that the mortality has been reduced to less than 1 per cent.

RHEUMATISM.

Inflammation of fibrous structures of muscles, tendons, and joints; usually caused by cold and damp, but sometimes by specific infection; liable to shift from one part to another; believed to depend upon accumulation in body of some product of nutritive derangement, possibly lactic acid. Occurs in all classes of patients.

Alkalies, pot. bicarbonate and nitrate in drinking water.

Sodium salicylate, salol, naphthol, antipyrin.

Veratrine or morphine hypodermically, repeated daily for a week or ten days (Friedberger).

Amm. acetate and colchicum (Robertson).

Pilocarpine hypodermically (Fröhner).

Blood-letting believed to increase tendency to cardiac symptoms.

Hot fomentations, or flannels wrung out of hot water or oil, applied to affected parts. Wet pack in robust patients.

Subsequently moisten with aconite, opium, or other analgesics.

When acute symptoms abated, quinine, arsenic, Donovan's solution.

In strong dogs an emetic at outset, antipyretics, salicylate of sodium.

Perfect quiet in comfortable quarters.

Stiffness or swelling subsequently removed by massage; by flannels soaked with hot oil and alkaline solutions, kept in position for an hour or two with lightly-fitting bandages; soap liniment subsequently rubbed in; such treatment will not prevent the horse doing light work.

If milder remedies fail, apply cantharides ointment either near or immediately over affected part.

The actual cautery sometimes required in chronic articular rheumatism.

Articular rheumatism most frequent in cattle and dogs.

Salicylates, antipyretics; joints enveloped in cotton wool.

Embrocations of carbolic oil, iodine solution, mercury oleate.

Pyæmic cases in young foals, calves, and lambs sometimes result from thrombosis of umbilical vessels.

Prevented by the cord and adjacent skin at birth being rendered perfectly aseptic by phenol applications, and repeated daily for a week.

RICKETS.

Rachitis. Faulty development and softening of the bones of young animals, depending upon malnutrition.

Nourishing diet; milk, crushed oats with linseed for herbivora; milk, meat soup, cod-liver oil for dogs; healthful surroundings.

In young animals sucking, see that mother's milk sufficient in quantity and quality.

Aperients or antacids to rectify any digestive derangement.

RICKETS—continued.

Calcium phosphate ; Parrish's food ; iron salts ; healthy surroundings. Splints and bandages may be requisite to support the softened bones.

RINDERPEST.

Cattle plague. A specific malignant contagious fever affecting the bovine race, but communicable to sheep and other ruminants, depending upon a specific virus, and characterised by lesions chiefly localised in the mucous membranes and skin. Indigenous to the Asiatic Steppes of Russia and other parts of Asia.

Treatment ineffectual.

Slaughter of infected animals, and those in contact with them, and effectual disinfection promptly exterminated the disease imported into Great Britain in 1865, as well as the limited outbreak of 1872.

RINGBONE.

Exostosis ; situated around (a) the pastern joint, or (b) the coffin joint ; sometimes in both positions.

When occurring in the fore-limb, use a thin-heeled bar shoe ; when in the hind-limb, a high-heeled shoe, thus diminishing pressure and concussion.

Put to slow work on soft land. When in stable apply wet swabs.

Where there is lameness, rest, give dose physic, and blister.

RINGWORM.

Tinea. Circular elevated spots, becoming itchy, scaly, and hairless, appearing usually on the skin of the head, neck, and body, produced by the epiphyte *Trichophyton tonsurans*, which invades especially the hair bulbs. It is more common in cattle than in horses, dogs, or cats ; is rare in sheep, pigs, and poultry ; is transmissible from one species of animal to another.

Isolate affected animals, and disinfect all brushes, clothing, harness, or whatever the fungus may have lodged on.

Washing with soap and water, or soaking with oil and pot. carbonate, removes scabs and crust. Rub in solution or ointment of carbolic acid, creosote, or naphthol.

If these ineffectual, substitute mercuric nitrate ointment ; solutions of mercuric chloride, ferric chloride, or copper sulphate ; iodine tincture, or iodoform.

Salines, tonics, arsenic, internally, help to abate irritation and œdema.

Grooming or dressing of affected subjects should be interdicted, as it spreads the spores.

ROARING.

May depend on thickening of the mucous lining of the nares pharynx or larynx, or on fibrous growths in these regions ; but the majority of cases of roaring in horses consists in paralysis, wasting, and fatty degeneration of the whole of the intrinsic muscles of the left side of the larynx supplied by the recurrent nerve. The tube through which the air passes being narrowed, the characteristic noise is produced, especially when inspiration is quickened by excitement or exertion. Most roarers are wheezers and also grunters, and in the lighter breeds are whistlers.

Spurious roaring, depending upon cold, strangles, or influenza, is treated sometimes successfully by stimulation of the throat, and by pot. iodide and arsenic internally.

True roaring, depending on muscular wasting, is incurable.

Smart blistering, the actual cautery, and galvanism in the earlier stages, sometimes retard atrophy.

Relegate the animal to slower work.

A pad fitted on the nostrils regulating the supply of air lessens the noise in bad cases.

Tracheotomy also affords relief.

ROARING—continued.

Strychnine persisted with for weeks in the earlier stages appears to arrest and may prevent the muscular wasting.

Of various surgical operations attempted, excision of the dropped aretoid cartilage has given most relief.

ROT IN SHEEP. DISTOMA HEPATICUM. See WORMS.**SADDLE GALLS.**

Bruises from badly-fitting saddles or harness.

Relieve from weight and prevent friction.

Apply cold water and antiseptic dressings, hot water if suppurating.

Swollen sebaceous follicles in the early stages are reduced by friction with soap liniment; in chronic cases by fomenting and lancing.

Portions of dead tissue or exudate constituting sitfasts, when inflammation has been subdued, should be dissected out.

SANDCRACK.

Fissure in horn of horse's foot, usually on inner quarter of fore-feet or toe of hind.

Remove shoe, bottom crack, clear out dirt, allow escape of pus.

Fomentation, poultice, and rest relieve inflammation and pain.

When these abated, pare away upper part of cracked horn, cutting off connection with secreting coronary substance.

Bar shoe, made to relieve fissured horn from pressure and concussion.

Superseding guttapercha plugging and clasps, adopt Captain Fred.

Smith's plan of screwing over the crack an iron plate one and a half to two inches wide, bringing it down within quarter of an inch of the web of the shoe.

SAPRÆMIA AND SEPTICÆMIA.

Sapræmia or septic intoxication. A febrile state, the result of the circulation in the blood of toxins or ptomaines, produced by non-pathogenic, saprophytic, or pathogenic organisms. The organisms multiply at the seat of inoculation, but have no power of entering the circulation. Sapræmia is not so common in the lower animals as in man, but occurs occasionally from suppurating wounds in the horse, usually from those of the feet and joints.

Septicæmia or septic infection. A febrile state, the result of the circulation in the blood of pathogenic or infective organisms and the toxins or ptomaines to which they give rise. The organisms multiply at the seat of inoculation, and have the power of entering the circulation, and thus forming secondary infective foci. Septicæmia occurs in puerperal metritis in cows and ewes, in the fever occasionally following castration and other surgical operations, as well as accidental wounds in horses, and in the infective fever artificially produced by inoculating animals with various micrococci.

Pyæmia is a form of septicæmia.

The principles of treatment are the same in both *sapræmia* and *septicæmia*.

Arrest if possible the primary source of inoculation.

Cleanse and render aseptic any wound. Sterilise dead tissue.

Corrosive sublimate solution 1 to 1000. Zinc chloride 1 to 100.

Continue dressing with non-irritant aluminum acetate or other antiseptics.

Administer antiseptics, antipyretics, creolin, sulphites, quinine.

Generous dietary; milk, eggs, oatmeal gruel, beef tea.

Alcoholic stimulants, acids, and bitters.

SARCOMATOUS TUMOURS

Are chiefly composed of embryonic or immature connective tissues; they contain blood-vessels, but neither nerves nor lymphatics have been clearly made out; they differ greatly in appearance, rapidity of

SARCOMATOUS TUMOURS—continued.

growth, and malignancy, and occur in all the lower animals. Melanosis and actinomycosis belong to this group.

In the earlier stages, especially if likely to interfere with any important function, they may be removed by the knife.

SCAB IN SHEEP.

Skin irritation, inflammation, and scabbing, caused by *Sarcoptes ovis*.
See ACARI and MANGE.

In all bad cases the sheep should be bare shorn and affected parts soaked with pot. carbonate dissolved in 20 parts water before the insecticide is applied.

Dress carefully and thoroughly every itching spot with corrosive sublimate 1 part, common salt 8 parts, water 500 parts.

Or creolin and alcohol each 1 part, soft soap 8 parts. Non-poisonous (Fröhner).

Within a few days immerse each sheep for three minutes in bath of two parts each of creolin and pot. carbonate and 100 parts water. Repeat bath in eight days.

Watch for any rubbing, examine each sheep twice a week, and, if required, apply either the corrosive sublimate or creolin dressing.

Decoctions of tobacco and stavesacre and solutions of arsenic, tar oil, and creosote are also used, both as lotion and bath.

All affected sheep should be isolated; while, further to prevent the spread of the parasites, racks, rubbing-posts, or anything on which they have lodged, are washed with the corrosive sublimate solution.

SCARLATINA.

Scarlet fever of horses. A febrile disease exhibiting petechiæ on mucous membrane of nose and mouth, and scattered eruption, usually vesicular, of skin, with swollen cervical glands and sore-throat, occurring in connection with or as sequel of debilitating disease.
Not contagious.

Comfortable box; light digestible laxative food.

Water, given with sodium sulphite and hyposulphite as antiseptics.

Ammonium acetate, spirit of nitrous ether, and camphor in draught, thrice daily, abate fever.

Medicines given in electuary when swallowing difficult.

Inhalation of hot water vapour, medicated with antiseptics or anodynes, relieves breathing.

Fomentations, woollen cloths, soaked in hot water or hot oil, relieve sore or swollen throat.

Tracheotomy when dyspnoea serious.

Fomentations with hot water, mixed with sulphurous acid, check external œdema.

Gargles of pot. chlorate, borax, or sulphurous acid lessen discharge and fœtor from mouth and throat.

Small doses alcoholic stimulants, acid solutions of quinine or iron salts, milk, eggs, soup, help recovery.

Perfect rest, carefully regulated nutritive diet, are needful throughout convalescence.

SCROFULA. See TUBERCULOSIS.**SEEDY TOE OF HORSES.**

A perverted secretion of horn towards the ground surface of the wall of the foot, causing detachment of the horny crust. It frequently follows laminitis. A similar condition occurs in sheep.

All diseased horn must be removed.

Healthier growth encouraged by moisture, and blisters to coronet.

A bar shoe relieves pressure; clips interdicted; weight thrown on sole.

Captain Fred. Smith, A.V.D., saws out the whole of the separated wall, carefully removes dead horn and crust, applies a suitable shoe, loosely

SEEDY TOE OF HORSES—continued.

packs the exposed laminar surfaces with tar and tow, kept in place by an iron plate screwed on to the wall, and the horse continues at work. The plate is removed once a week and the parts dressed.

SEPTICÆMIA. See SAPRÆMIA and PYÆMIA.**“SHIVERER.”**

Immobilité. Jinkback. Several chronic incurable conditions of the cerebro-spinal nervous system of horses. The most common forms—

- (1) Injury of the spinal cord or meninges, presenting usually imperfect motive power of the back and loins, generally resulting from accidents such as casting in the stall.
- (2) Dropsy of the cerebral ventricles, inducing impaired brain power, as well as impaired motility. Frequently discovered when the animal is quickly turned or backed; hereditary; sometimes enzootic; occurring in horses over four years; occasionally met with in cattle, sheep, dogs, and swine (Friedberger).

Treatment of little avail. The horse may do moderate, slow work.

SHOULDER SLIP.

Strain of muscles of horse's shoulder. Rare in other animals.

Foment, remove shoes, rest, purgatives.

Blister when tenderness and swelling removed.

SIDE BONE.

Ossification of lateral cartilages of horse's foot.

The treatment, hitherto not very successful, has been bar shoe, cold applications, rest, blisters, firing, with neurotomy in chronic cases if feet otherwise sound.

Veterinary Captain Fred. Smith's operation will now be adopted in all uncomplicated cases.

Consists in relieving pressure caused by ossifying cartilage by making with a saw or knife three or four incisions over the side bone, cutting through the horny wall from the top of the hoof to the sole surface, and reaching down to the horny laminae, avoiding only the coronary secreting substance. The segments of the cut wall are then separated along their sole surface by a groove run with the knife between the wall and the sole. Several days' poulticing or soaking the foot in a bucket of hot water moderates inflammation. A bar shoe is applied, and the horse should be fit for work in twelve to thirty days (*Journal of Comparative Pathology*, March 1891).

SORE-THROAT. See PHARYNGITIS.**SORE SHINS. See OTITIS.****SPAVIN, BOG. See BOG SPAVIN.****SPAVIN, BONE.**

An exostosis on the inner and lower part of the horse's hock, arising from inflammation of the cuneiform and metatarsal bones, terminating generally in ankylosis of one or more of the joints comprising the hock (Professor Williams).

Rest; cathartic and fomentation where there is much lameness.

In young horses hasten the inevitable ankylosis by a blister, firing, seton, or periosteotomy.

In old horses the otitis sometimes partakes of the character of fragilitas ossium, and is incurable.

SPLENIC APOPLEXY. See ANTHRAX.**SPLINT.**

An exostosis usually on the inner aspect of the metacarpal or metatarsal bones of the horse; occasionally of the ox.

In slighter cases stop fast work, give half dose physic, foment, and subsequently blister.

SPLINT—continued.

In more acute cases adopt subcutaneous periosteotomy.
 A seton may subsequently be passed over the deposit.
 Pyro-puncture preferable to ordinary firing, as it does not blemish.
 Mercuric iodide ointment usually reduces deposit.

SPEDDY-CUT.

A bruise on the inner aspect of the horse's limb, in the region of the knee, caused by the opposite foot.
 Fomentations; open any abscess; antiseptic dressing.
 Prevent by reducing inner crust of offending foot, using nicely-fitting three-quarter shoes, and removing shoes every three weeks.
 A boot sometimes worn on the leg liable to cutting.
 Avoid over-pacing such horses.

SPRAINS OF MUSCLES, TENDONS, AND LIGAMENTS.

The fibres are severely stretched, in serious cases sometimes torn, causing inflammation and subsequent contraction, and, in case of muscles, atrophy.
 Endeavour to rest horse at once.
 Relieve injured parts from strain and weight. In horses in bad cases sling.
 In strains connected with back tendons tack on high-heeled shoe.
 Foment until tenderness removed. Support with bandage.
 Subsequently cold applications; regular exercise.
 Blister and turn out to grass.
 In bad and repeated ligament and tendon sprains, contraction occurs, which is incurable. Tenotomy of little avail.
 Contraction of back tendons relieved by use of plain shoe with projecting toe-piece.

STOMACH STAGGERS IN HORSES. See INDIGESTION.**STOMATITIS.**

Inflammation of buccal mucous membrane, chiefly occurring in young animals—(a) erythematous and catarrhal; (b) aphthous, vesicular, pustulous, and frequently contagious; (c) diphtheritic.
 Soft digestible food, laxative, salines. Remove any gastric derangement.
 See to any irritation of gums, carious or faulty teeth.
 Give slowly pot. chlorate or borax, 1 to 4 per cent., in glycerine solution.
 In sucking foals and calves, besides local treatment, see that mother's milk is sound and that she is properly fed.
 Ulcerous spots dressed with glycerine of tannin or painted with silver nitrate, ten grains to ounce water.
 A contagious pustular form amongst horses, occurring in the Berlin clinique, is described by Professor Friedberger, and treated by pot. permanganate solution or creolin tincture.

STRANGLES IN HORSES.

Febra pyogenica. A contagious catarrhal eruptive fever, peculiar to the equine species, caused by a streptococcus. Normally, abscesses develop in the connective tissue in the space between the branches of the lower jaw, and involve adjacent glands, while infective pyogenic organisms are liable to be carried to and inflame other glands in the shoulder, groin, or internal organs. The disease occurs chiefly in young animals, and seldom more than once in a lifetime.
 Good nursing; perfect sanitary surroundings.
 Steam head where catarrhal symptoms troublesome.
 Fomentations or poultices to the throat hasten tardy formation of abscess.
 Sodium sulphite and pot. chlorate dissolved in drinking water.
 Horse at grass shelter at night, unless weather warm and case slight.
 When abscess tardy in development apply soap or cantharides liniment.

STRANGLES IN HORSES—continued.

Supply mash, gruel, grass, sliced roots, malt, steamed oats, or whatever soft digestible food patient will eat.

Milk, eggs, beef tea, with ale or wine if animal weak.

Sweet spirit of nitre or quinine if pyæmia supervenes.

Abscess should be fully matured before it is opened; indeed, many practitioners prefer that it be allowed to burst.

While discharging, keep parts clean; dress daily with carbolic oil.

Tracheotomy performed when dyspnoea not relieved by steaming and fomentations; its timely performance lessens chances of roaring, and often saves life.

Isolate infected subjects and disinfect premises.

Inoculation with attenuated virus secures immunity, but, besides other disadvantages, creates centres of contagion.

STRINGHALT IN THE HORSE.

Involuntary spasmodic choreac movements of the muscles of the limbs, usually of one or both hind limbs; not traceable to definite pathological lesions.

Incurable; becomes worse with hard work and advancing years.

Relieve any spavin or other condition which may aggravate reflexly.

Temporary benefit results from a laxative, a course of bromides, and moderation of work.

Stretching and section of the tibial nerves are of no avail.

STURDY. HYDATID IN BRAIN. *See* WORMS.

SURFEIT. NETTLE-RASH. *See* URTICARIA.

SWINE FEVERS. SWINE PLAGUES.

Under these titles are grouped three specific contagious epizootic fevers of the pig, each depending on its special microbe.

(1) Swine fever proper. In America termed hog cholera. A diphtheritic inflammation of the alimentary and pulmonary mucous membrane and skin, with fever. The large intestines are chiefly affected; exhibit "ringed" patches of necrosis, in more chronic cases nodular elevations; catarrhal pneumonia is more or less pronounced; the skin discoloured. The incubation stage is eight to ten days; the mortality 40 to 60 per cent.; higher among young pigs; death occurs in eight to sixteen days. Attacks swine of all ages; is the disease of which the British Contagious Diseases (Animals) Act takes cognisance.

(2) Swine erysipelas. *Mal rouge*. An acute septicæmia, characterised by erysipelatous inflammation of the skin, which at first is bright red, becoming blue or brown red. The gastro-intestinal mucous membrane is acutely inflamed, the spleen is enlarged, there is generally endocarditis, but no pneumonia. Incubation stage three to four days; swine three to twelve months chiefly affected; mortality 50 to 75 per cent.

(3) Swine plague. Described by German authors as pneumonic inflammation, with fever, discoloration and swelling of skin, but no gastro-intestinal lesion or notable enlargement of spleen.

Principles of prevention and cure the same in several forms.

Slaughter, burn, or deeply bury infected, especially first cases. Isolate in-contacts. Disinfect.

An emetic in earliest stages. Antipyretics.

In erysipelas form, vaccination with attenuated virus (although causing mortality of 1 or 2 per cent.) renders most subjects immune for a year.

SYNOVITIS.

Inflammation of the synovial membrane from strain, puncture, localisation of the rheumatic or tuberculous virus. *See also* ARTHRITIS.

Fomentation or swathing the joints with cloths wrung out of hot water, persisted with for some hours, parts afterwards rubbed with soap liniment and laudanum.

SYNOVITIS—continued.

Anatomical rest may be helped by splints and bandages.

Slings where hock or other large joint of horse's hind limb affected.

If not relieved in a few days, blister; fire in chronic cases.

Mercury oleate in rheumatic and tubercular cases, which are specially intractable.

TABES MESENTERICA. See TUBERCULOSIS.**TAPEWORM. TENIA. See WORMS.****TEATS, OBSTRUCTED.**

The teats of cows and ewes are obstructed by curdled milk, lacteal calculi, tumours attached to mucous membrane, or inflammatory thickening.

Where not removable by careful manipulation, concretions may be displaced or broken up by bougie or teat syphon.

Tumours within the teat not reducible by mechanical means or iodine dressings are excised.

Warts on the teats removed by knife or ligature.

Inflammation treated by fomentations and poultices of spent hops.

Stricture, usually a sequel of inflammation, relieved by passing probe or syphon.

TENDONS OR LIGAMENTS, RUPTURED.

Occurs chiefly in horses. *See also* SPRAINS.

Fomentations allay inflammation.

Treat as for fractured bones; keep parts perfectly quiescent.

Splints, starch bandages, slings.

When inflammation moderated stimulate externally.

TETANUS.

Lockjaw. Tonic muscular spasms depending on a toxine, produced by an anerobic bristle-shaped microbe. This organism is found in many soils, is inoculable from animal to animal; when brought into contact with a part, especially if bruised or injured, it produces its tetanising toxine, which acts like strychnine on the spinal cord. Horses and sheep are most susceptible, cattle and swine less so; dogs are resistant.

There is hope of recovery if the amount of toxine circulated is limited, if its production by attention to the wound can be arrested, and the patient's strength be sustained.

The infecting wound must be rendered aseptic; if closed, may be laid open, and any irritant removed. In lambs and other young animals cleanse and sterilise the navel cord.

Although the jaws are closed, most patients suck up sloppy food, which is rendered as nutritive as possible and offered frequently.

Action of bowels encouraged by mashes, gruel, treacle, and salines in drinking water, which should be within reach.

Place horse in darkened box, where he will not be disturbed; put him loosely in slings.

Medicines are of little avail. Bromides and chloral afford temporary relief, especially where excitement considerable.

Powdered opium and cannabis indica extract, thirty grains each in electuary, placed thrice daily within the molar teeth.

Occasional administration of chloroform relaxes spasms for a time, and may enable food to be swallowed; but such advantage in irritable patients is usually counterbalanced by the irritation caused by giving the anæsthetic.

Kitasato and Dr Behring have prepared tetanus vaccin, which renders rabbits, mice, sheep, and even horses, resistant to the inoculation of toxic doses of virus, and which cures mice which have become tetanised.

TEXAS FEVER.

A malarial fever, produced in Southern Texas and adjacent States by a microbe which destroys the red corpuscles, reducing them to one-third or one-fourth of their normal number, their colouring matters being excreted in the urine. The life history of the organism has not been made out, but one stage of its existence is said to be passed in the body of a tick (Dr Salmon's Reports).

Texas cattle cannot be moved from infected regions from March to November unless under strict railroad restrictions.

Treatment consists of antiseptics, antipyretics, and tonics.

THICK WIND IN HORSES.

Generally depends upon thickening of the mucous lining of the bronchial tubes, or imperfect power of emptying the air-cells.

Seldom curable, but relieved by good, rather concentrated, damped food.

Allow water in moderate quantity frequently.

Relieve gastro-intestinal irregularity.

Professor Dick's cough balls.

THOROUGH-PIN OF THE HOCK AND KNEE.

A bursal enlargement on the inferior lateral aspect of the thigh and upper and posterior part of the horse's hock, arising from disease of the tendon of the flexor pedis perforans muscle, which is enclosed in a synovial sheath upon the inner side of the os calcis, or from dropsy of the sheath without disease of the tendon (Professor Williams).

Rest, high-heeled shoe, flannel bandages.

Equable pressure from a spring truss.

Where the swelling is not thus reduced apply a smart blister.

Other treatment failing, the distended bursa may be opened at its most dependent point.

Thorough-pin of the knee consists in distension of the bursa containing the perforatis and perforans tendons at the back and a little above the knee-joint.

Treated similarly to thorough-pin of the hock.

THROMBOSIS.

Coagulation of blood in a vein.

Absolute rest, in order to diminish risk of a portion of clot being detached and obstructing circulation in the brain or pulmonary artery.

The œdema frequently resulting is abated by carefully applied bandages.

THRUSH IN MOUTH. See APHTHA.**THRUSH IN HORSE'S FROG.**

A morbid condition of the secreting surfaces of the fibro-fatty frog, producing fetid discharge.

Scrupulous cleanliness; a leather sole is sometimes placed within the shoe while the animal is stabled.

Calomel dusted over diseased surfaces; dressings of tar or wood-tar oil.

Dose of physic, especially when associated with constitutional causes.

Regulate feeding, exercise, or work.

Shoe with tips if feet strong and animal works chiefly on the farm.

TICKS.

Belong to the family Ixodidæ, class Arachnidæ, order Acaridæ.

Ixodes ricinus attacks dogs, cattle, and sheep. Infest the skins of all the domestic animals.

Destroyed by any of the volatile oils.

When not numerous may be snipped off with a pair of scissors.

Melophagus ovis or *ked*—infests the skin of sheep.

Bath of arsenic, potashes, soft soap and water.

Dressing with wood-tar, coal-tar, or petroleum oils, or 3 per cent. creolin solution.

TINEA TONSURANS. See RINGWORM.

TOOTHACHE.

Usually results from caries, attacking chiefly the molar teeth.
 Extract diseased tooth with forceps; where in molars of horse this cannot be done, the alveoli has been opened and tooth punched out.
 Freely moisten gum with tannin dissolved in alcohol and ether, or with morphine solution.
 Warmth, or light dressing of mustard externally.

TREAD.

A wound on the horse's coronet, usually caused by the opposite foot.
 See also BRUISE.
 Poultice, foment, antiseptic dressings, cathartic.
 Heels of shoes well rounded off.

TUBERCULOSIS.

A specific disease caused by the bacillus tuberculosis, which develops irritation either directly or by formation of toxins, or in both ways. Nodular cells are produced of one or more of the three descriptions—lymphoid, epitheloid, or giant; exhibit a tendency to necrosis, followed by caseation, occasionally by fibroid degeneration.

The disease is distinctly contagious, and is spread chiefly by expectorated bacilli. The bacillus of one mammal multiplies in the bodies of other mammals; dogs and poultry have been infected by the sputa of consumptive human patients; the milk from tuberculous cows has infected calves and pigs, and probably children; but the avian bacillus is a distinct species.

Tuberculosis occurs in man and all the domesticated animals; cattle, swine, and poultry are most frequently affected; horses stand next; sheep and goats are not so susceptible; dogs and cats still less so.

The tubercule may be (1) localised in particular organs, or (2) generalised, affecting several systems, their serous membranes and lymphatic glands.

Tuberculosis of the lungs. Pulmonary consumption. Phthisis pulmonalis is the primary and prominent form in more than two-thirds of the cattle, dogs, and cats attacked.

Tubercule of the mesenteric glands, the spleen, and liver is the form most common in horses, pigs, and poultry.

Tubercular arthritis, common in human patients, is not so frequent in the lower animals.

Preventive more important than curative treatment.

Affected animals isolated. No suspects used for breeding.

Milk from cows with tuberculous udders or generalised tuberculosis frequently contains the bacillus, and is more likely than the flesh to communicate disease.

Milk from affected subjects should not be used; that from suspects, if used, should be boiled for ten minutes.

Carcases showing generalised tubercule to be destroyed.

Diseased carcases and organs burned or deeply buried.

Animals in earlier stages tied by themselves in airy, comfortable quarters, and fattened.

Antiseptic inhalations relieve bronchial irritation.

Tonics, alcoholic stimulants, iodine, and other rubefacients relieve some of the symptoms.

TYMPANITIS. See HOVEN.

UDDER, INFLAMMATION OF. See MAMMITIS.

ULCERS.

A breach of continuity in a part, leaving an indented suppurating wound. Ulcers are classified as Healthy, Weak, Indolent, Inflamed, Phagedenic, and Specific.

ULCERS—*continued.*

- (a) *Healthy ulcers* discharge laudable pus, and if kept aseptic and irritation avoided, they heal quickly by granulation.
- (b) *Weak or oedematous ulcers* require mild astringent dressings. Dust with calomel.
A flannel bandage, where it can be used, affords equable healthy pressure.
Easily digestible nourishing diet; the patient should have suitable exercise.
- (c) *Indolent or callous ulcers* have their hard edges softened by emollients, and are then stimulated by mercurous oxide wash or mercuric iodide solution.
A blister sometimes benefits. A purgative generally useful.
- (d) *Inflamed ulcers* require removal of any irritant, with poulticing or fomentation, and boric acid or mild astringent.
Where there is sloughing use antiseptics freely.
Purgative and digestible cooling diet.
- (e) *Phagedenic or gangrenous ulcers* require free scarification.
Removal of any irritant, fomentations, antiseptic poultices.
Occasional painting of sloughing edges with silver nitrate or nitric acid.
Purgatives, salines, antiseptics, tonics internally.
- (f) *Tuberculous or strumous*, from breaking down of tuberculous lymphatic glands or ulceration of abscesses or nodules.
Pare or scrape away edges.
Iodoform and other antiseptics.

URINARY DEPOSITS. See CALCULI.

URTICARIA.

Surfeit; Nettle-rash. An evanescent erythema of the skin, occasionally of the mucous membranes, with circumscribed, rather itching, serous elevations; usually appearing and disappearing with equal rapidity.
Not infrequent in horses, dogs, and pigs; rare in cattle or sheep.
Damp the skin repeatedly with an alkaline solution. If there is itching conjoin 1 per cent. pot. cyanide or "Sanitas" fluid.
When rash persists or recurs give cathartic; attend to diet and cleanliness of clothing; avoid washing with cold water.

URETHRITIS.

Inflammation of the urethra: (1) Simple or catarrhal; (2) Specific or gonorrhoeal. Not uncommon in dogs.
Copper, zinc, or silver salts injected in dilute solution, 1 part to 60 water. Thorough cleanliness. Diluents.
Oils of copaiba and eucalyptus as anodynes and antiseptics.
Prevent occlusion by cautious introduction of catheter.
Persistent obstruction from inflammation or gravel in male sometimes requires perineal opening.

UTERUS, INFLAMMATION OF. See METRITIS.

VAGINITIS.

Inflammation of mucous membrane of vagina. Occurs in all animals.
Irrigate with mild astringent solutions.
To astringent add a little laudanum if irritation persistent.
Laxative cooling diet; keep patient quiet.

VARICOSE VEIN.

Permanent and unequal dilatation of vein and degeneration of its coats. Bandages wetted with cold water.
Any abscesses are opened; good food; tonics.
Where enlarged vein liable to injury or blocked with clot obliterate by acupressure, subcutaneous ligature, or excision.

VARIOLA OVINÆ.

Sheep-pox. A contagious, inoculable, eruptive fever, probably depending upon a microbe. The incubation stage four to seven days. Papules appear, passing into vesicles and pustules. The mortality ranges from 10 to 20 per cent., but is greater in the confluent malignant form occasionally occurring. Animals attacked are subsequently immune. Goats, swine, and dogs have been infected.

Under the Contagious Diseases (Animals) Act infected and in-contact subjects are slaughtered, and the measures adopted in other contagious diseases rigorously carried out.

As the disease runs a definite course, treatment consists in good nursing and guarding against complications.

Digestible laxative food. Dress in bad cases with antiseptics.

Inoculation of healthy sheep with attenuated virus is not desirable, for the attack produced is distinctly contagious, rather severe, and the mortality averaging 2 per cent.

Variola ovina is the only variola which occurs in the lower animals primarily and independently of inoculation.

Variola vaccina, or cow-pox, without doubt results from accidental retro-vaccination from recently vaccinated human patients, and similar eruptions in like manner occur in swine and occasionally in dogs.

A *variola equina* may be similarly produced, but the conditions described as horse-pox are not variolous, and appear to be pustular stomatitis and eruptions on the genital mucous membrane (Friedberger, Fröhner, Traasbot).

VERTIGO IN HORSE. See MEGRIMS.

VELLITIS.

Coronitis. Inflammation of the coronary substance in horses. Occurs from standing in cold water or snow. Prevails in America among horses grazed on alkaline marshes, where secretion of crust checked or arrested, and hooves sometimes gradually separate.

Remove shoes; fomentations; poultices and a laxative abate inflammation.

Stimulate coronet with a mild blister so soon as inflammation removed.

Where even one hoof is undergoing separation the horse for months requires attention.

VOLVULUS.

Ileus. Twist of bowels. Affects small, occasionally large, intestines of horse.

Cannot be rectified by medical treatment, but laparotomy, if undertaken early, may be successful.

WARTS.

Verrucæ. Excrescences on the skin formed by hypertrophy of the papillæ and epidermis. Occur in all veterinary subjects; most common in young animals.

Remove by excision, torsion, or ligature.

Those about the penis liable to reappear unless their site is cauterised.

Acetic, salicylic, nitric, and chromic acids, and silver nitrate, destroy warts.

WEED. See LYMPHANGITIS.

WHISTLING IN HORSES.

Like most cases of roaring, depends upon progressive paralysis and atrophy of the muscles of the larynx. It is a more high-pitched noise than roaring, and is manifested chiefly in the lighter breeds.

Incurable. See ROARING.

WIND-GALLS.

Ganglions ; Enlarged synovial bursæ.
 Equable pressure by flannel or wash leather bandages.
 Bandages wetted with white lotion.
 Rest, hand-rubbing, blisters.
 Careful shoeing so as to minimise concussion.

WIND-SUCKING IN HORSES.

The animal lays hold of any fixed object and makes deep inspirations.
 Treat as for crib-biting, which see.
 Spiked strap on throat.

WITHERS, FISTULOUS. See FISTULA.

WORMS.

Vermes. A group of endo-parasites, the following most frequently infesting the domestic animals.

NEMATODA. ROUND AND THREAD WORMS.

ASCARIDES.

Ascaris megalocephala, inhabiting stomach and small intestines of horses.
Ascaris lombricoidis, in cattle and swine.
Ascaris Marginata and *Mystax*, round worms of dogs and cats.
Ascaris Heterakis and other species, in poultry and pigeons.
Trichina spiralis, occurring in immature form in flesh of swine, which, when eaten, causes trichiniasis in man and other animals.
 In horses and cattle, aloes, oil of turpentine, bitters, creolin.
 Ferric chloride solution, copper sulphate, arsenic, salt in manger.
 For dogs and cats, santonin, with extract of male shield fern, repeated at intervals of two days, and second dose followed by laxative.

OXYURÆ.

Oxyuris curvula and *mastigodes*, in horses, generally lodged in the rectum.
Oxyuris vermicularis, in dog.
 Enemas of vinegar, or sulphur and soft soap.

STRONGULI.

- (a) In digestive tract ; (b) In air-passages.
 (a) *Strongylus armatus* and *tetracanthus*, in intestines of horses.
Uncinaria radiata, *Esophagostoma inflatum*, &c., in cattle.
Strongylus contortus and others, in abomasum of sheep and goats.
Uncinaria trigenocephala, in dog and cat.
Strongylus tenuis and *notularis*, in poultry.
 (b) *Strongylus micrurus*, in air-passages of young cattle, rarely of horse and ass.
Strongylus filaria, in air-passages of sheep and goats.
Strongylus paradoxus, in swine.
 Various species not yet identified in dogs and cats.
Syngamus trachealis, in birds.
 Stronguli-infected horses and sheep are fasted, and receive a cathartic, conjoined with oil of turpentine.
 For the *S. contortus* in sheep, 1 part Chabert's oil, 3 of oil of turpentine, or pot. picrate.
 For dogs and cats santonin and male shield fern extract.
 For the *S. micrurus* in air-passages, turpentine in drench, or intratracheally for two or three consecutive days.
 Sulphurous or chlorine inhalations. Liberal concentrated dietary.
 Remove from rough old pastures to seeds, or to closely-cropped, recently-mown dry grass.
 House calves at night.

STRONGULI—continued.

In poultry, the tip of a partially-stripped feather, introduced into the fauces and larynx, and twisted round a few times, usually withdraws some of the parasites.

The feather, moistened with oil of turpentine and similarly introduced, destroys many worms which it does not reach.

TREMATODA. FLUKEWORMS.

Distoma hepaticum, causing liver rot in sheep, rabbits, and hares, and occasionally cattle.

Furnish affected sheep with concentrated dry food.

Common salt and ferrous sulphate dissolved in water, given daily, mixed with bran or crushed grain.

To prevent affected sheep losing condition and disseminating the disease slaughter as soon as possible.

Keep sound sheep from pastures on which rotten sheep or rotten hares or rabbits have grazed, from low-lying wet land, or from grazings with stagnant pools—situations which nurture the fluke ova and embryo forms, and the fresh-water snail (*Limnæus truncatulus*), which constitutes the intermediary host.

Other species of distomata occur in the liver and organs of sheep and other animals.

CESTODA. TÆNIA. TAPEWORMS.

Most animals infested with one or more species, in their mature stage inhabiting the intestines.

Tænia perfoliata, *plicata*, *mamillina*, in horse.

T. expansa, *denticulata*, and *alba*, in cattle.

T. expansa, in sheep and goats, destroys in some seasons many lambs.

T. cucumerina (most common), *serrata*, *marginata*, *cœnurus*, *echinococcus*, *bothriocephalus*, in dogs.

T. infundibuliformis and others, in poultry.

The cysticercus or measles of pork, beef, and mutton are tænia larvæ, found chiefly in the muscles. Each produce their particulate tapeworm.

The *cœnurus cerebralis*, the hydatid causing sturdy in sheep, is the encysted larva of *Tænia cœnurus*, and attains its mature form in the intestines of the dog, which in turn disseminates the ova which undergoes one of its developments in the brain of the sheep.

Patients should be fasted twenty-four hours before they receive the tænicide.

Horses and cattle, eating tolerably clean vegetable food, are not so much infested as the omnivorous dog or pig, are given oil of turpentine and male shield fern extract in milk for two or three consecutive days, and after last dose a cathartic.

Dogs from different sources swallow the larval forms of six different tænia. Treated with areca-nut thirty to sixty grains, male shield fern extract ten to fifteen minims, given with oil, syrup of buckthorn, or mucilage. Dose repeated in two days.

For poultry, areca-nut twenty to thirty grains, repeated for two or three days, followed by a dose of oil.

Tæniasis prevented by isolating and curing infested subjects, burning their excreta, and preventing animals eating uncooked viscera of sheep, hogs, rabbits, or other animals in which tænia larvæ are liable to occur.

WOUNDS.

A wound is defined as a breach of continuity of any part of the body.

Wounds may be open or subcutaneous. The open are classified as Incised, Punctured, Lacerated, Contused, and Poisoned.

WOUNDS—continued.

Every variety requires attention to the following conditions :—

- (1) Absolute asepsia.
- (2) Perfect arrest of hæmorrhage.
- (3) Accurate apposition of severed parts.
- (4) Physiological and mechanical rest.

To secure asepsis—

Foreign bodies are removed from accidental wounds.

Adjacent skin is shaved or closely clipped.

In wounds of soft parts, the edges, if very dirty or damaged, are carefully cut away.

The wound and adjacent parts are thoroughly and freely washed with an effectual germicide, such as—

Carbolic acid, 1 part to 20 to 40 of water.

Creolin is as effectual as carbolic acid, but less irritant and non-poisonous.

Corrosive sublimate 1 part, common salt 8 parts, water 1000 to 2000.

Zinc chloride 1 part, water 80 to 100 parts.

Mercuric iodide and pot. iodide each 1 part, water 1000 parts.

Sir Joseph Lister uses a double cyanide of mercury and zinc.

When wounds are septic several of these germicides should be used in succession.

Wounds may be dusted with a dry dressing of iodoform, iodol, zinc oxide, or boric acid.

When an aseptic state has been secured, less powerful agents suffice to maintain it, such as solutions of boric, salicylic, or sulphurous acid, aluminium acetate, chlorinated soda, or "Sanitas."

Large, lacerated, contused wounds are provided with drainage, a piece of rubber tubing being introduced into the deepest part, and dependent opening secured.

Introduction of fermentable, putrefactive, or infective material prevented by covering with several folds of antiseptic lint, jute, or oakum.

Antiseptic precautions to be further observed as to instruments, hands of operator, &c.

Hæmorrhage is arrested temporarily by application of a tourniquet, more permanently by ligature, torsion, pressure, water at a temperature of about 120° Fahr., styptics or cautery.

Accurate apposition of severed parts effected by careful suturing with silver wire, catgut, horse-hair, silk, &c.

Physiological rest is secured by analgesics; belladonna liniment and tincture equal parts, diluted with 60 to 100 water. Laudanum diluted; morphine hypodermically.

Anatomical rest obtained by equable pressure of dressings and bandages, support of splints, and slinging of larger animals.

Wounds properly put up and going on satisfactorily should be disturbed as little as possible, except for cleansing and replacing external dressings; there need be no hurry in removing sutures.

If a wound becomes inflamed or painful, or the discharges are unhealthy, the dressings must be removed, sutures cut out, any clots or other irritants removed, the surfaces irrigated or syringed with an antiseptic, and over the carbolic lint a poultice if needful applied.

Opium and belladonna used, with poultices or antiseptics, when there is much pain.

Excessive granulation checked by pressure, astringents, or occasional use of caustic.

Attention to state of bowels, cooling digestible diet, and healthful surroundings essential to successful treatment.

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